



IMPROVED **D**ROUGHT **E**ARLY **W**ARNING AND **F**ORCASTING TO STRENGTHEN  
PREPAREDNESS AND ADAPTATION TO DROUGHTS IN **A**FRICA  
(DEWFORA)

A 7<sup>th</sup> Framework Programme Collaborative Research Project

**Work Package 2**

**Assessing existing drought monitoring and forecasting  
capacities, mitigation and adaptation practices in Africa**

**DELIVERABLE 2.2 - INVENTORY OF INSTITUTIONAL  
FRAMEWORKS AND DROUGHT MITIGATION AND ADAPTATION  
PRACTICES IN AFRICA**

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## EXECUTIVE SUMMARY

*This document identifies historical droughts mitigation and adaptation actions, and provides an inventory of institutional frameworks for drought mitigation and adaptation in Africa. This is done on case study basins selected across Africa namely; The Oum-er-Rbia River Basin, (Morocco), Eastern Nile Basin (Burundi, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda), Limpopo Basin (Botswana, Mozambique, South Africa and Zimbabwe) and Niger Basin (Algeria, Benin, Burkina-Faso, Guinea, Ivory Coast, Mali, Niger and Nigeria). For each of these basins, historical droughts (Chapter 3), mitigation actions related to these droughts (Chapter 4), institutions involved in drought mitigation (Chapter 5) and the related institutional frameworks (Chapter 6) are presented. Regarding drought adaptation, the actions, the institutions involved and the institutional frameworks are respectively presented in chapter 7, 8 and 9. The tables below summarize the inventories carried out in the studies basins.*

### Historical droughts

*The experience of drought in Africa dates back many centuries but this study identified specific drought years from around 1920s from readily available literature. During the period 1921/22 to 1950/51, this study only identified droughts in the Limpopo River basin in Southern Africa (10 seasons) and the North Africa - Maghreb Region (14 seasons).*

Year	Southern Africa -Limpopo Basin				North Africa - Maghreb Region		
	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco
1921/22				X			X
1923/24				X			
1925/26			X				
1927/28			X				
1929/30			X				
1930/31							X
1931/32			X				X
1932/33							X
1933/34							X
1934/35							X
1935/36							X
1936/37			X				X
1937/38							X
1938/39							X

	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco
1944/45			X			X	X
1945/46						X	X
1946/47			X	X		X	
1947/48			X	X			
1948/49							X
1950/51							X
Count	0	0	8	4	0	3	14

The period 1950/51 to 1980/81 is more informative. The Southern Africa region recorded 9 seasons of drought, the North Africa - Maghreb Region 5 seasons, West Africa - Niger Basin 6 seasons, East Africa- Nile Basin 9 seasons and the Ethiopian Plateau 10 seasons. The droughts for the East Africa- Nile Basin Ethiopian Plateau occurred between 1969/70 and 1980/81. For the period 1950/51 to 1980/81 drought in the East Africa- Nile Basin Equatorial Lakes Region was not well captured. The identified drought years are as follows:

Year	East Africa- Nile Basin		Ethiopian Plateau	East Africa- Nile Basin Equatorial Lakes Region			Southern Africa -Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Sudan		Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	
1951/52 to 1959/60														
1960/61										X		X		
1961/62											X	X		
1962/63								X						
1963/64								X						
1964/65								X						
1965/66														
1966/67								X						
1967/68									X					
1968/69										X			X	
1969/70		X											X	
1970/71	X		X										X	
1971/72	X	X	X										X	
1972/73	X	X	X						X				X	
1973/74		X	X										X	
1974/75	X	X	X									X		
1975/76			X	X								X		



	Egypt	Sudan	Ethiopia	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	Inner Niger Delta
1976/77														
1977/78		X	X	X										
1978/79	X	X	X				X		X					
1979/80	X	X	X						X					
1980/81			X				X		X	X				
Count	6	8	10	2	0	0	2	0	7	3	2	1	4	6

The period 1981/82 to 2008/09 the Southern Africa region recorded 14 seasons of drought, the North Africa - Maghreb Region 18 seasons, West Africa - Niger Basin 4 seasons, East Africa- Nile Basin 21 seasons, the Ethiopian Plateau 10 seasons and the East Africa- Nile Basin Equatorial Lakes Region 15 seasons. The droughts for the East Africa- Nile Basin Ethiopian Plateau were poorly recorded for this period. The identified drought years are as follows:

Year	East Africa- Nile Basin		Ethiopia n Plateau	East Africa- Nile Basin Equatorial Lakes Region			Southern Africa -Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Sudan	Ethiopia	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	Inner Niger Delta
1981/82	X	X		X			X	X	X	X			X	
1982/83	X	X				X		X	X	X			X	X
1983/84		X		X			X	X		X			X	X
1984/85					X			X	X	X			X	X
1985/86		X			X					X				X
1986/87		X					X			X	X		X	
1987/88		X			X		X	X		X			X	
1988/89														
1989/90	X	X												
1990/91	X	X												
1991/92		X		X	X	X		X	X	X				
1992/93		X							X				X	
1993/94											X		X	
1994/95								X		X	X	X	X	
1995/96	X	X						X					X	
1996/97		X		X	X									
1997/98		X				X								

					Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	Inner Niger Delta
1998/99														
1999/00		X		X		X							X	
2000/01													X	
2001/02	X	X								X			X	
2002/03		X						X	X				X	
2003/04		X			X			X					X	
2004/05				X		Egypt	Sudan	opla	Kenya					
2005/06		X		X		X		X						
2006/07		X		X	X			X		X			X	
2007/08		X		X									X	
2008/09		X		X									X	
Count	6	21	0	10	8	5	4	12	6	11	3	1	18	4

*Meteorological, hydrological, agricultural and socio-economical droughts are experienced in Africa. Classification of historical droughts into these categories in existing literature is only done for the North Africa - Maghreb Region and Southern Africa. Desertification is another phenomenon affecting Africa. This is degradation of land in arid, semi-arid and dry sub-humid areas in Africa resulting from various factors, including climatic variation and human activities. It is very closely linked to drought.*

*The spatial extent of drought is well documented at national and administrative scale. This is informed by the need to map drought impacts in terms of food shortage and people affected. In direct contrast mapping of drought at catchment scale, the hydrological unit is not well documented.*

### **Drought mitigation actions**

*This study identified drought related mitigation actions implemented in Africa. The most common actions being food aid, drought relief programs, growing of drought tolerate crops, saving livestock, improved water use efficiency and installation of boreholes, wells and small dams. The following table presents a summary of the mitigation actions identified.*

Mitigation Actions	East Africa-Nile Basin		Ethiopian Plateau	East Africa-Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa -Niger Basin
	Egypt	Sudan	Ethiopia	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	
Giving priority to drinking water		X	X	X	X			X		X	X			
Public awareness campaigns										X	X			X
Restructuring bank debt										X				
Rescheduling of farmers' credits						X		X	X	X				
Debt forgiveness								X		X		X		X
Better and easier access credit											X			
Importing and subsidizing drilling										X	X			X
Restricting summer crops						X			X	X				
Wells digging and irrigation					X	X			X	X	X			
Farmers cropping strategies	X				X					X	X		X	X
Water use efficiency	X	X	X	X	X	X			X	X	X			X
Drought relief program	X	X				X		X	X	X	X	X	X	X
Saving livestock	X	X	X		X	X		X	X	X		X		X
Livestock watering points									X	X		X		
Opening of preserved pastures												X	X	X
Controlled forest grazing						X		X	X		X		X	
Livestock feeding program	X	X	X	X	X	X		X	X			X		
Livestock vaccination campaign						X		X	X	X		X	X	X
Importing & distributing stockfeed												X		
Setting of preserved pastures												X	X	X
Livestock vaccination campaign						X								
Boreholes, wells and small dams	X	X	X	X		X		X	X	X		X	X	X
Diversification of income sources	X	X		X					X	X		X		
Livestock husbandry practices					X									
Food storage and crop varieties					X									
Food security information					X									
Harvesting of rainfall water	X					X	X		X	X				X
New drought tolerant crops	X	X	X	X	X		X	X		X		X		X
Natural forest plantations						X								
Agroforestry						X		X	X	X				
Food aid				X		X	X	X	X	X	X	X	X	X
Vegetative material				X				X						
Agro-pastoral fares								X						
Horticulture	X	X	X					X	X	X				
Local seed production		X	X						X	X	X	X	X	X
Fruit production				X				X	X					
Irrigation systems	X							X	X		X	X	X	X

Mitigation Actions	East Africa-Nile Basin		Ethiopian Plateau	East Africa-Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa -Niger Basin
	Egypt	Sudan	Ethiopia	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	
Use of lowlands								X						X
Irrigation management	X								X	X				
Cloud seeding										X				

### Institutions involved in drought mitigation and institutional framework

There are different types (distinguished by role) of institutions involved in drought mitigation. The most common actions being agriculture extension services, food aid, policy, advocacy and water supply. The following table presents a summary of the types of institutions identified.

Type of Institutions/Role	East Africa-Nile Basin		Ethiopian Plateau	East Africa-Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Sudan	Ethiopia	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	Inner Niger Delta
Water Infrastructure Development	1	1	1	1	1	1	1	2	1	1	3	1	3	1
Forecasting	1		1	1	1	1	1	1	1	1	3	1	1	1
Early Warning			1	1	1	1			1	1	3		1	1
Agriculture Extension Services	1	1	2	1	1	3	1	2	3	3	8		11	1
Food aid		1	2	5	3	3	1	2	1	4	2		1	3
Management of Water Infrastructure	1	1						2	1	1	5	1	2	1
Funding		1	1	2	2		1	1	4	2	6			1
Policy	1	1	1	2	3	2	1	1	1	1	3	3	1	1
Advocacy	2	1		2	5	1	1	1		1			7	2
Water supply (tankering etc)										1	1		1	
Total	8	6	16	15	7	12	5	11	8	15	36	6	31	11

The table below presents a summary of the inventory of institutional frameworks for drought mitigation by presenting the role institution have in the process of drought

mitigation. The most common actions being agriculture extension services, food aid, policy and funding.

Type of Institutions/Role	East Africa-Nile Basin		Ethiopian Plateau	East Africa-Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Sudan	Ethiopia	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	Inner Niger Delta
Water Infrastructure Development					1									
Forecasting	1				1			1						
Early Warning	1			1										
Agriculture Extension Services		1	1			1	1	2						
Food aid		1	1		4		1	3	3	4	1		1	1
Management of Water Infrastructure	1					1							2	
Funding			1	1			1	3	2	2	3		1	1
Policy		1	1		2	1		1	1	1			1	1
Advocacy	1		1	1			1	1	1	1				
Water supply (tankering etc)														
Total	4	3	5	3	8	3	4	11	7	8	4		5	3

### Drought adaptation actions

Communities in Africa are engaged in activities to be able to survive future droughts and climate change, depending on duration and magnitude of deficit. This is being done through changes in processes, practices, and structures to moderate potential impacts of future droughts. The most common actions are water harvesting, construction of water infrastructure, traditional/cultural practices and technologies, water conservation, crop monitoring and crop diversification. The following table presents a summary of the adaptation actions identified (The same actions are identified as climate change adaptation actions).

Adaptation Actions	East Africa-Nile Basin		Ethiopian Plateau	East Africa-Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Ethiopia	Ethiopia Plateau	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	
Water harvesting	X		X	X	X	X	X	X	X	X	X		X	X
Water infrastructure	X	X		X		X					X		X	

Adaptation Actions	East Africa-Nile Basin		Ethiopian Plateau	East Africa-Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Ethiopia	Ethiopia Plateau	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	
Desalination											X	X	X	X
Multi-activity agriculture			X	X	X	X	X	X	X	X		X	X	X
Cereal sole and fruit-trees												X		
Market gardening							X		X			X		
Local bovine												X		
Extra-agricultural incomes		X		X	X	X						X	X	X
Dry land farming practices	X	X					X	X	X	X		X		
Drought resistant crop varieties												X		
Water development		X	X		X	X						X	X	
Management of water networks			X			X	X		X	X		X		
Demineralization of water												X		
Reuse of treated waste water												X		
Construction of large dams	X	X					X		X	X			X	X
Integrated Water Management													X	
Food-for-work programmes	X	X												
Diversification of Species		X	X			X								
Herd splitting and distribution														
Improve lake water environment	X													X
Planting short maturing crops		X			X	X								
Reducing biomass fuel use														
Cultural practices		X	X	X		X	X	X	X	X				X
Water conservation technologies			X	X	X	X	X		X					
Construct small scale dams	X	X					X	X	X	X				X
Capacitation of farmers							X	X	X	X				X
Management of coastal zones				X										
Management of water resources			X						X					
Inter-basin water transfers	X								X	X				
Water recycling														
Water conservation	X		X	X	X	X	X		X					X
Importation of water									X					
Control of deforestation							X	X	X	X				
Tree planting at homesteads														X
Rangeland management.		X												
Changing crop varieties														
Expansion of protected areas							X		X	X				
Expansion of Community Based programmes														

Adaptation Actions	East Africa-Nile Basin		Ethiopian Plateau	East Africa-Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Ethiopia	Ethiopia Plateau	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	
Resource Management							X	X	X					
Strategic destocking														
Diversification of breeds/species														
Managing wildlife							X		X					
Control of animals & grazing														
Recycling of water									X					
Water rationing	X						X	X	X					
Management of groundwater	X								X	X				X
Conservation Farming														
Drought early warning systems							X		X					
Livestock health programmes		X	X	X	X	X								X
Soil and water conservation	X													
Crop monitoring	X		X	X	X		X	X	X	X				
Crop diversification	X		X	X		X	X	X	X					X

### Institutions involved in drought mitigation and institutional framework

There are four different types (distinguished by role) of institutions that are involved in drought adaptation namely water infrastructure development, agriculture extension services, management of water Infrastructure and policy. The following table presents a summary of the types of institutions identified.

Type of Institutions/Role	East Africa-Nile Basin		Ethiopian Plateau	East Africa-Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Sudan	Ethiopia	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	Inner Niger Delta
Water Infrastructure Development	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Forecasting														
Early Warning														
Agriculture Extension Services	1	1	2	1	1	1	1	2	1	1	1		1	1
Food aid														
Management of Water Infrastructure	1	1						2	1	1	2	1	2	1
Funding														

Policy	1	1	1	1	1	1	1	1	1	1	4	1	1	4	4
Advocacy															
Water supply (tankering etc)															
Total	4	4	4	3	3	3	3	6	4	7	5	3	8	7	

*Regarding the inventory of institutional frameworks for drought adaptation there are again only four different types (distinguished by role) of institutions that, according to this inventory, are involved namely water infrastructure development, management of water infrastructure, agriculture extension services and policy. Policy and agriculture extension are the dominant types. The following table presents a summary of this inventory by presenting the role institution have in the process of drought adaptation.*

Type of Institutions/Role	East Africa- Nile Basin		Ethiopian Plateau	East Africa- Nile Basin Equatorial Lakes Region			Southern Africa - Limpopo Basin				North Africa - Maghreb Region			West Africa - Niger Basin
	Egypt	Sudan	Ethiopia	Kenya	Tanzania	Rwanda and Burundi	Botswana	Mozambique	South Africa	Zimbabwe	Tunisia	Algeria	Morocco	Inner Niger Delta
Water Infrastructure Development					1				1				1	
Forecasting														
Early Warning														
Agriculture Extension Services	1	1	1			1	1	2	1					
Food aid														
Management of Water Infrastructure	1					1			1				2	
Funding														
Policy		1	1	1	1	1	1	1	1	1	1		3	1
Advocacy														
Water supply (tankering etc)														
Total	2	2	2	1	2	3	2	3	4	1	1		6	1

*The reliance on the internet, published materials and contacts for information limited the identification of historical droughts, mitigation and adaptation actions, and institutional frameworks for drought mitigation and adaptation in Africa particularly at national and local levels. The information presented here is thus not exhaustive. However additional information is expected from other stages of Work Package 2 and Stakeholder Platform(s).*



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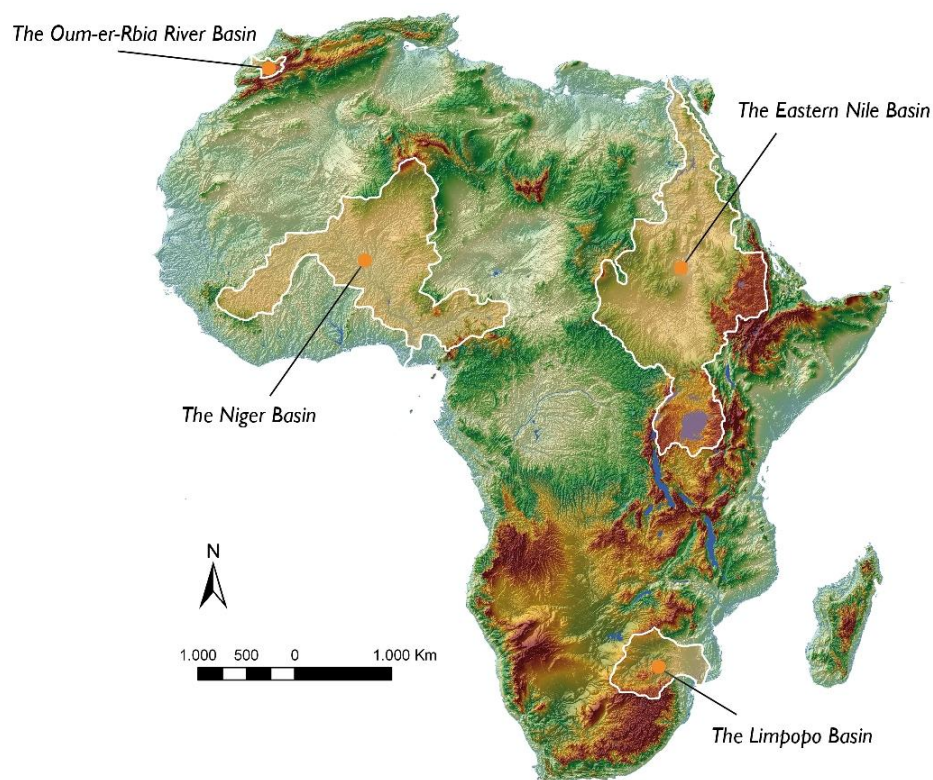
## LIST OF ABBREVIATIONS

AFR	Fourth Assessment Report
ANE	National Roads Administration
ARA's	Regional Water Administrations
CCGC	Coordinator Committee for Disasters Management
CTGC	Technical Committee for Disasters Management
CVM	Red Cross of Mozambique
DINAGECA	Direcção Nacional de Geografia e Cadastro
DNA	National Directorate of Water
DNGA	National Directorate for Environmental Management
EMA	Environmental Management Agency
FAEF	Faculty of Agronomy and Forestry Engineering
FAO	United Nation Food and Agriculture Organization
FEWS Net	Famine Early Warning System Network
FSTAU	Food Security Technical and Administrative Unit
GOZ	Government of Zimbabwe
GOZ-NEPC	Government of Zimbabwe - National Economic Planning Commission
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
INAM	National Meteorological Institute
INGC	National Institute for Disaster Management
MAE	Ministry for State Administration
MCT	Ministry of Science and Technology
MTC	Ministry of Transport and Communications
ME	Ministry of Energy
MIC	Ministry of Trade and Industry
MICOA	Ministry for the Coordination of Environmental Affair
MINAG	Ministry of Agriculture
MINED	Ministry of Education
MIREME	Ministry of Mineral Resources
MITUR	Ministry of Tourism
MDN	Ministry of National defense
MOPH	Ministry of Public Works and Housing
MP	Ministry of Planning
MTC	Ministry of Transport and Communications

NAPA	National Action Programme for Adaptation
NGO	Non-governmental Organization
RDCs	Rural District Councils
SADC	Southern African Development Community
USAID	Unites States Agency for International Development
NID	Niger Inner Delta
CILSS	Permanent Inter-State Committee for Drought Control in the Sahel
AGRHYMET	Agro-Hydro-Meteorological Center
INSAH	Institut du Sahel
ICRISAT	International Crops Research Institute for the Semi Arid Tropics
PRESAO	Prévision saisonnière des pluies et des écoulements en Afrique de l'Ouest)
HYCOS-A	West and Central Africa component of the World Hydrological Cycle Observation System
FRIEND	Flow Regimes from International Experimental and Network Data
AIACC	Assessment of impacts and adaptations to climate change including projects on West Africa
AMMA	Multi-disciplinary Analysis of the African Monsoon and its impacts

# 1 INTRODUCTION

This document identifies *historical droughts* and provides an inventory of institutional frameworks for *drought mitigation and adaptation in Africa*. This is done on case study basins selected across Africa namely; The Oum-er-Rbia River Basin, (Morocco), Eastern Nile Basin (Burundi, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda), Limpopo Basin (Botswana, Mozambique, South Africa and Zimbabwe) and Niger Basin (Algeria, Benin, Burkina-Faso, Guinea, Ivory Coast, Mali, Niger and Nigeria). These basins are shown in Figure 1.



**Figure 1: Location of case study basins**

However in order to have adequate range of scales, climates and societies this investigation was extended to four geographical areas comprising countries in Northern Africa, Northern and Eastern Africa, Southern Africa and Western Africa.

In the Northern part of Africa, the area considered covers the three countries of the Maghreb: Morocco, Algeria, and Tunisia as shown in Figure 2.



The countries in Southern Africa considered in this assessment are shown Figure 4

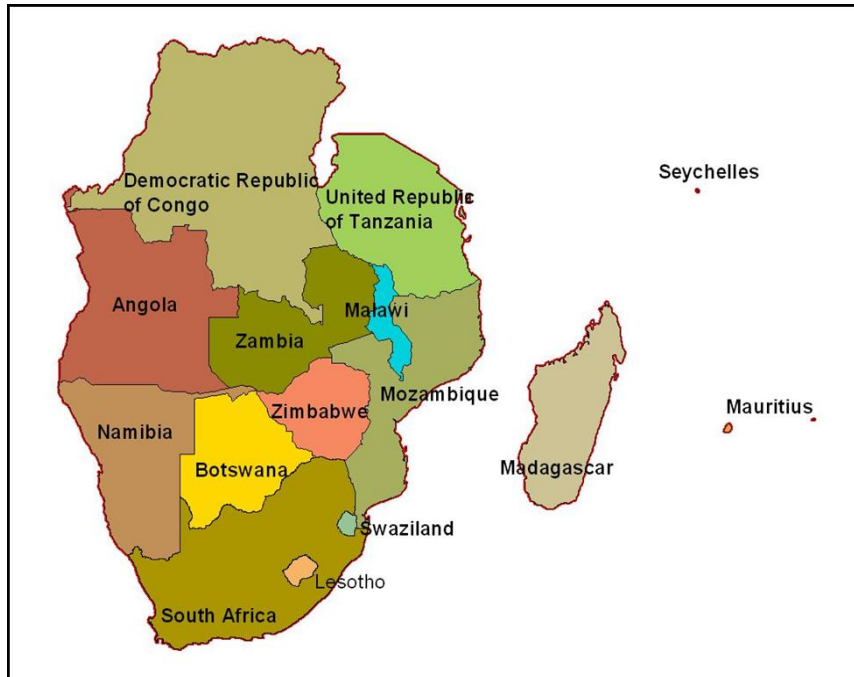


Figure 4: Countries in Southern Africa

The Niger Basin countries and other countries, which cover the Western parts of Africa, are shown in Figure 5.

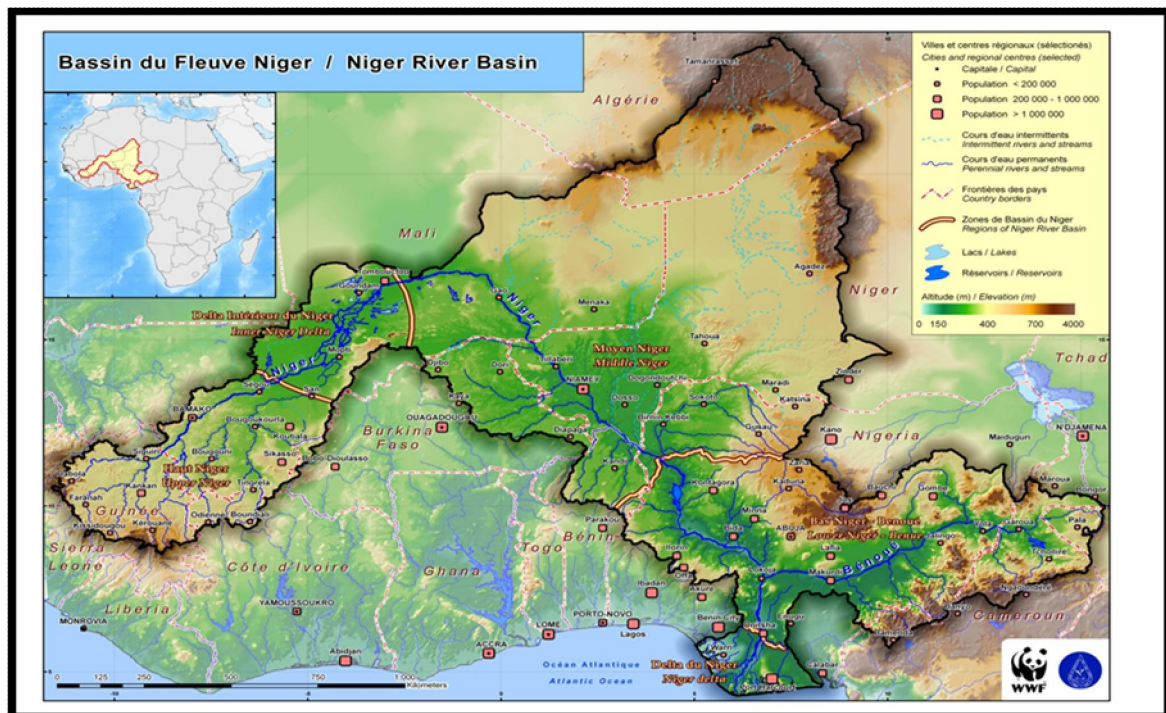


Figure 5: The Niger Basin and other countries in Western Africa



## 2 IMPORTANT DEFINITIONS

The following definitions apply to this document:

- **Drought** – a condition that originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector.
- **Meteorological drought** – occurs when annual precipitation is between 70% and 85% of the long-term annual mean precipitation.
- **Hydrological drought** - a deficit in runoff in rivers, surface reservoirs and groundwater.
- **Agricultural drought** - a situation of inadequate soil moisture for rain-fed crops.
- **Socio-economical drought** - a drought which results in social stress and economic hardships.
- **Drought mitigation** – the reduction in the classification of a drought in terms of frequency and magnitude of risks and resulting from reduction of the potential impact of a drought.
- **Drought adaptation** – a process of being able to survive in a drought condition. It refers to changes in processes, practices, and structures to moderate potential impacts of future drought.
- **Desertification** - a process of land degradation in arid, semi-arid and dry sub-humid areas, resulting from various factors, including climatic variation and human activities. Land degradation manifests itself through soil erosion, water scarcity, reduced agricultural productivity, loss of vegetation cover and biodiversity, drought and poverty.



### **3 HISTORICAL DROUGHTS IN AFRICA**

#### **3.1 NORTH AFRICA – ALGERIA, MOROCCO AND TUNISIA (MAGHREB REGION)**

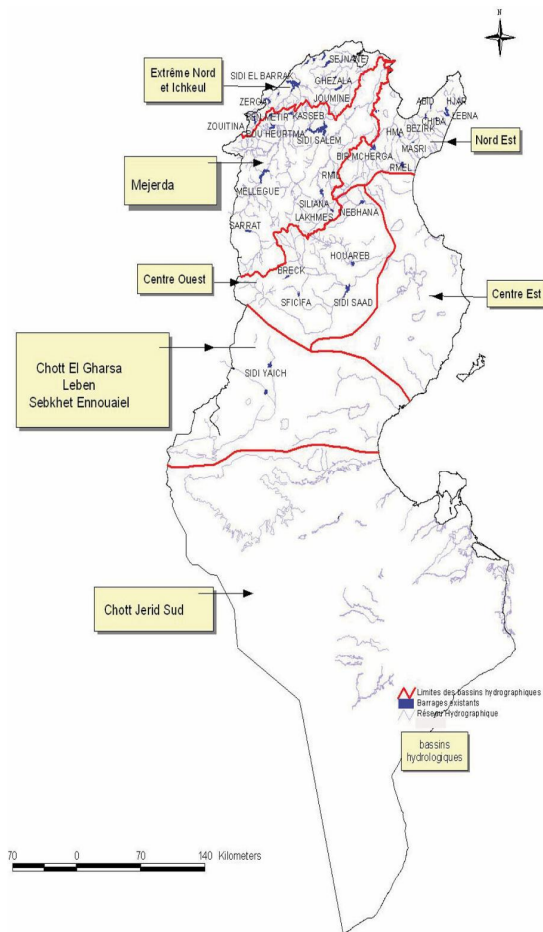
In the Northern part of Africa, the area considered on this study covers the three countries of the Maghreb: Morocco, Algeria, and Tunisia. The Maghreb region (Figure 2) has diverse climatic conditions with generally low and highly variable annual rainfall and high degree of aridity. The typically prevailing climatic conditions are characterized by extended periods of dry spells and wet periods with a regime of irregular precipitation, with flash flood, associated with low probabilities of occurrence. Inter-annual rainfall variability is also high, within the range of 25-50 percent in sub-humid and semi-arid parts to 50-100 percent in the arid and hyper-arid zones. As a result of aridity and rainfall variability, the region is extremely vulnerable to drought which represents a structural recurrent phenomenon. Moreover, the vulnerability to climate variability in the Maghreb region has intensified with today's demographic, economic growth and resource use patterns. Several studies indicate also that global climate change will add more to the existing problems resulting from drought and desertification, especially in this region where water resources are already limited and fragile. Indeed, during the three last decades, countries from the Maghreb regions faced more frequent, more intense and longer drought episodes.

Historical precipitation measurements before the twentieth century that could be used to determine drought conditions are not generally available in most locations. Therefore, researchers often use other indicators such as lake sediments, ice cores, tree rings, and geological or other environmental analysis to reconstruct past climate. Historical evidence corroborated by tree ring studies in North Africa illustrates the recurrent nature of drought in the region. FAO (2002) reported that drought episodes have been traced back to the year 707 in Tunisia. Similarly, in Morocco, the number of drought episodes as revealed by tree ring analysis over 1000 years (Chbouki, 1992; Stockton, 1988) varied from century to century around an average of 22 dry years per century. Other literature studies of historical drought occurrence in Morocco revealed 49 major drought-related famines from the late ninth century to the early 1900s, and approximately 28 years of agricultural drought since 1912, when the country was partitioned into French and Spanish protectorates (Swearingen and Bencherifa, 2000).

### 3.1.1 Tunisia

During the last century, Tunisia faced several drought episodes in each decade but these decades did not have the same frequency of drought. The period 1950-1970 reveals a limited number of dry years whereas the years 1920, 1940, and 1960-1980 are characterized by long lasting and severe drought episodes spread over the whole country.

The drought, which occurred in the 1940's was the most severe of the century. It lasted 6 to 8 years in a row in certain areas. In the sixties, drought was experienced from 1960-61 to 1968-69 (OSS, 2008). The 1987-1989 and 1993-95 droughts were characterized by "two consecutive dry years". During 1987-1989, drought was severe in the whole country. The north-east, central-west, south east and south-west (see Figure 6) were the most sensitive regions, with a rainfall deficit of 60% in some areas (OSS, 2008).



**Figure 6: Map of Tunisia showing the main dams and the limits between hydrographic basins**

During this period, the total water resources in the reservoirs fell to less than 50% of dam capacities. The 1993-1995 drought was similar to this event. The rainfall deficit was 33% to 56% and at national scale, it was around 35%. The 1993-1994 and 1994-95 droughts can be described as severe hydrological droughts. Statistical studies conducted on dams show that there was very low inflow in 8 of the 18 dams in use during these periods. In January 1995, the stored water volumes were at their lowest levels (Table 1).

**Table 1: Water volumes stored in the dams during 1992-1993, 1993-1994 and 1994-1995**

Dams	1992-1993		1993-1994		1994-1995	
	Volume (M m <sup>3</sup> )	Filling rate (%)	Volume (M m <sup>3</sup> )	Filling rate (%)	Volume (M m <sup>3</sup> )	Filling rate (%)
North West	864.8	81.7	698.7	66.0	403.3	38.1
Centre	307.3	84.0	287.2	78.5	194.8	53.3
North East	36.7	71.5	29.9	58.2	26.0	50.6
Total	1208.8	81.9	1015.8	68.8	624.1	42.2

Source: DGBGTH (1996)

More recently Tunisia faced a dry episode lasting 3 years from 1999 to 2002. This drought was felt at regional, global, seasonal and annual dimensions as follows:

- In 1999-2000 the autumn was normal but the winter and spring were severely dry in the central and southern regions. During this period the water deficit reached 80%. Drought was seasonal and moderate in the North and severe in the South and Central regions.
- In 2000-2001 drought was spread across the country, but the northern region was not affected.
- In 2001-2002 the whole country was dry. The drought was severe and spread across the country during the autumn and the winter. The spring was moderate in the North, Central, and South-West parts of the country. A severe drought occurred in the South-East region (Louati *et al.*, 2007)

### 3.1.2 Algeria

During the last century, Algeria faced several drought periods. The most severe ones were recorded in 1910, 1945, 1961 and 1994. During the period 1945 to 1947 drought was so severe that in the South of the country where 80-90 mm of rain is recorded in normal times there was no rainfall. According to official sources, in the

region of Ain Sefra, south of Oran (Figure 7), about 3,000 people died of starvation in a population of 80,000 inhabitants and 900,000 sheep which represents 90% of livestock perished (Vaillant, 1977).



**Figure 7: Algeria; Region of Ain Safra (Naâma province)**

A study of the climatologic evolution of Northern Algeria completed in 1994 highlighting the temporal evolution of precipitation, statistical calculations performed on a sample of 120 rainfall stations showed the existence of dry periods and wet periods between 1922 and 1992 as follows:

- A wet period from 1922 to 1939
- A dry period from 1939 to 1948
- A wet period from 1948 to 1972
- A pronounced dry period from 1973 to 1992 (Demmak *et al.*, 1994).

In 2001, a similar study confirmed the drought tendency of the 1975 to 1998 period, with a rainfall deficit ranging from 20% to 11 % from west to east (Demmak et Ould Amara, 2001).

In 2002, the whole country faced a severe drought episode and big cities such as Oran and Algiers knew severe water shortages (Ait Mouhoub et Kattab, 2002).

### **3.1.3 Morocco**

Since 1896, Morocco experienced the following 13 dry periods spread across major parts of the country and had moderate to strong intensities: 1904-1905, 1917-1920, 1930-35, 1944-45, 1948-50, 1960-61, 1974-75, 1981-84, 1986-87, 1991-93, 1994-

1995 , 1999-2003, 2006-2008. Other drought periods, which are less spread occurred during the years 1906-07, 1910-14, 1924-53, 1965-67 and 1972-73 (Bouignane, 2010). According to Mimouni and Mahyou (2007) an analysis of drought occurrence during these periods reveals that drought is tending to become chronic in Morocco and that its frequency and duration are increasing as follows:

- 1940-1979: 5 dry years over 40 years (1/10)
- 1980-1995: 6 dry years over 16 years (3/10)
- 1996-2006: 4 dry years over 10 years (4/10)

- Meteorological droughts at national and regional scales

Generally dry conditions began to occur in Morocco in 1975. A serious drought began in the water year of 1981 (September 1, 1980 to August 31, 1981), with precipitation ranging from 40 to 60 percent below normal. This occurred in important agricultural areas (especially in central Morocco) severely reducing the country's water supply. Comparable precipitation deficiencies had not occurred since the late 1930/s. Overall, the following (1982) water year was slightly less dry but brought a shift in the precipitation distribution with the greatest deficiency in the North. The 1983 water year had the worst precipitation deficits since the dry period started. Precipitation amounts nationwide ranged from 40 to 80% below normal. There was a slight increase in precipitation during the 1984 water year, but the cumulative amount still ranged from 20 to 40% below normal. The 4-year cumulative precipitation deficiency was over 120 percent of yearly normal in much of the central, southern, and eastern areas (Figure 8). Groundwater storage and reservoir supplies were depleted significantly. Reservoirs held about 10 to 20 percent of their normal storage capacity. Many fell below their minimum operating level. Before 1980 hydroelectric power had met about 30% of the nation's energy needs; by 1984 the contribution was down to 8 %.

Table 2 presents rainfall deficits during 1982-83, 1994-95 and 1998-2000 drought episodes at regional and national levels. These regions are representative of the main bioclimatic flows across country. It shows that these years figure among the driest years since their rainfall deficits were generalized (about 40% coverage at the national level). In 1982, Morocco received less than 60% of mean rainfall. During this sequence the total runoff was limited to 5.3 billion m<sup>3</sup> instead of the usual 16 billion m<sup>3</sup> (Benabderrazik and Doukkali, 2003).



Figure 8: Map of Morocco showing the main cities of the country

More recently Morocco faced 4 dry agricultural seasons as follows: 2001-2002, 2004-2005, 2006-2007 and 2007-2008. These were spread across the whole country (average national rainfall deficit ranged from 25 to 35%) but excluded the oriental region where rainfall slightly exceeds that of the period 2006 to 2008 (Loudiki *et al.*, 2008, MAPM (2009), MAPM (2011) ).

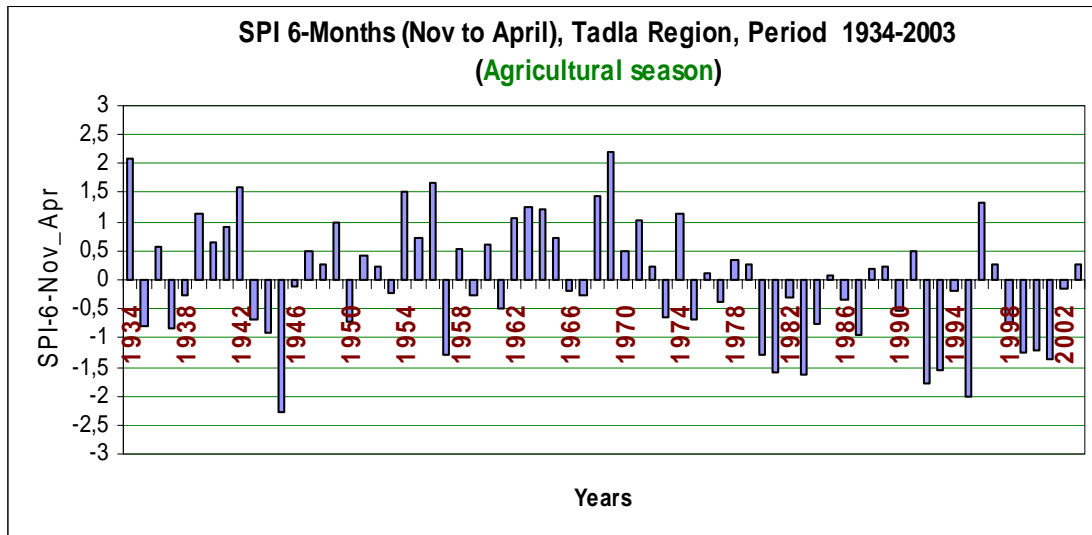
Table 2: Comparison of drought episodes 1982-83; 1994-95 and 1999-00

Parameter	Cropping season	Region							Average Deviation
		1	2	3	4	5	6	7	
Annual total rainfall (mm)	1982-83	193	89	101	273	419	536	151	
Deviation from the mean (%)		-41	-64	-59	-41	-33	-29	-57	-46
Annual total rainfall (mm)	1994-95	185	121	259	149	285	360	232	
Deviation from the mean (%)		-44	-51	9	-64	-50	-51	-28	-40
Annual total rainfall (mm)	1999-00	170	118	185	264	317	603	146	
Deviation from the mean (%)		-48	-53	-23	-32	-44	-18	-53	-39

**NB Regions:** 1. Beni-Mellal, 2. Agadir , 3. Marrakech, 4. Casablanca, 5. Meknes, 6. Tanger, 7. Oujda

### Meteorological droughts in the Oum er Rbia basin

The meteorological drought in Tadla region (Oum er Rbia basin) was characterized using the Standardized Precipitations Index (SPI) over the period 1934-2003 (see Figure 9).

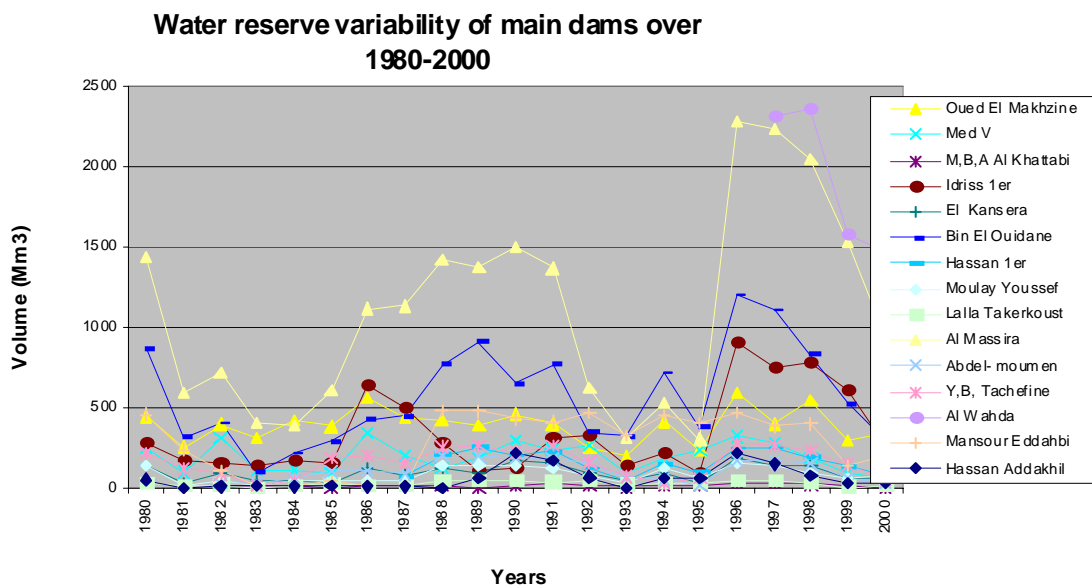


**Figure 9: Determination of SPI values for Tadla region (Oum Er Rbia basin).**

These data show that the most severe drought episodes for the Tadla region (Oum Er Rbia basin) over the last seventy years are the 1940-45, 1957-1958, 1980-85, 1992-93, 1994-95 and 1998-2002 periods (Ouassou *et al.* 2007).

- Hydrological droughts at national and regional scales

The most striking droughts from the hydrological point of view were recorded in 1980-81 to 1985-86; 1991-92 to 1994-95 and 2000-2001 to 2002-2003 (Figure 10).



**Figure 10: Water reserve variability of main Moroccan dams from 1980-2000**

(Source: Ouassou *et al.*, 2007)

Figure 11 shows the main hydrological basins and main dams in Morocco.

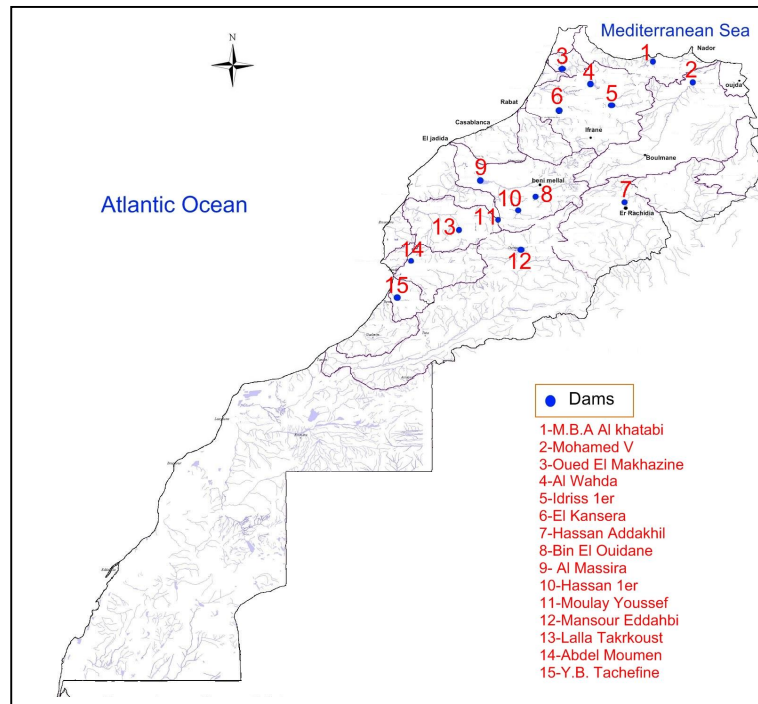


Figure 11: Location of the main dams in Morocco

Figure 12 shows the inflow in the main basins and the cumulative deviations from the inter-annual average for the period 1945-95.

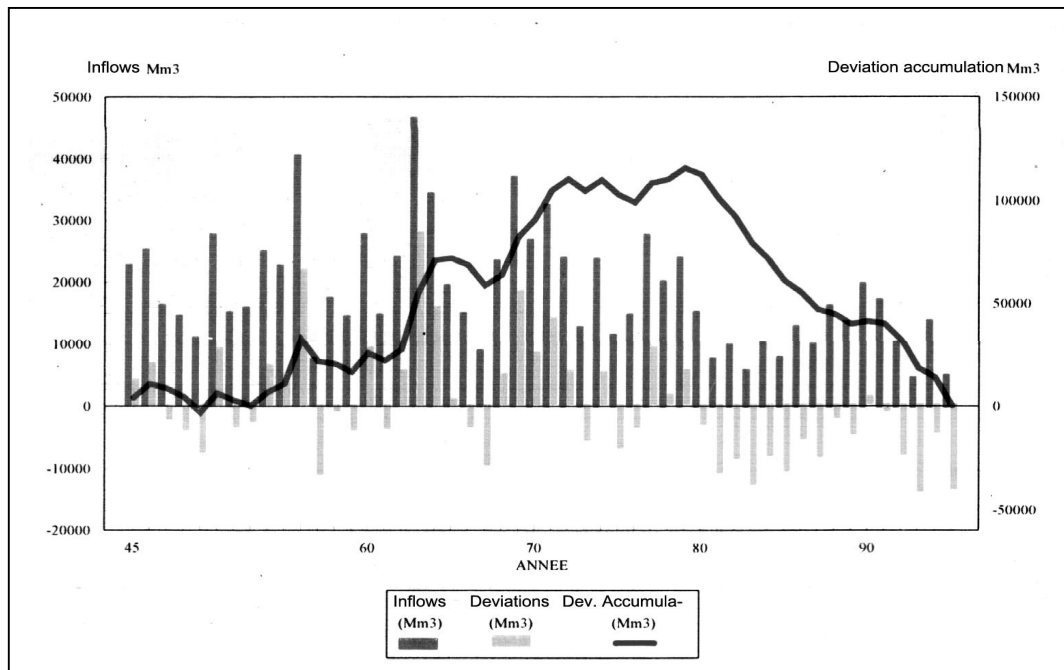
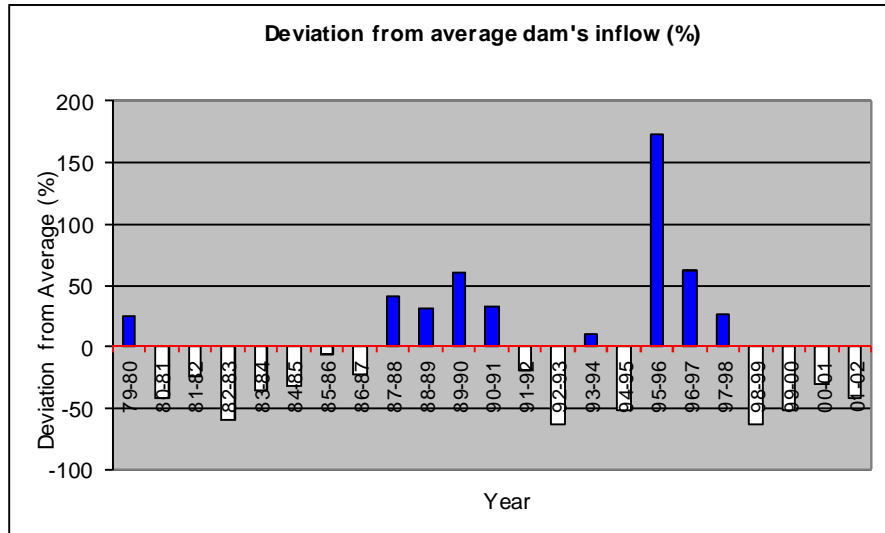


Figure 12: Variations of the main hydrological basins and their cumulative deviations from the inter-annual average for the period 1945-95

Source: MTP, 1997



Figure 13 shows deviations from the inter-annual average inflow for the period 1980-2002.

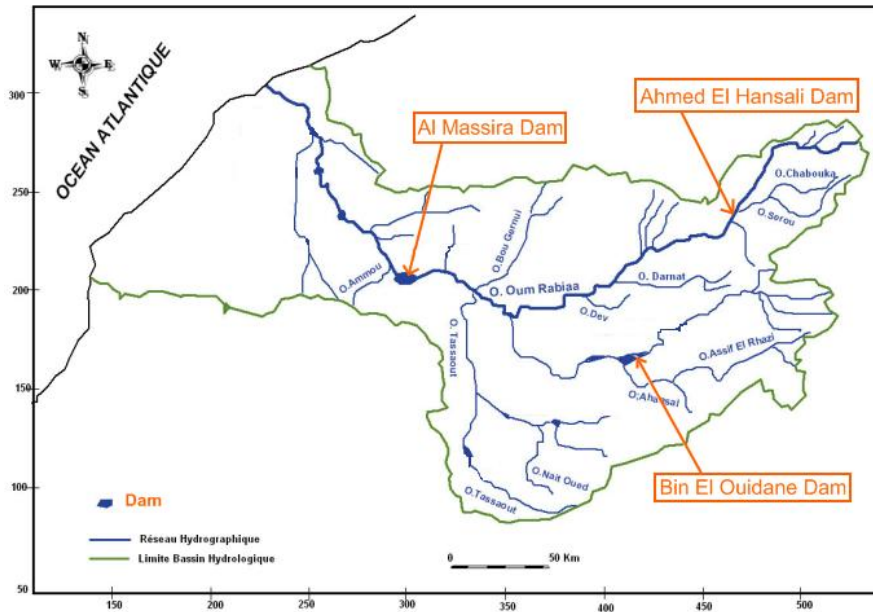


**Figure 13: Deviations of dam's inflows from the inter-annual average for the period 1980-2002**

The average annual surface water inflow into the basins is estimated at about 16 billion m<sup>3</sup>. The annual inflow was reduced to 5.3 billion m<sup>3</sup> in 1982, 10 million m<sup>3</sup> for the period 1980-85, 4.9 billion m<sup>3</sup> in 1992-93 and 5.3 billion m<sup>3</sup> in 1994-95 (fig. 10)

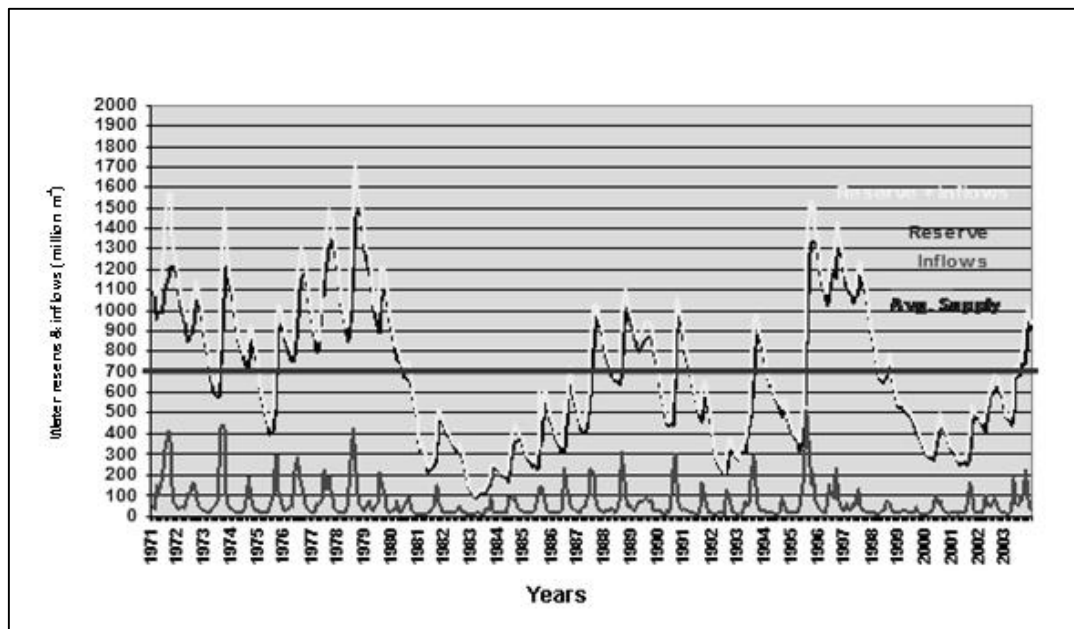
#### **Hydrological drought in the Oum er Rbia basin**

The Oum er Rbia basin has 15 multi-purpose dams. They supply various uses such as drinking water, irrigation and hydro-electricity power. Bin Al Ouidane, Al Massira and Ahmad al Hansali dams (Figure 14) are the most important in terms of capacity.



**Figure 14: Location of Bin Al Ouidane, Al Massira and Ahmad al Hansali dams in the Oum Er rbia basin**

Figure 15 presents the variability of water reserves in inflows (million m<sup>3</sup>) for Bin El Ouidane dam from 1971 to 2003. It shows three main periods of severe hydrological droughts as follows: 1980-81 to 1986-87, 1990-91 to 1994-1995 and 1998-1999 to 2002-2003.



**Figure 15: Variability of water Reserves and Inflows (Mm3)**

Source: Bin El Ouidane dam in Oum Er Rbia Basin; 1971-2003

The hydrological droughts for Bine El Ouidane dam were also characterized by the 9-months SPI and by a modified Surface Water Supply Index (SWSI) (Svoboda, 2004) (Figure 16 and Figure 17)

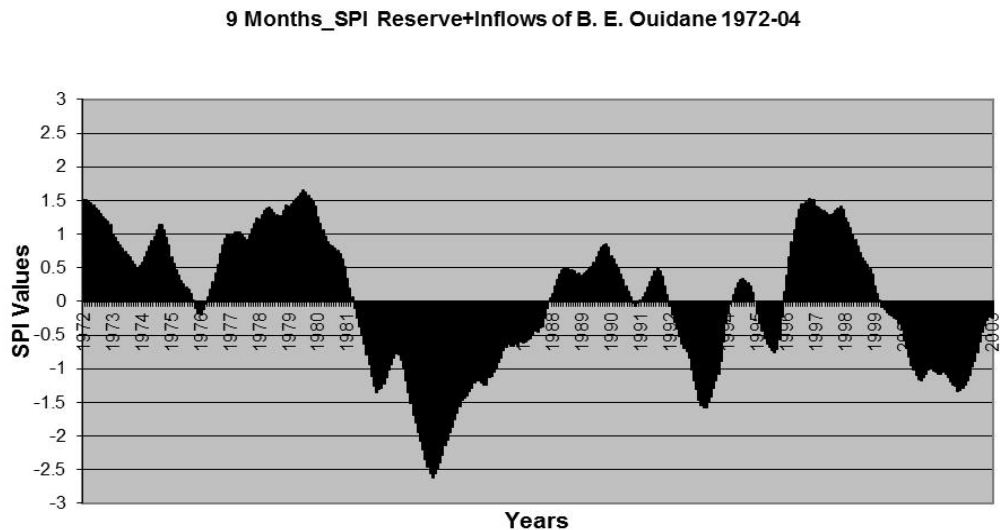


Figure 16: Use of SPI to monitor reserve and inflows for the Bine El Ouidane Dam (Oum Er Rbia basin)

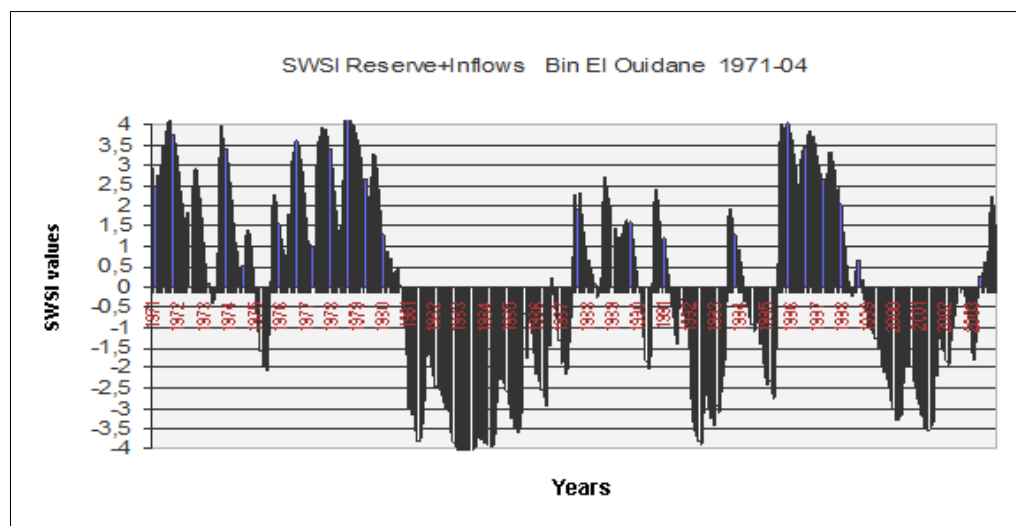


Figure 17: SWSI values in the Oum Er Rbia river basin over the period 1971 – 2004 for the Bin El Ouidane Dam

- Agricultural droughts at national and regional scales

Barakat and Handoufe (1998) highlighted agricultural drought from 1940 to 1995 years in the 8 regions of Moroccan where cereals are mainly cropped by calculating the running mean national cereal production for 5-year periods and using a regression confidence interval of this mean as a function of time (years). There were 11 droughts over the whole period, corresponding to a drought frequency of 20%, i.e. one dry year every 5 years. Results also show an increase in drought frequency during the 1980-1995 period with a total of 6 dry years (frequency of 40%). Drought

intensity was assessed using the deficit production index relative to the normal value, i.e. cereal production calculated by linear regression. The agricultural seasons of 1944-45, 1980-81, 1991-92, 1992-93 and 1994-95 faced very severe droughts with an intensity greater than 30%. The most severe drought was recorded in 1994-95 with an intensity of 60%. With the exception of the 1944-45 dry year the 1980-95 period had more intense dry years. This was quantitatively and qualitatively the driest period.

### Agricultural drought in the Oum er- Rbia basin

The characterization of drought years based on the yield threshold profitability over the cropping seasons from 1980 to 2000 is illustrated in Figure 18. Based on results of field surveys, the yield threshold for profitability was calculated to be 11 Quintals per hectare (or 1.1 ton per ha). On average, there were 9 severe drought years during 1980 – 2000 of which 6 dry years in the decade 1990 – 2000.

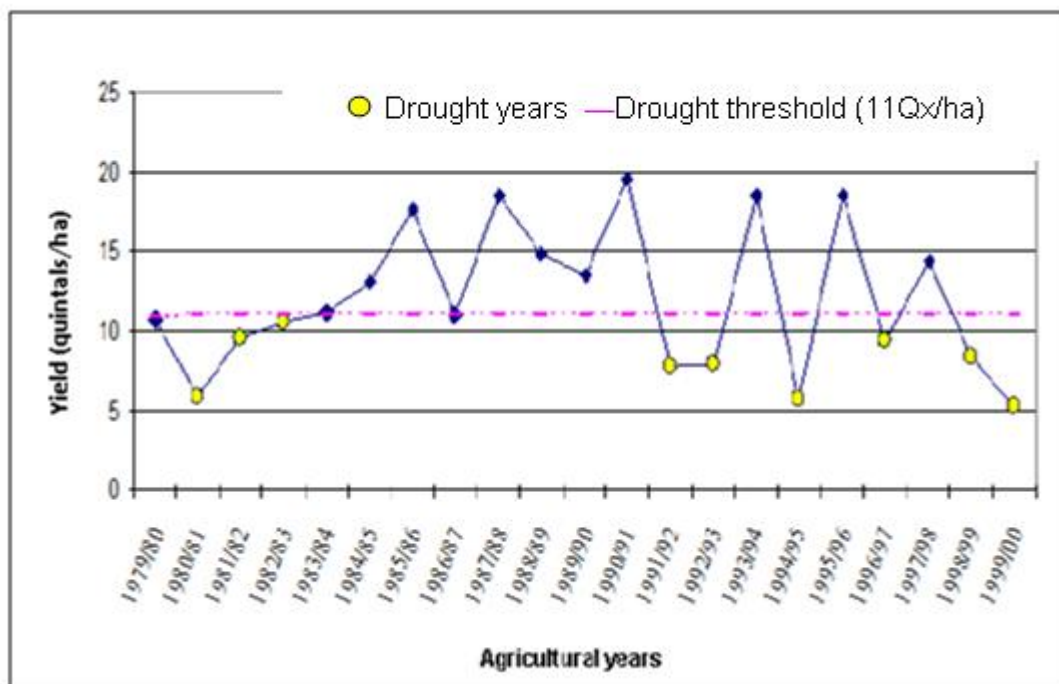


Figure 18: Characterization of drought years based on cereal yield threshold in Oum Er Rbia basin from 1979-80 to 1999-2000

### 3.2 EAST AFRICA- NILE BASIN EQUATORIAL LAKES REGION (BURUNDI, KENYA, TANZANIA, RWANDA AND UGANDA)

### 3.2.1 Tanzania

Tanzania is prone to natural and human made hazards including drought and agricultural pests, floods and earthquakes that affects livelihoods, destroy infrastructure and cause food insecurity and health problems. The government of Tanzania conducted a Disaster Vulnerability Assessment study, which revealed that the three most occurring hazards at household level are pests (49.9%) (It includes wildlife), Drought (47%) and Disease outbreak (42.9%). At village level the major three hazards are pests and vermin (57%), disease outbreak (52%) and drought (46%). At district level the major hazards are HIV/AIDS (90%), Disease outbreaks (88%) and pests and vermin (79%). The differences in the order of the major hazards between the household, village and district level is due to the following reasons:

- differences in the sample sizes,
- lack of recorded and reliable data at district and village levels and
- differences in perception of hazards at the different levels.

The study also revealed that regions most vulnerable to droughts are Mwanza, Mara, Shinyanga, Tabora, Dodoma, Singida, Arusha, Manyara, part of Mbeya and Iringa. Regions, which are vulnerable to diseases outbreak are Kigoma, Rukwa, Mbeya and Iringa. Morogoro, Ruvuma, Dodoma, Manyara, Tanga, Kilimanjaro, Mtwara and Lindi regions are most vulnerable to pests. The administrative districts of Tanzania are shown in Figure 19.



**Figure 19: Tanzania and its administrative regions**

Source: NBST (2011)

The areas most frequently hit by drought are the Central Regions of Dodoma, Singida and Tabora. Some parts of Pwani, Shinyanga, Mwanza and Mara are also regular victims of droughts. These areas receive between 200-600 mm of rainfall annually (URT, 2003).

The period since 1996 was marked by a series of poor harvests caused by a combination of droughts and floods. Within a 10-year period from 1991-2001, drought occurred 8 times, affecting 3,629,239 people. Analyses undertaken by the World Food Programme (WFP) Vulnerability Analysis and Mapping unit (VAM) indicates an increase in the number of emergency relief assistance operations in response to natural disasters since 1996 (Amani and Standen, 2004). Since WFP's first drought operation in 1975, 15 relief operations have been implemented. Consecutive relief operations were approved in 1999, 2000, 2001 and 2002 but there were no emergency operations during the 2002/2003 season, however this was immediately followed by the 2003/2004 relief operation (Amani and Standen, 2004). The WFP reported a significant increase in both the frequency and scale of its interventions, particularly in the central regions of Tanzania, reflecting not only an increase in

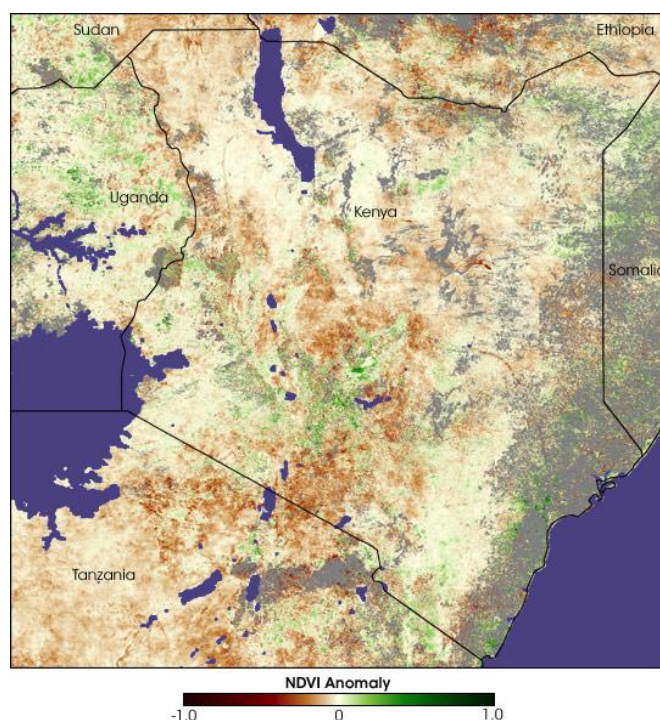
drought frequency, but also a decline in the capacity of the populations in the affected areas to cope with climate related shocks, and a concurrent increase in their levels of vulnerability. An estimate of the number of people affected during different drought years in Tanzania is shown in Table 3.

**Table 3: Ranking of droughts in Tanzania by number of people affected**

Date	Number of affected people
2006	3,700,000
1996	3,000,000
1984	1,900,000
2003	1,900,000
1991	800,000
2004	254,000
1988	110,000
Source: "EM-DAT: The OFDA/CRED International Disaster Database, Universitetcatholique de Louvain, Brussels, Bel.", Data version: v11.08; PreventionWeb (2011).	

### 3.2.2 Kenya

Kenya experiences meteorological and hydrological droughts annually in its arid (Northern Kenya) and semi-arid (Rift Valley and Coastal) catchments. Most communities in these areas have traditional ways of coping, namely nomadic life style. The drought in Kenya has over the last half a decade (2005 to 2010) endangered the lives of 2.3 million to over 3.5 million people living in 26 districts across the country (Figure 20). This spatial map is better than the district map because Kenya districts are no longer what they were at the time of the droughts. Droughts are also events that are not defined at district boundaries. In Kenya, between 1975 and 2011, there have been at least ten serious droughts, five of which took place over the last 17 years.



**Figure 20: Kenya spatial drought coverage**

An estimate of the number of people affected during different drought years in Kenya is shown in Table 4.

**Table 4: Number of people affected by drought in Kenya, 1975-2011**

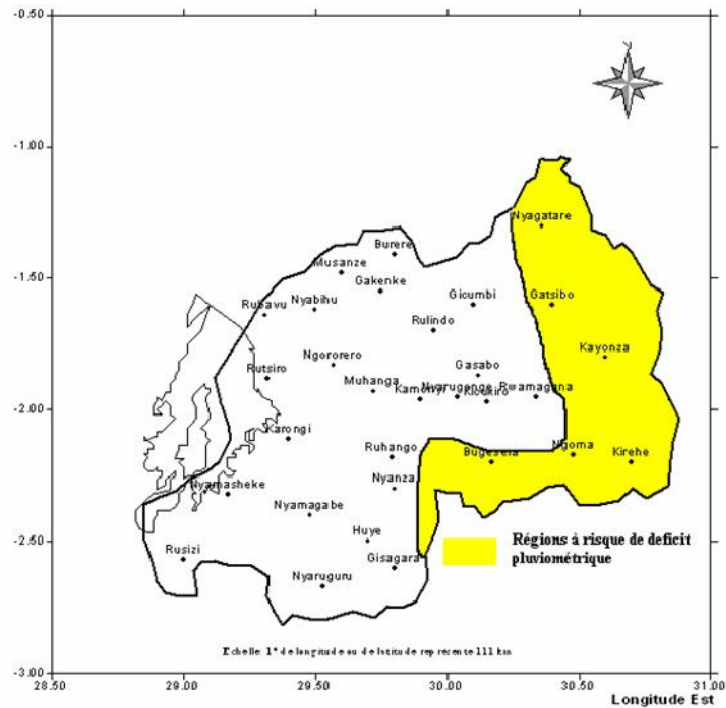
Season/Year	Coverage	No. of people affected
1975	Widespread	16,000
1977	Widespread	20,000
1980	Widespread	40,000
1983/84	Widespread	200,000
1991/92	Widespread	1,500,000
1996/97	Widespread	1,450,000
1999/2001	Widespread	4,400,000
2004/2006	Widespread	3,500,000
2007/2009	Widespread	3,000,000
2011	Widespread	4,500,000

Source: Adopted from National Disaster Policy 2004 and updated

### 3.2.3 Rwanda

In Rwanda, the drought prone areas are mainly in the eastern and south-eastern regions of the country (Figure 21). A recent study on temperature change in Upper Kagera basin revealed that rivers crossing these drought prone areas are experiencing a decrease in surface water level (Museruka et al., 2011).





**Figure 21: Drought prone areas of Rwanda**

Source: REMA (2009)

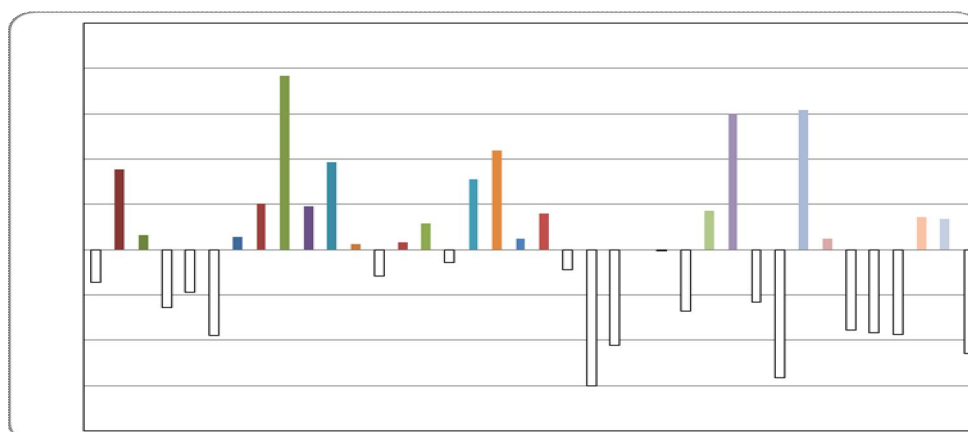
Severe drought induced famines are part of the historical experience of Rwanda. The infamous Ruzagayura famine during 1943 to 1945 was also as a result of prolonged drought (PANA Rwanda, 2006). Observations show that from 1961 and 2008 the period between 1991 and 2000 was the driest. These observations show significant rainfall deficits in 1992, 1993, 1996, 1999 and 2000 and rainfall excesses in 1998 and 2001. From 1999 to 2000, a prolonged drought seriously affected Bugesera, Umutara and Mayaga regions and more recently in 2008. This led to food insecurity: famine, food shortages, reduction in plant and animal productivity and displacement of people in search of food and pasture (REMA, 2009). Table 5 gives an inventory of famines, which occurred in linkage to El Nino / La Nina with highlight to those associated to drought events.

**Table 5: El Nino/La Nina Episodes and Droughts in Rwanda**

Period	El Nino /La Nina Episodes	Catastrophe	Consequence	Affected Region
1943/44	La Nina	Drought	"Ruzagayura" Famine	Most parts of the country
1982/83	El Nino Episode	Drought, strong heats	Low agricultural production	Most parts of the country
1991/92	El Nino Episode	Drought	-	Eastern part of the country
1997/98	El Nino Episode	Drought, high heats	-	-
1999/2000	La Nina	Drought, high heats	Famine	Eastern part of country especially Bugesera
2005/2006	La Nina	High heat and prolonged drought	Famine; water sources drying; tendency of desertification	Most part sof the country but Eastern and Southern parts most affected

Source: NAPA-Rwanda, 2006

Most of these droughts were either meteorological drought or agricultural / hydrological drought or a combination of all as in most of cases; meteorological drought precedes the other kinds of drought (Wikipedia, 2011). Figure 22 plots the difference between the annual total rainfall and the mean annual rainfall is divided by the mean annual rainfall for the period 1971 to 2008. The mean annual rainfall for Rwanda is about 1250 mm per annum (REMA, 2009). The negative values show years with deficits on mean annual rainfall and large deficits are significant drought years.



**Figure 22: Annual rainfall anomalies in Rwanda (at Kigali synoptic station 1971 to 2008)**

Source: Rwanda Meteorological Services

These droughts were responsible of certain diseases, food insecurity, migrations of the population, reduction or loss of vegetation and animal species. For example, in 2000, hippopotamuses died in the central valley of Umutara, volumes of available water resources fell significantly and marshes in the region of Bugeserawere heavily drained. Lake Cyohoha North dried up in 2000 (Twagiramungu, 2006).

Another hydrological drought was experienced in 2003-2004 when the runoff from Rugezi marshland was very low. There was very low inflow into the Burera and then Ruhondo lakes. During this period, Lake Burera dropped down by about 5m which caused a serious drop in electricity production at Ntaruka hydropower station located between the two lakes (Hategekimana, 2010).

### 3.2.4 Burundi

The drought prone areas in Burundi are shown in Figure 23.

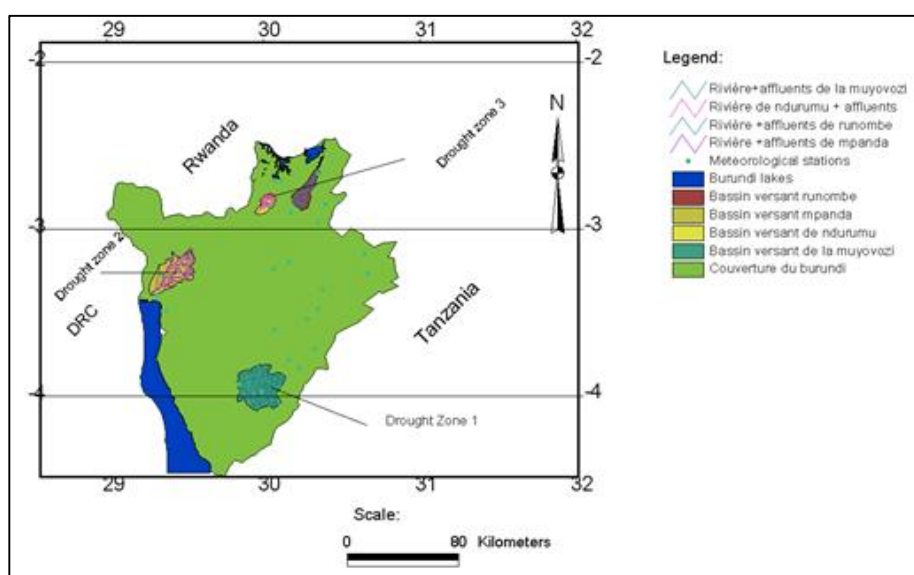


Figure 23: Drought prone areas of Burundi

Table 6 shows some of the impacts of droughts events, which occurred in Burundi during the period 1917 to 2008.

Table 6: Synthesis of the principal events related to rainfall deficits in Burundi

Year	Climatic events	Impacts	Affected Zones
1917	Marked dryness	Loss of crops, generalized famine	All country
1923	Marked dryness	Loss of crops, generalized famine	All country
1931	Marked dryness	Loss of crops, generalized famine	All country
1933	Marked dryness	Loss of crops, generalized famine	All country
1943	Marked dryness	Loss of crops, generalized famine	All country
1950	Marked dryness	Loss of crops, generalized famine	All country

Year	Climatic events	Impacts	Affected Zones
		, decrease level of the lakes	
1958	Dryness	Loss of crops, generalized famine, decrease level of the lake Tanganyika (772.8 m)	All country
1973-1974	Marked dryness	Bad agricultural output without humanitarian aid	All country
1983-1984	Marked dryness	Loss of crops, generalized famine with humanitarian aid	All country
1990	Dryness	Loss of crops	All country
1993	Late rainfall	Bad agricultural yield	All country
1999-2000	Marked dryness	Loss of crops, famine, displacement of populations, humanitarian aid	North-Est. of the country(Kirundo and Muyinga)
2004-2005	Late rainfall	Bad agricultural output in the North-East of the country, decrease levels of the rivers, the level of the lake Tanganyika drops dangerously, Insufficient of hydroelectric Energy	All country

Source: Evaluation of the vulnerability of the water resources and priority actions of Adaptation to the Climate changes, May 2006

### 3.3 EASTERN NILE REGION (ETHIOPIAN PLATEAU)

Ethiopia has along history of recurring drought. Since the 1970s, the magnitude, frequency, and impacts of droughts have become more severe. In 1974, drought affected 300,000 people; by 1981 the figure escalated to 3 million, and to 12.6 million in 2003.

Figure 24 shows the area in Ethiopia, which experiences a high frequency of drought.

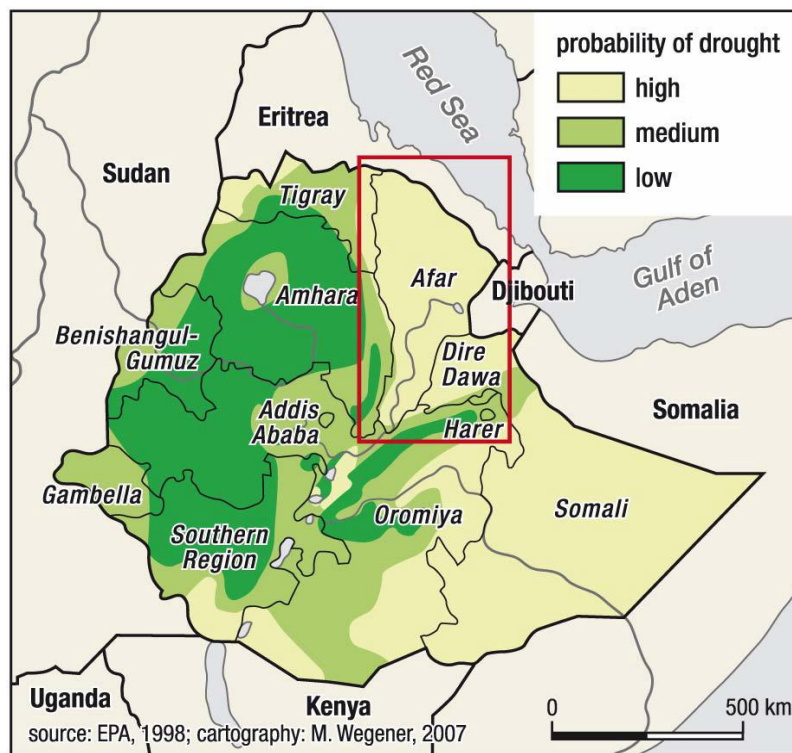


Figure 24: Probability of drought in Ethiopia

Smallholders dependent on rain-fed crop production and pastoralists in drought-prone areas are the most vulnerable rural livelihood systems. Approximately 85% of the population lives in rural areas and depends on the local natural resource base to meet their basic welfare needs. The vulnerability to climate-related hazards and food insecurity is closely linked to land degradation. About 85% of the land surface in Ethiopia is considered susceptible to moderate or severe soil degradation and erosion. In the Highlands, shrinking farm sizes and soil degradation and erosion are reducing the sustainability of agricultural production and causing downstream pollution (including siltation of dams), thereby making it difficult for rural populations to meet their basic needs. The annual costs of land degradation are estimated to be at least 2-3% of agricultural GDP. The relatively under-developed, semiarid, and arid regions of Afar and Somali have been historically vulnerable to drought. The Amhara and Oromia regions are characterized both by areas of good agricultural production in the highlands and midlands and by recurrent droughts. The Tigray region is vulnerable to recurrent drought and climate change (Temesgenet, al 2008). The years 2003, 2005 and 2008 experienced severe drought, which affected 12.6 million, 2.6million and 4.5million people respectively (Source: EM-DAT: The OFDA /CRED International Disaster Database, Universitécatholique de Louvain, Brussels, Belgium).

The water resources in Ethiopia are unevenly distributed both spatially and temporally. Between 80-90% of the country's surface water resources are found within four major river basins –Abay (Blue Nile), Tekeze, BaroAkobo and Omo and Omo Gibe. These are located in the west and southwest of the country with no more than 30-40% of the total population. In the east and central river basins, where 60 percent of the population resides, there are only 10-20% of the country's surface water resources. Figure 25 shows the river basins of Ethiopia.



**Figure 25: A map shows the river basins in Ethiopia**

### **3.4 EASTERN NILE REGION DOWNSTREAM COUNTRIES (EGYPT AND SUDAN)**

#### **3.4.1 Historical droughts in Egypt**

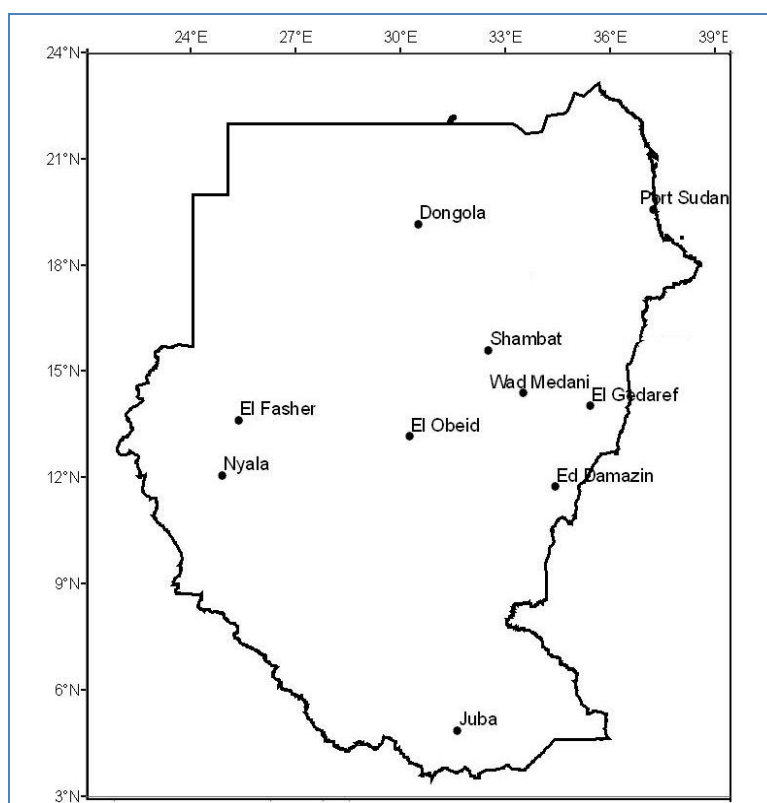
The Nile River is main source of fresh water for Egypt. The country is therefore vulnerable to hydrological droughts affecting this river system. A team of scientists believe they have discovered that world's first great civilization, established in Egypt nearly 5000 years ago, crumbled and plunged into a dark age that lasted for more than 1000 years because of decades of drought. These drought events were identified from a study of layers of sediment at the source of the Blue Nile at Lake Tana in northern Ethiopia. One of the team, Dr Richard Bates, of St Andrews University's school of geography and geosciences, pointed out that sediment samples from the lake bed obtained during a three-week climate-change study showed that drought conditions existed in the lake during the same period. This is used as proof that the downfall of the kingdom was triggered by a drought caused by a shift in climate and resulting in a decrease in the Nile floods.

#### **3.4.2 Sudan**

The major drought experiences in Sudan occurred during 1973/74 and 1983/1984 and during the 1990's and 2000's in the central, eastern and western part of the country. Table 7 shows historical drought events at major stations in five states of the Sudan. The location of the stations is shown in Figure 26 .

**Table 7: Drought events in 5 states in Sudan**

Station	Drought period
Juba	1972-1974; 1977-1979; 1981-1984; 1997-1998
Ed Damazin	1972-1973; 1978-1980; 1983-1988; 2002-2007
Nyala	1972-1973; 1981-1987; 2001-2002; 2004-2005
El Obeid	1969-1970; 1972-1973; 1979-1982; 1984-1988; 1990-1991; 2000-2005
El Fasher	1972-1973; 1975-1976; 1982-1985; 1995-1997; 2001-2004
El Gedaref	1969-1970; 1983-1984; 1987-1988; 1990-1992; 1997-1998; 2000-2002; 2004-2008
Wad Medani	1972-1973; 1979-1980; 1982-1984; 1986-1987; 1990-1991; 2000-2006
Shambat	1969-1970; 1979-1981; 1984-1985; 1990-1991; 1998-2000; 2004-2005
Dongola	1984-1987; 1990-1991; 1995-2008
Port Sudan	1969-1970; 1973-1974; 1979-1981; 1987-1989; 1998-2008



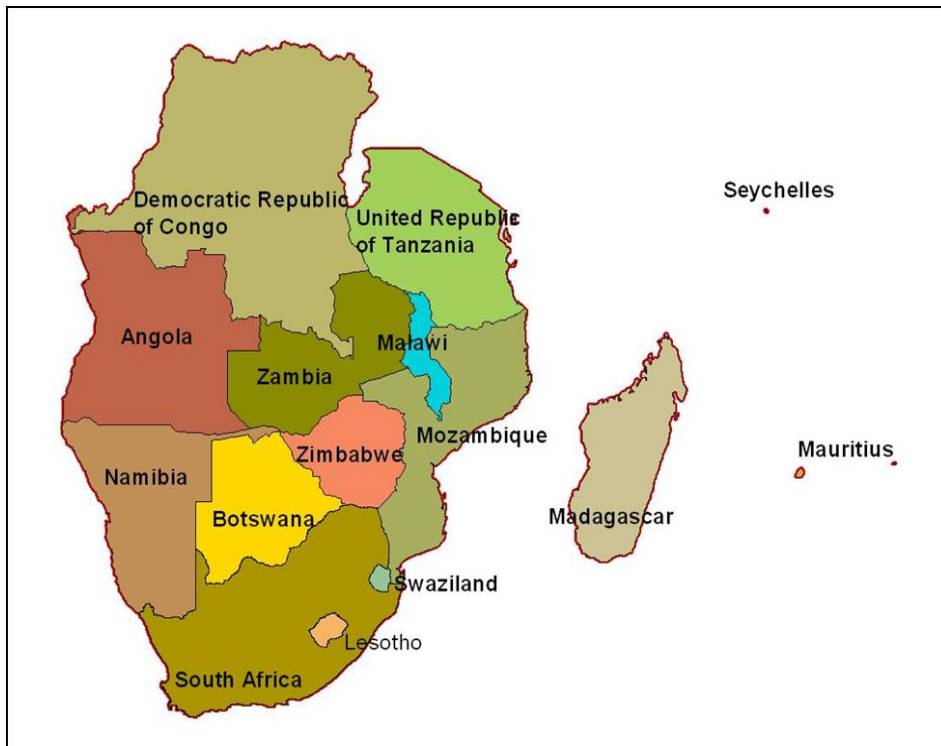
**Figure 26: A map of Sudan**

Source: Elagib and Elhag (2011)

### 3.5 SOUTHERN AFRICA – SADC AND THE LIMPOPO BASIN

The countries in Southern Africa considered in this assessment are shown in Figure 27.





**Figure 27: Countries: in Southern Africa**

According to the International Fund for Agricultural Development (IFAD), as cited by Benson, Thomson and Clay (1997), at least 60 percent of sub-Saharan Africa (SSA) is vulnerable to drought and probably 30 percent is highly vulnerable. Extreme drought in the Limpopo River Basin is a regular phenomenon and has been recorded for more than a century at intervals of 10-20 years. In the period 1980-2000, the SADC region was struck by four major droughts, notably in the seasons 1982/83, 1987/88, 1991/92 and 1994/95. This corresponds to an average frequency of once every four or five years, although the periodicity of droughts is not necessarily so predictable. FAO (1994) identified three drought cycles during the years 1960 to 1993 with lengths of 3.4, 7.1 and 5.8 years, respectively. Amplitudes were 0.38, 0.35 and 0.28 standard deviations, respectively.

In the case of the 1991/92 drought in southern Africa, estimates put the total number of people affected at 86 million, 20 million of whom were considered to be at serious risk of starvation. Botswana experienced several periods of prolonged drought affecting the entire country from 1981 to 1986 that were caused by a succession of below average rainfall years. The cumulative effect was devastating in terms of food and water availability and caused large-scale mortality in livestock and wildlife. This drought is widely regarded as the worst to affect Botswana in living memory. A



second period of drought in 1991/92 also affected the entire country and caused widespread crop failure and livestock mortalities

The 1991/92 drought in Southern Africa, referred to as the "apocalypse drought" because of the magnitude of the problem, provides an unusually dramatic example of a large-scale natural disaster that resulted in very few deaths. Rains failed (or were late) across a wide region in 1991/92; the worst rainfall levels in over a century followed generally below-average rains across Southern Africa in 1989/90 and 1990/91. Grain yields in the ten states of the Southern African Development Community (SADC) were 56 per cent of normal (Green 1993). Regional stockpiles were woefully inadequate to cope with the shortage. The drought placed 17-20 million people at risk of starvation. Yet there were no famine-related deaths reported, except in Mozambique where there was an on-going civil war (Callihan et al. 1994).

### **3.5.1 Meteorological droughts**

The drought of the early nineteen thirties reached maximum development during the 1932-1933 seasons with vast areas of the country severely affected whilst large areas were similarly affected during the 1948-1949 season. An interesting period is that from 1963-1964 to 1965-1966 where the influence of the Eastern Transvaal (now part of Mpumalanga and Limpopo provinces) escarpment is clearly apparent. The worst drought in the South Western Cape from a water resources point of view occurred during the 1972-1973 season. The event was very largely confined to the coastal regions and the southern interior with serious shortfalls in dam levels. Over most of the interior the early and mid-seventies were particularly wet with serious flooding during the 1974-1975 season. The present drought is seen to have developed over the Northern Transvaal during 1978-1979 and over Natal during 1979-1980.

Dry conditions began in the Limpopo Basin in 1965 to 1975. A serious drought began in the year 1981 up to 1987. The amount of rainfall received was relatively enough for the storage in the dams but the issue was the period at which the rain fell. No rainfall was experienced at crucial times in the year.

#### **3.5.1.1 Mozambique**

Since 1975, after the independence, Mozambique has been affected by a long period of drought which resulted in stagnation of the national economy contributing for high levels of vulnerability of Mozambican citizens (SETSAN, 2005). Every year droughts

affected the country, the most frequent and severe droughts taking place in the southern and central region. The agriculture was the first sector that suffered the direct consequences followed by other sectors of economy. According to INGC *et al.* (2003), the most dramatic droughts during the last two decades (1980 to 2008) are listed in Table 8.

**Table 8: Major drought in Mozambique (ING *et al.*, 2003)**

Year/Season	Area affected	No. of people affected
1980	South and Central provinces	No data available
1981-83	South and Central provinces	2.46 Million
1983-84	Most of the country	No data available
1987	Inhambane province	8,000
1991-92	Entire country	1.32 Million
1994-95	South and Central portions	1.5 Million
2002-06	43 districts in South and Central provinces	800,000 Million

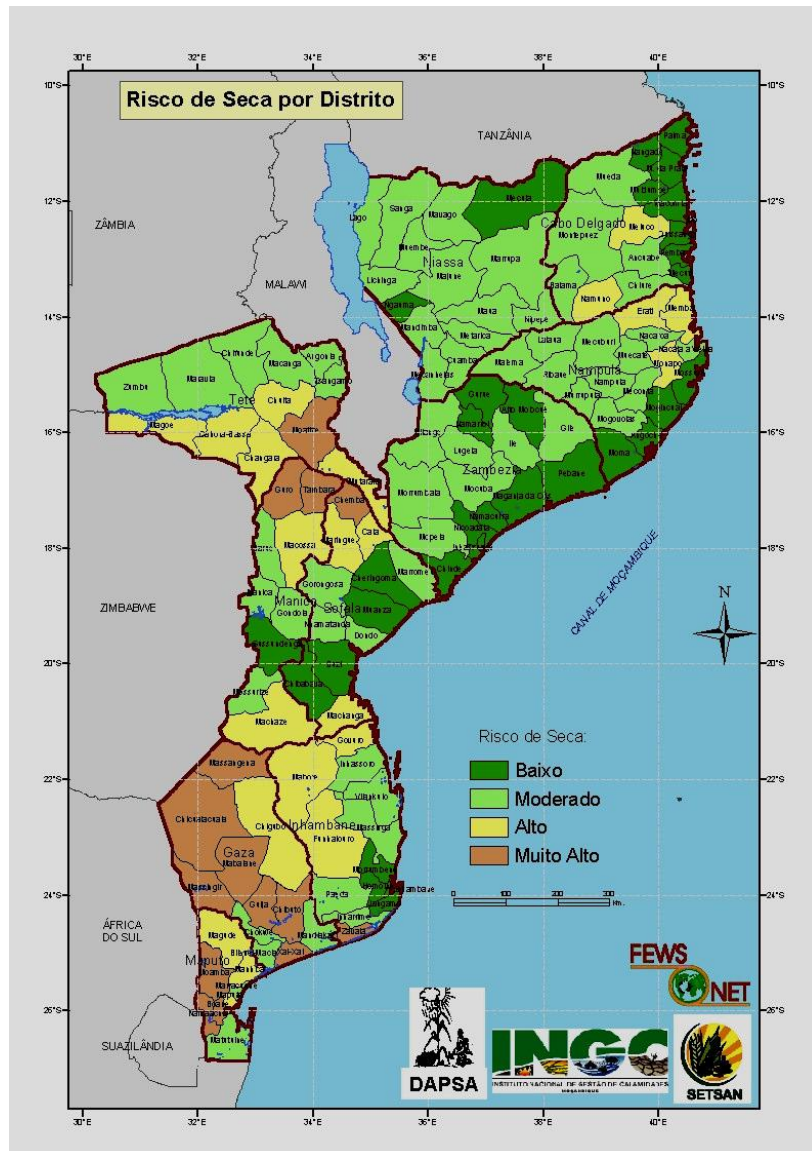
Table 9 and Figure 28 illustrate the drought prone zones in the country.

**Table 9: Frequency of droughts occurrence (MICOA, 2006)**

Region	Province	Number of consecutive drought years	Return period (years)
Northern	Niassa	6	5.0
	Cabo Delgado	5	6.0
	Nampula	6	5.0
Central	Tete	5	6.0
	Zambezia	6	5.0
	Sofala	9	3.3
	Manica	5	6.0
Southern	Inhambane	5	6.0
	Gaza	5	6.0
	Maputo	5	6.0

The experience of Southern Africa during the 1991/92 drought is not a complete success story. Mozambique fared less well than other Southern African countries, in part because donors were reluctant to send food aid from fear that with the existing conflict situation the food could be stolen and not reach displaced people (Ayisi 1992). Largely owing to the ongoing civil war, production also did not rebound with the good rains in 1992/93 to the same extent as it did in neighbouring nations. Another, less severe, drought afflicted the region in 1994/95, and farmers who might otherwise have been able to cope were pushed into bankruptcy, since they were

already in debt from the 1991/92 drought. Nevertheless, the experience during the worst drought in over a century clearly shows that drought does not have to lead to famine. The physical and biological causes of production shortfalls are in no way the sole determinants of food shortage. They must always be viewed against an institutional background dedicated to preventing and alleviating shortage.

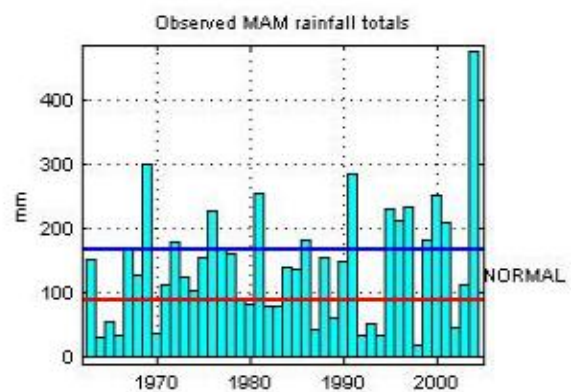
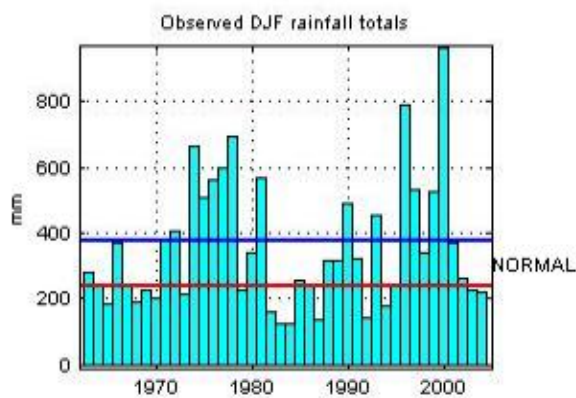
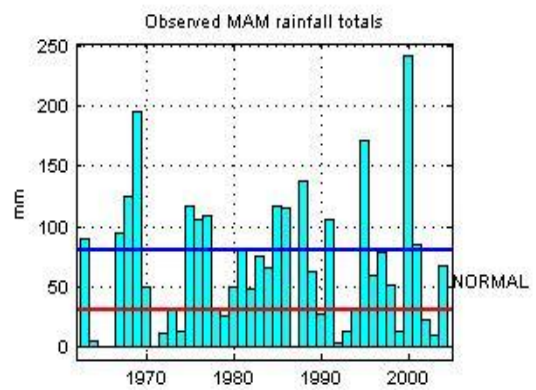
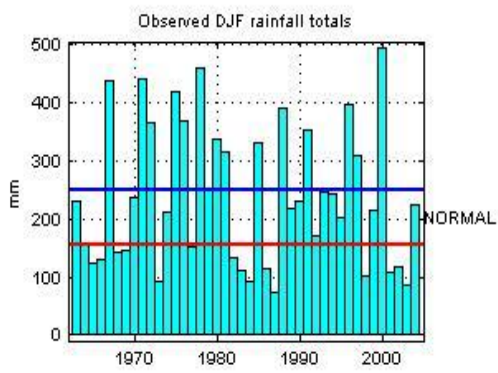
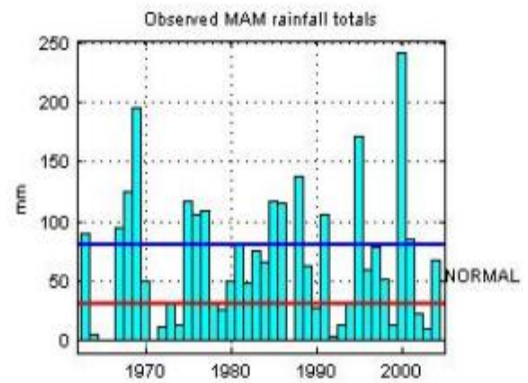
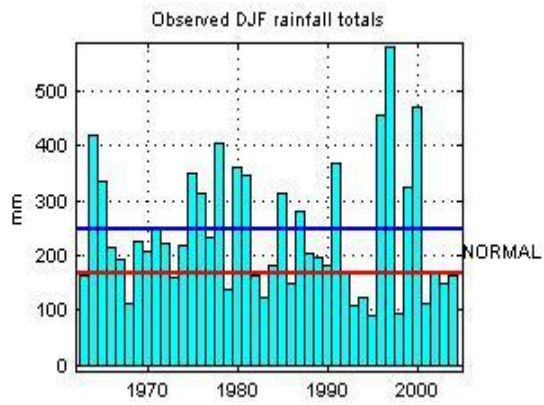


**Figure 28: Drought prone zones in Mozambique**

Source: MICOA, 2007

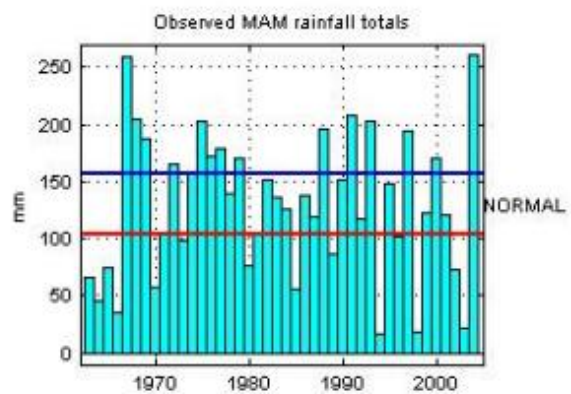
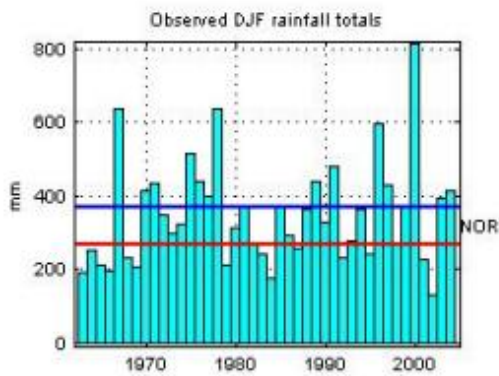
### 3.5.1.2 South Africa

Figure 29 and Figure 30 show years of below normal rainfall (wet months only) for selected rainfall stations in the Limpopo River Basin.

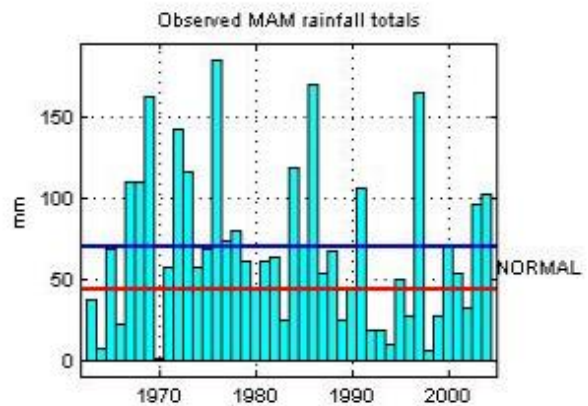
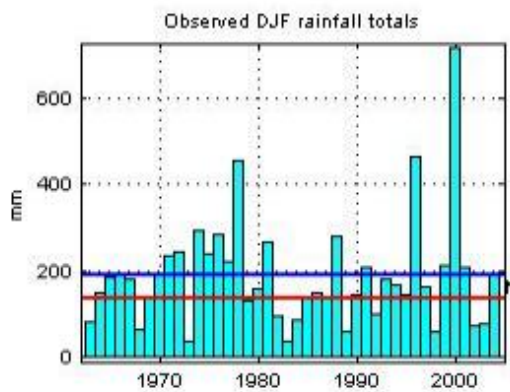


Makhado

**Figure 29: Graphs of rainfall at selected rainfall stations in the Limpopo basin (South Africa)**



Thabazimbi



Musina

**Figure 30: Graphs of rainfall at selected rainfall stations in the Limpopo basin (South Africa)**

Source: SAWS

The time-series of total annual rainfall can be analysed to pick out droughts lasting 1, 2, 3 or 'n' years. The length of data available determines the n<sup>th</sup> year. The sum of rainfall during each period is an important quantity and this can be assigned a probability of exceedance as shown in Figure 31 for selected rainfall gauges in the Limpopo River Basin.

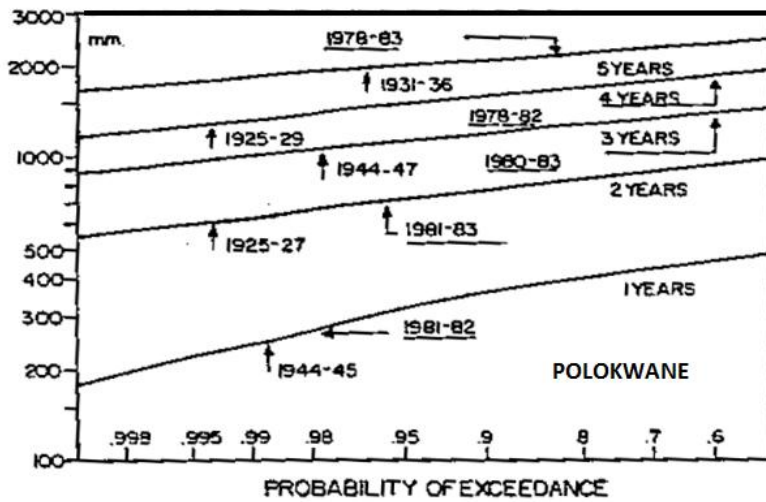
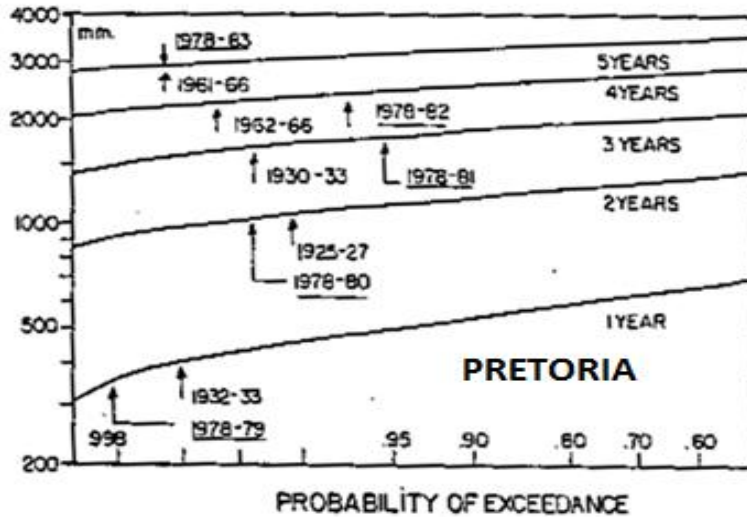


Figure 31: Estimated n-year droughts and their probability of exceedance in Limpopo Basin (South Africa)

Source: Zucchini et al, (1984)

### 3.5.1.3 Zimbabwe

The meteorological drought events identified for Zimbabwe are shown in Table 10 and the 1991/92 season is ranked as the driest in history.

Table 10: Zimbabwe- Meteorological Drought Events

EXTREME			SEVERE			MODERATE		
Year	Below Ave(mm)	Total (mm)	Year	Below Ave(mm)	Total (mm)	Year	Below Ave(mm)	Total (mm)
1911-12	-229	433	1902-03	-170	493	1912-13	-113	550
1915-16	-268	394	1913-14	-189	473	1916-17	-96	567
1921-22	-277	385	1926-27	-150	513	1927-28	-109	554



EXTREME			SEVERE			MODERATE		
Year	Below Ave(mm)	Total (mm)	Year	Below Ave(mm)	Total (mm)	Year	Below Ave(mm)	Total (mm)
1923-24	-263	399	1941-42	-162	501	1930-31	-95	568
1946-47	-297	365	1948-49	-127	535	1933-34	-97	565
1967-68	-258	405	1950-51	-146	517	1937-38	-109	553
1972-73	-291	371	1959-60	-179	483	1969-70	-124	539
1981-82	-223	440	1963-64	-195	467	1978-79	-93	569
1982-83	-259	403	1964-65	-153	509	1997-98	-26	536
1986-87	-240	422	1983-84	-198	464	1949-50	-143	519
1991-92	<b>-327</b>	<b>335</b>	1990-91	-161	502	1993-94	-143	519
1994-95	-244	419	2001-02	-197	466	2004-05	-133	529

Adapted from (MLG 2007)

### 3.5.2 Hydrological droughts

The Limpopo basin has a number of medium to large dams. These mainly used for domestic and irrigation water supply. Figure 32 shows the response of the dam during the periods of severe hydrological drought namely: 1981-82 to 1984-85, 1990-91 to 1994-1995 and 2003-2005. It shows that a dam can be used to support irrigation reliably during a drought period. Extended periods of low inflow or hydrological droughts followed by short periods of extreme floods mean that it is important to have dams of large ratio of MAR (Mean Annual Runoff) to Storage Capacity to allow for considerable carryover capacity for the next year. Evaporation losses should be kept as low as possible.

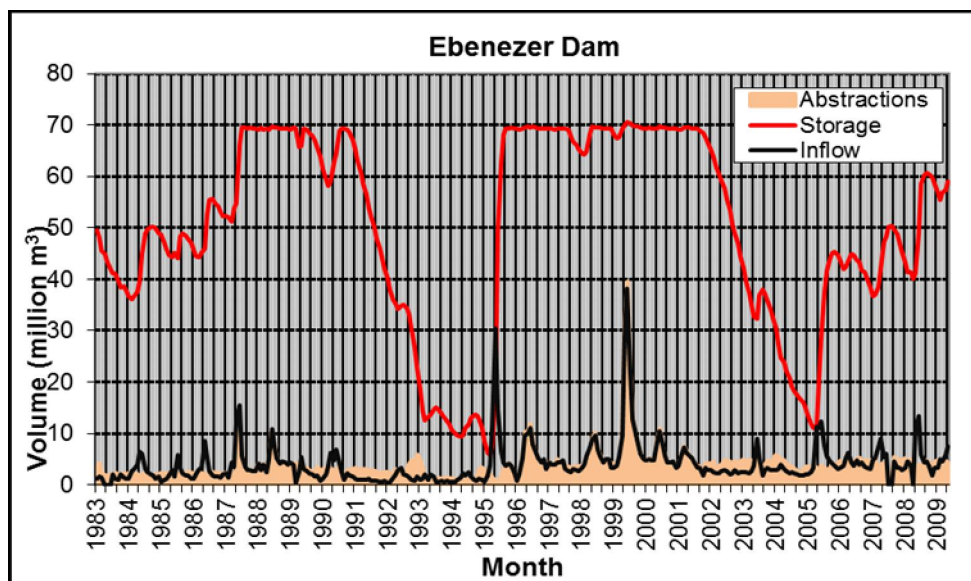
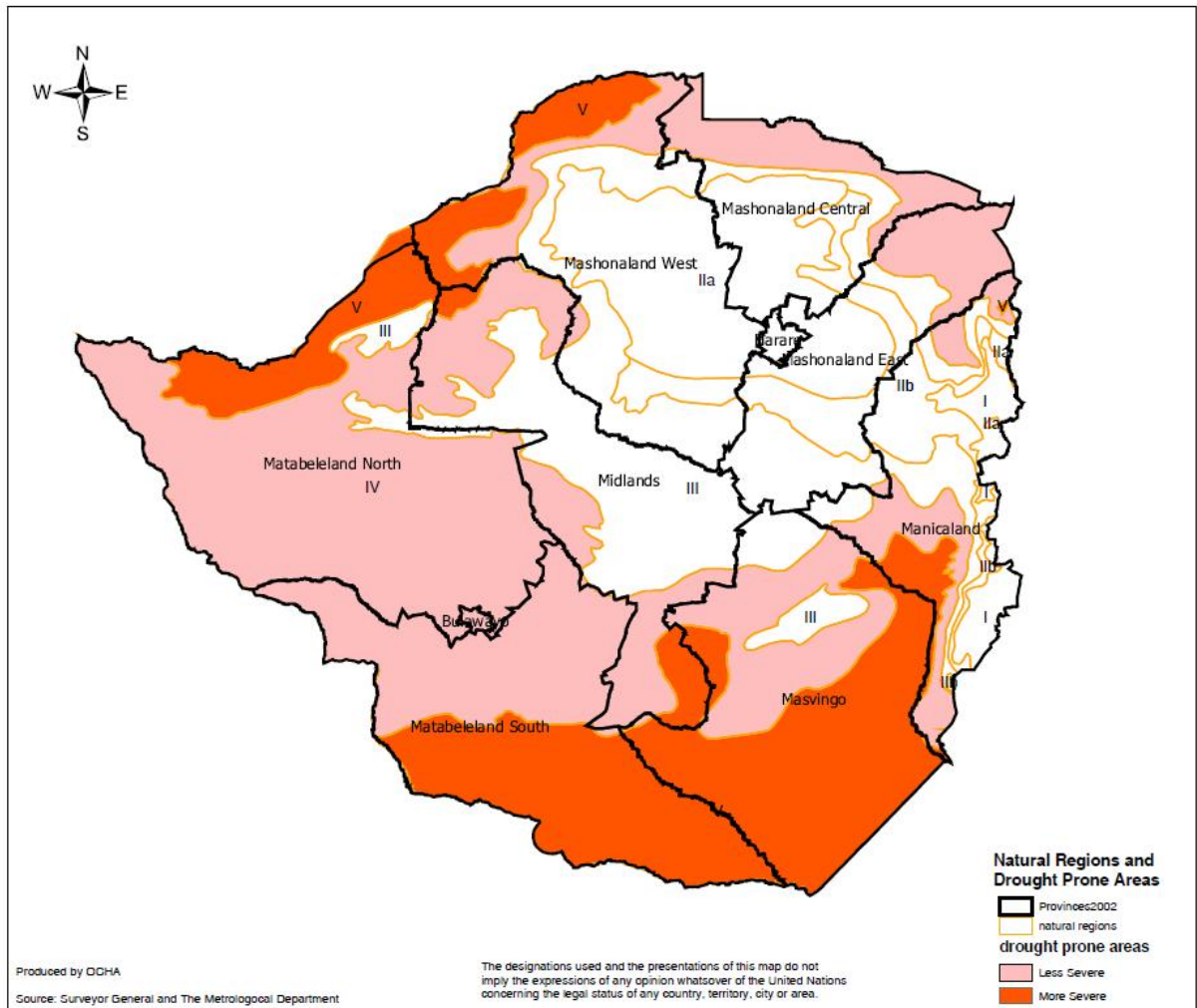


Figure 32: Impact of changes in rainfall patterns on availability of water from storage

Source: WRNA, 2011

Figure 33 shows drought prone areas in Zimbabwe. The Southern region, which covers mostly Matabeleland South and Masvingo are the mostly affected by Droughts compared to the rest of the country and these two areas fall within the Limpopo basin.



**Figure 33: Drought prone areas of Zimbabwe**

Source: OCHA, 2008

Nyabeze (2004) investigated the occurrence of hydrological droughts in the Mzingwane river catchment, a sub-catchment of the Limpopo Basin. The ratio of runoff experienced during the season to the long-term mean annual runoff at tertiary catchment level estimated with the HDAM model was used to determine the hydrological drought index. The results are reproduced in Table 11.

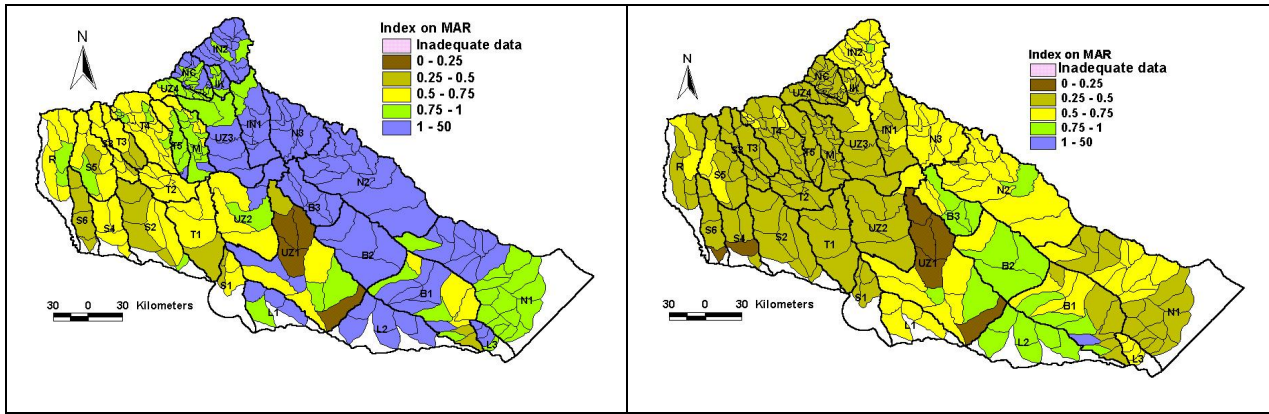


**Table 11: Summary of area affected considering an index on MAR (Mean Annual Runoff)**

Season	Percentage of Area of Mzingwane affected				
	0>=Index<0.25	0.25<=Index<0.5	0.5>=Index<0.75	0.75>=Index<1	Index>=1
1984/85	3%	6%	27%	21%	43%
1985/86	4%	48%	34%	13%	1%
1986/87	14%	79%	7%	0%	0%
1987/88	3%	5%	1%	2%	88%
1988/89	11%	26%	60%	3%	0%
1989/90	12%	23%	42%	22%	1%
1990/91	15%	22%	35%	23%	5%
1991/92	39%	58%	3%	0%	0%
1992/93	13%	26%	35%	16%	10%
1993/94	13%	12%	51%	23%	1%

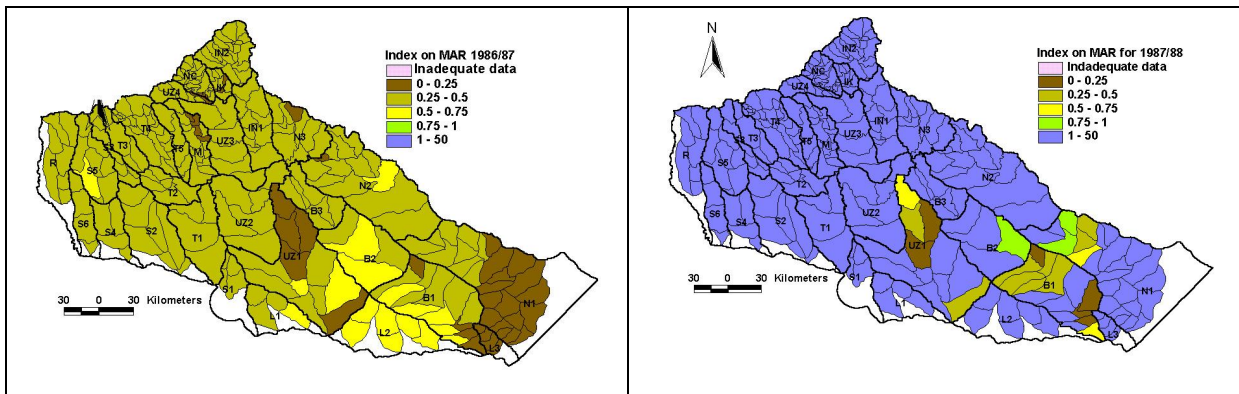
Source: Nyabeze (2004)

The indices at tertiary catchment level were plotted on maps to show the spatial coverage of the drought per season and the deficit on MAR. The results are reproduced in Figure 34 to Figure 38. According to Nyabeze (2004) show that the 1986/87 season was very dry for most of the sub-catchment, the following season namely 1987/88 was very wet but 1988/89 was quite dry again. However even in the wettest season some part of the sub-catchments experienced a drought conditions. The 1991/92 season was drier than the 1986/87 season and it can in the fourth year of a dry spell.



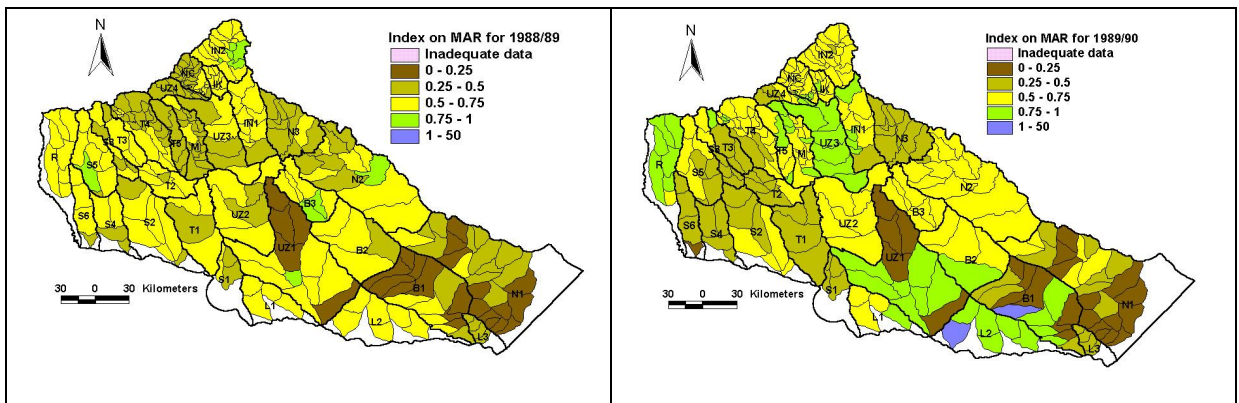
**Figure 34: Index on MAR (Mean Annual Runoff) for 1984/85 and 1985/86**

Source: Nyabeze (2004)



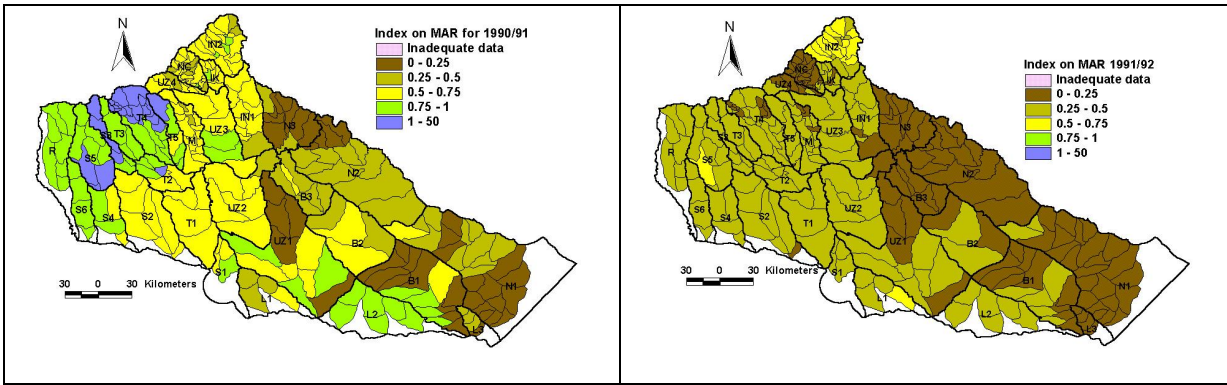
**Figure 35: Index on MAR (Mean Annual Runoff) for 1986/87 and 1987/88**

Source: Nyabeze (2004)



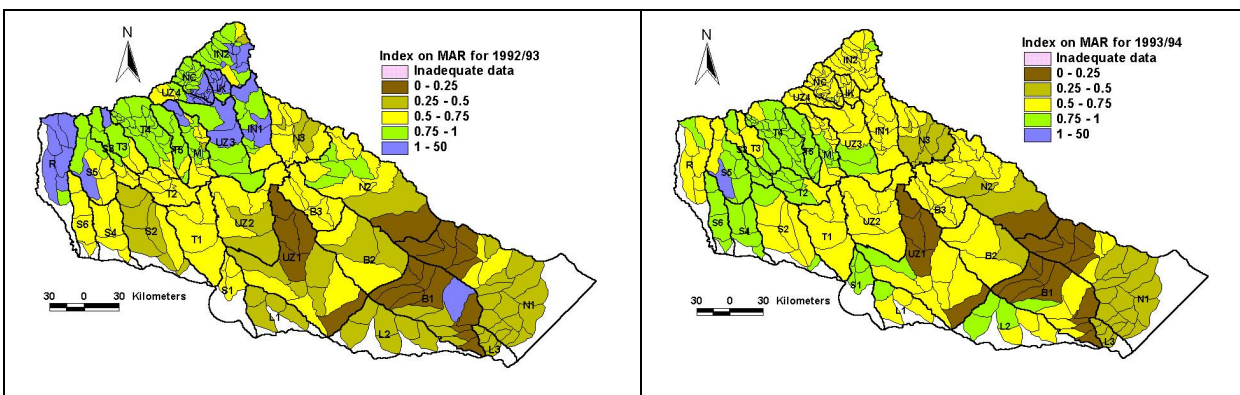
**Figure 36: Index on MAR (Mean Annual Runoff) for 1988/89 and 1989/90**

Source: Nyabeze (2004)



**Figure 37: Index on MAR (Mean Annual Runoff) for 1990/91 and 1991/92**

Source: Nyabeze (2004)



**Figure 38: Index on MAR (Mean Annual Runoff) for 1992/93 and 1993/94**

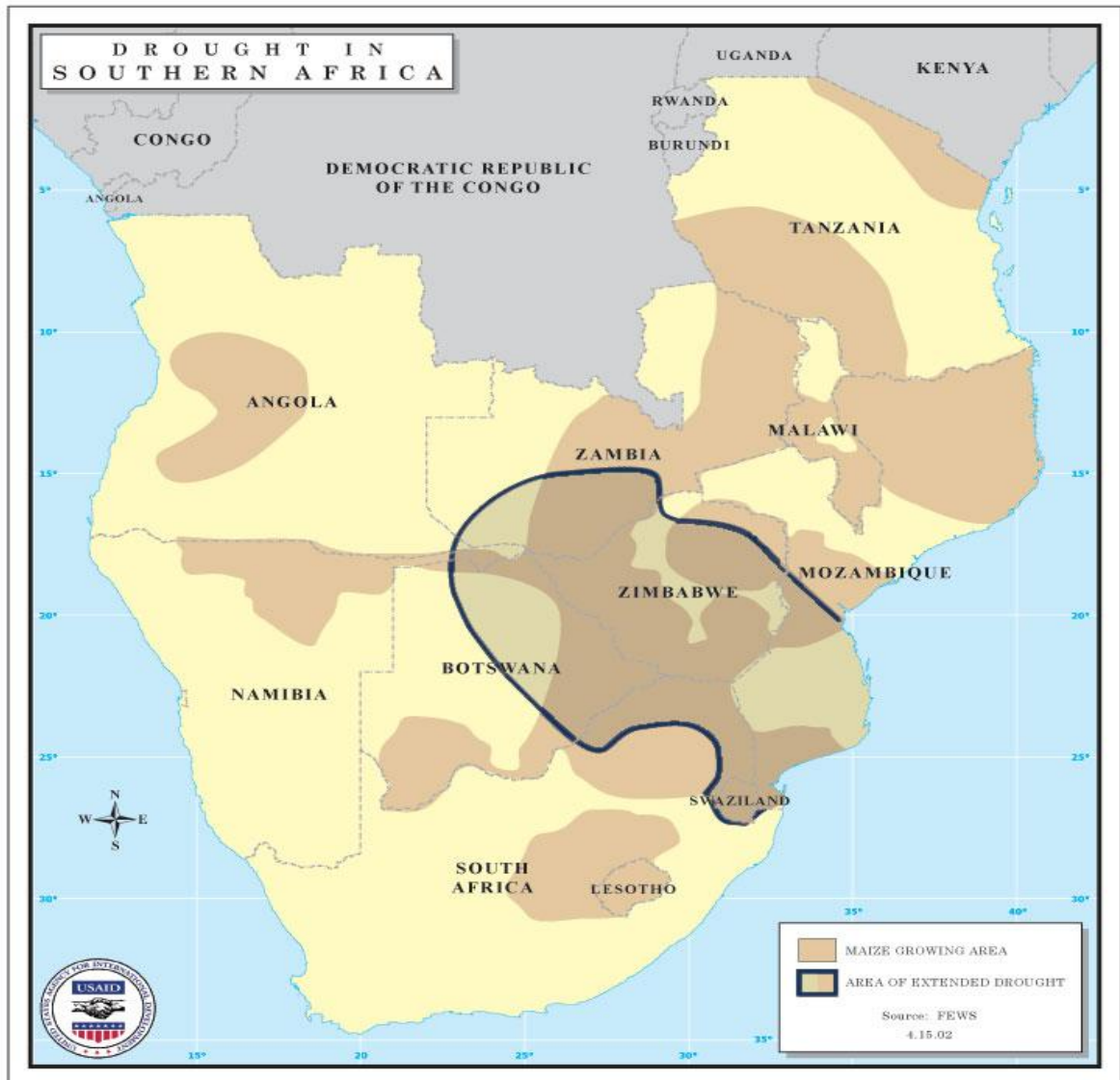
Source: Nyabeze (2004)

**3.5.3 Agricultural droughts**

Extensive droughts have afflicted southern Africa in recent times, e.g. 1946-47, 1965-66, 1972-73, 1982-83 and 1986-87 culminating in the most severe droughts in the period 1991-95. These times were also major El-Nino years.

The 1991/92 drought had a most crippling effect over much of southern Africa with many countries from central Zambia through central Malawi and Mozambique southwards having seasonal deficits of up to 80% of normal rain. Large sections across South Africa, Mozambique, Zimbabwe, Botswana and Zambia received scanty rainfall (20 to 75% of normal) during the rainy season from October 1991 through April 1992. The extreme dryness was exacerbated by abnormally high temperatures. Temperatures above 40° C scarred the region for days. Readings reached 47° C along the South Africa-Zimbabwe border. Some of the members of Southern Africa Development Community (SADC) countries, which include Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique,

Namibia, Seychelles South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, experienced the worst drought of the century. There were unprecedented crop failures. Roughly, five times more food had to be brought into southern Africa than that delivered to the Horn of Africa during the famine of 1984-85. The spatial extend of the 1992 agricultural drought in Southern Africa is shown in Figure 39.



**Figure 39 Agricultural Drought Stricken Areas in SADC in 1992**

Source: USAID

### 3.5.4 Classification of drought periods in the history of Southern Africa

The periods shown in Table 12 can be identified in the history of Southern Africa as both meteorological and hydrological droughts.

**Table 12: List of historical drought events in Africa obtained from available literature**

Drought Period		Type of Drought	Spatial Coverage
From	To		
1964	1970	Meteorological and Agricultural	SADC
1981	1984	Meteorological and Agricultural	SADC
1987	1988	Meteorological and Agricultural	SADC
1991	1995	Meteorological, Hydrological and Agricultural	SADC
2002	2005	Meteorological and Agricultural	SADC

Table 13 shows the drought events identified by the Ministry of Local Government in Zimbabwe.

**Table 13: Zimbabwe drought years**

Drought Years	Rainfall (mm)	Deviation from normal (mm)	Percentage of normal	Severity	Drought type	Area coverage	Duration (Years)
1911/12	433.	-229	67	Extreme	Meteorological, Agricultural & Hydrological.	Whole of Zimbabwe	2
1913/14	473	-189	73	Severe	Meteorological & Agricultural	Extend not known	2
1915/16	394	-268	61	Extreme	Meteorological & Agricultural	Extend not known	2
1921/22	385	-277	59	Extreme	Meteorological & Agricultural	Extend not known	2
1923/24	399	-263	61	Extreme	Meteorological, Agricultural & Hydrological.	Extend not known	2
1926/27	513	-150	79	Severe	Meteorological & Agricultural	Extend not known	2
1941/42	501	-162	77	Severe	Meteorological & Agricultural	Extend not known	2
1946/47	365	-297	56	Extreme	Meteorological, Agricultural & Hydrological.	Extend not known	2
1949/50	519	-143	80	Severe	Meteorological & Agricultural	Extend not known	2
1950/51	517	-146	80	Severe	Meteorological & Agricultural	Extend not known	2
1959/60	483	-179	74	Severe	Meteorological & Agricultural	Extend not known	1
1964/65	509	-153	78	Severe	Meteorological & Agricultural	Extend not known	1
1967/68	405	-258	62	Severe	Meteorological & Agricultural	Extend not known	1
1972/73	371	-291	57	Extreme	Meteorological & Agricultural & Hydrological.	Whole of Zimbabwe	2
1981/82	440	-223	68	Extreme	Meteorological, Agricultural & Hydrological.	Whole of Zimbabwe	2
1982/83	403	-259	62	Extreme	Meteorological & Agricultural	Extend not known	2



Drought Years	Rainfall (mm)	Deviation from normal (mm)	Percentage of normal	Severity	Drought type	Area coverage	Duration (Years)
1986/87	422	-240	65	Extreme	Meteorological & Agricultural	Extend not known	1
1990/91	502	-161	77	Severe	Meteorological & Agricultural	Extend not known	1
1991/92	335	327	52	Extreme	Meteorological, Agricultural, & Hydrological.	Whole of Zimbabwe	2
1993/94	519	-143	80	Severe	Meteorological & Agricultural		1
1994/95	419	-244	64	Extreme	Meteorological & Agricultural	Whole of Zimbabwe	2
2001/02	466	-196	72	Severe	Meteorological & Agricultural	Extend not known	1
2006/07	n/a	n/a	n/a	severe	Meteorological & Agricultural	Whole of Zimbabwe	1

Adapted from (Gandure 2005:74)

### 3.6 WEST AFRICA - NIGER BASIN

The Niger Inner Delta (NID) is located at the heart of the Malian Sahel, see Figure 40. It is a humid zone subject to an increasing pressure from the part of the working population in various the production sectors (Agriculture, Livestock-breeding, Fishing) and to natural resources management methods not much adapted to the drought situation that has strongly disturbed ecosystems in this zone for about three decades (30 years) now.

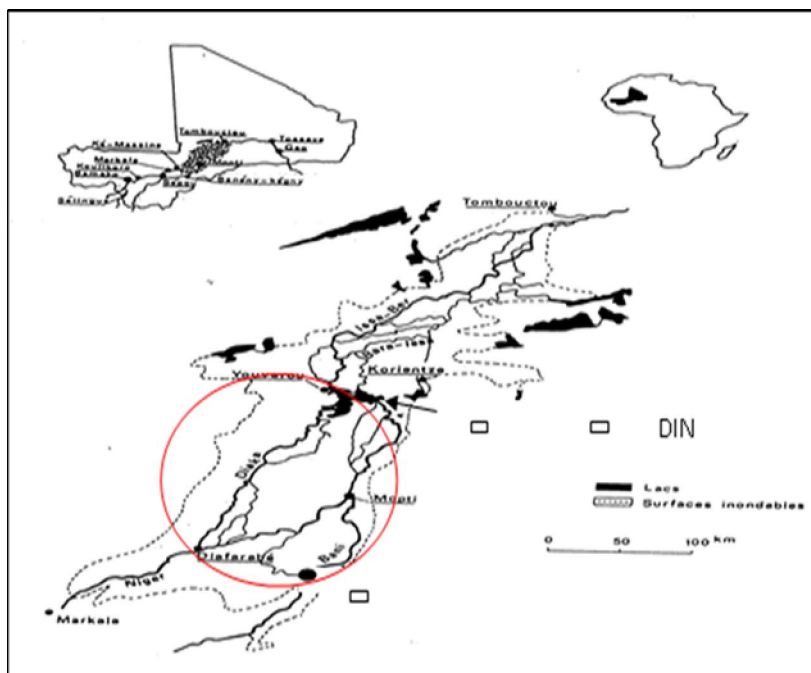


Figure 40: Location of the NID



population. Local communities were able to cope with food deficits for years and during the nineties (1980s) most of the herds of the Fulani livestock-breeders could not survive during the dry and hot season. In the long run, periods of low levels of water flows in rivers cause a modified zoning of the vegetation. The recent severe drought is not unique. The decrease observed in the nineteen-eighties (1980s.) seems considerable, given that the peak in the end of the nineteen-fifties (1950s.) was exceptionally high. Africa's climate history, worked out on the basis of meteorological, hydrological and historical sources (Nicholson, 1981b, 1982, 2001) as well as paleo-hydrological research (Gasse 1998), has shown several similar climate periods in the course of recent centuries .The Ghana, Mali and Songhay Empires got developed, flourished, then declined with long periods of abundant rains or droughts (McCann 1999). The period extending from 800 to 1,300 is assumed to have been relatively humid, followed by a drier period from 1,300 to 1,450, a more humid period until 1,800, and finally a gradual decrease since then.

If one resorts to the oral traditions of the populations, one can remark only droughts, owing to their tragic consequences, mentioned in the calendar of history as well as years of drought. One can also note there the years of famine or years of lack of pastures that serve as a reference for such or such a year and they are renewed at more or less regular periods:

- **1830-1840** Drought in the Bani region and in the North-West region of Upper Volta (Current Burkina Faso).
- **1900-1903** Drought in some parts of the Sahel-Sahara zone
- **1911-1914** Drought in the whole Sudano-Sahelian zone.
- **1968-1973** Drought in the whole Sahelian zone
- **1982-1985** Drought in the Sahel.

Drought periods fit in the climate oscillations elsewhere. Some of them contribute to dry cycles expanding all over the Sahelian zone whereas others are localized (rainfall deficit or poor distribution). Thus, the 1911-1914 dry period prevailed in the sahelo-sudanian zone.



## **4 IDENTIFICATION OF DROUGHT MITIGATION ACTIONS**

### **4.1 EXPERIENCES FROM NORTH AFRICA – ALGERIA, MOROCCO AND TUNISIA (MAGHREB REGION)**

#### **4.1.1 Tunisia**

The water resources in Tunisia are characterized by scarcity and a pronounced irregularity. Systems and legislation have been put in place to assure access to drinking water for the majority of the urban and rural population and to provide supplies for agricultural irrigation, as well as the industrial and tourism sectors.

In Tunisia, exploitation of conventional water resources is very advanced and it is expected that water demand, driven by population increases and improvements in living standards could reach its maximum around the year 2030. But (Louati et al, 2005), the planning for drought for moving from crisis to risk management dates only from the end of the eighties. Before, drought was erroneously considered as a temporary and rare climatic event, and consequently its management was "a forced reaction" to respond to immediate needs. A drought management system was developed and used for the drought events that occurred during 1987-1989 and 1993-1995. In 1999, Tunisia elaborated its first drought mitigation guideline (Louati et al., 1999). Then later, during the drought of 1999-2002, the MEDROPLAN project implemented the update process of the drought management system in Tunisia building on the previous guideline.

##### **4.1.1.1 General actions**

First we collected the various mitigation actions listed in different references. We then presented specific actions related to some droughts or depending on actors like:

- Giving priority to drinking water;
- Implementing public awareness campaigns;
- Restructuring farmers' bank debt;
- Rescheduling of farmers' credits;
- Importing and subsidizing drilling products;
- Controlling the opening of forest land for grazing;
- Restricting certain number of summer crops;
- Assuring provisions of supplementary feeds to safeguard livestock with the predominant investments going to subsidies towards the distribution and costs of concentrates;

- Wells digging and irrigation equipment purchase;
- Debt forgiveness;
- Creation of work activities in the rural areas have been also part of the Governments' programs under severe drought conditions.

#### **4.1.1.2 Farmers cropping strategies**

##### a) Rangelands and Feedstock

Four types of actions are currently implemented by farmers on rangelands in Tunisia during drought (Cialdella et al, 2004)

- Abandoning of grazing and feeding with commercial feeds;
- Mixing grazing on surrounding rangelands and to complement feedstock;
- Implementing extensive use of local forage resources, particularly harvesting of specific native range species;
- Transferring animals to distant pastoral areas where there is better rainfall or rangeland

##### b) Improvement of Water Use Efficiency

Agriculture is the largest water user in Tunisia, accounting for about 83% of annual consumption. The quantity of water allocated to the irrigation sector being estimated at 2 billion m<sup>3</sup> per year, with an irrigable area of nearly 400,000 ha. Thus, for drought adaptation, the following strategies were developed to increase water use efficiency:

- The buried stone pocket in the “Jessours” (see section on adaptation) for the localized, underground irrigation of fruit trees (Frigui, 2010);
- Change of crops;
- Use of intercropping;
- Mulching (See section on adaptation);
- Modification of irrigation practices and systems.

Table 14 summarizes the main adjustments used by farmers (Masmoudi et al, 2010).

**Table 14: Differential impacts of drought on irrigation practices and reactive responses of farmers under two contrasting environments.**

Survey area	Investigated farms Observed adjustments	Observed adjustments
Nabeul (semi-arid, 450 mm)	12, large state and private citrus growers	<ul style="list-style-type: none"> <li>• Over irrigation early in the season,</li> <li>• deficit irrigation in summer,</li> <li>• supplementation from groundwater having higher salt concentration</li> </ul>
Medenine (arid, 15 adjustments 0 mm)	16, small private properties on shallow wells	<ul style="list-style-type: none"> <li>• Use of very saline water from shallow wells (3-7 dS/m),</li> <li>• shift to winter production of vegetables,</li> <li>• development of intercropping with drip irrigation</li> </ul>

#### 4.1.1.3 Drought relief program

In situations of acute drought, the following relief actions are implemented (Agoumi, 2003):

- Undertaking the restructuring of farmers' bank debt;
- Import and subsidizing drilling products;
- Controlling the opening of forest land for grazing;
- Giving priority to drinking water;
- Restricting certain number of summer crops;
- Carrying out a public awareness campaign.

Due to the frequent drought years (1981, 1984, 1988, 1989, 1996), a temporal national program was developed to help small farmers, facing drought, avoiding livestock loss, and to reserve a budget for the implementation of this program starting from 1988. Decisions taken in this regard concern the following main aspects (Ben Salem *et al*, 2007):

- Provision of supplementary feeds (authorizing the livestock access to protected rangelands, increase areas for irrigated crops, import concentrate feeds like barley, Lucerne pellets, and bran);
- Organize the distribution of feed resources (barley and bran) and the transport of bulky roughages (e.g. oat hay and cereal straws);
- Subsidizing the prices of sorghum seeds and barley;
- Subsidizing the transport of bulky roughages;
- Exoneration of roughages and some imported seeds from custom taxes and added value taxes;
- Distribution of donated amounts of barley (free of charge) to small holders;

- Control of livestock health (subsidized vaccination, provision of exonerated veterinary medicaments, etc.);
- Complementary decisions (e.g. authorizing slaughtering of female and low producing animals, increasing the rate of animal reform).

Herders on their side developed the following strategies:

- Provision of sufficient amounts of feeds (authorizing the livestock access to protected rangelands, increase areas for irrigated crops, import concentrate feeds like barley, Lucerne pellets, and bran);
- Organize the distribution of feed resources (barley and bran) and the transport of bulky roughages (e.g. oat hay and cereal straws);
- Subsidizing the prices of sorghum seeds and barley;
- Subsidizing the transport of bulky roughages;
- Exoneration of roughages and some imported seeds from custom taxes and added value taxes;
- Distribution of donated amounts of barley (free of charge) to small holders;
- Control of livestock health (subsidized vaccination, provision of exonerated veterinary medicaments);
- Complementary decisions (e.g. authorizing slaughtering of female and low producing animals, increasing the rate of animal reform).

During the drought of 2002, the specific following actions were implemented:

- Selling barley at low price (17 Tunisian Dinar/quintal);
- Offering donated amounts of barley (150 g/head/day) to smallholders (flock size corresponding to 10 females);
- Continue allowing access to rangelands under the control of forestry services;
- Encouraging cropping of summer roughages mainly in irrigated zones connected with treated wasted water;
- Subsidizing seeds by 80% for the benefit of small farmers;
- Subsidizing imported bran and fixing its selling price to 15.3 Tunisian Dinar /quintal;
- Facilitating procedures to encourage farmers and agricultural professional organisms to get seasonal credits from banks to purchase feedstuffs and to transport and store them;
- Giving exceptional incentives (8 Tunisian Dinar /quintal) for rapid supply of barley;

- Allocation of an incentive of 100 Tunisian Dinar for each heifer to keep it in the farm;
- Incite private importers, great farmers and societies of agricultural development to import their needs of feedstuffs exonerated from custom fees and taxes;
- Charging the Cereal Agency to import bulky roughages and the Pasture and Livestock Agency to distribute these feedstuffs among small farmers.

Regarding water provision, it was decided to:

- Prepare an intervention program in zones suffering from water scarcity to guarantee their provision with water in the summer season;
- Encouraging farmers to get credits from the special box of agriculture development to purchase water tanks and pumps for crops irrigation. The auto-funding was limited to only 1% of the credit;
- Make people aware of the necessity of appropriate use of water and avoiding any wasting of water.

A summary of the funds allocated to protect livestock against drought is shown in Table 15.

**Table 15: Evolution of funds (in millions of Tunisian Dinar) allocated by the Tunisian government to protect livestock against drought.**

Item	Drought Period		
	1987-1988	2000-2001	2001-2002
Livestock feeding cost	29.12	29.7	52.87
Imported feeds	0.5	16	33.5
Subsidized feeds	21.5	6.9	12
Feeds distributed free of charge	6.8	6.4	7
Subsidized transport of feeds	0.32	0.4	0.371
Control of livestock health	0.708	0.4	0.536
Incentives for heifer conservation	-	-	0.576
<b>Total</b>	<b>29.828</b>	<b>30.1</b>	<b>53.983</b>
Cost/total value of livestock and production	1.2	1.08	1.75

#### 4.1.2 Algeria

The near total of Algeria's territory is classified as desert and the annual average rainfall is estimated at 80mm making it one of the most overdrawn water countries. With less than 500m<sup>3</sup>/capita/year, Algeria has less than 50% of the theoretical

threshold of scarcity of water fixed by the World Bank at 1000 m<sup>3</sup> per capita and per annum. In addition, the long, lasting and severe period of drought that the country is facing for more than 25 years makes the situation more critical. The country's aridity means that more than 4/5th of the land is uncultivable, and most of the remaining agricultural land is suitable only for pasture. Cultivated land is restricted to coastal plains and valleys.

#### **4.1.2.1 Drought relief actions**

The following drought relief actions were implemented during droughts in Algeria:

- Purchase of concentrated food:

In a drought context, animal feed, based on bought and self-produced concentrate, is the first measure undertaken by the whole stockbreeders to ensure the survival of their animals and to accelerate the fattening process. There are two main animal concentrate feed purchase methods. The simplest strategy is founded on the regular sale of the animals. The sales are carried out during all the year while keeping a tolerable size allowing a compensation number of lambing. The other option is the purchase by credit, which is adopted by certain transhumants small and medium flock size owners when their treasury is reduced, what enables them to especially avoid a strong decapitalisation of their herds when the price of the animals on the market is low.

- Resort to the mixture of food:

The recourse to the mixture of 2 to 3 types of feed is a strategy adopted by small and medium stockbreeders aiming at minimizing the feed cost. The most usually distributed rations are made up of barley + bran. Other combinations made up of barley + wheat flour, barley + straw, bran + wheat flour and barley + bran + wheat flour can be found.

- Resort to the storage of food:

The fall of the rangelands productivity and the high price of the complementary feed pushed the stockbreeders to improve their means of storage and to benefit according to juncture, from the low prices of animal aliments.

- Resort to various land uses:

To reduce the expenses and the quantities of concentrated feed, stockbreeders resort to various land and crop products uses such as: the cultivation of green barley parcels for livestock feeding, the use of cereal crops residues, the development of pastoral plantations

- Relocation of herds:

Displacements of the herds remain an essential option, even if there is a tendency to sedentarization. The appearance of the motorization in the steppe gave the means of acting quickly when a unfavourable year is announced. In dry years, the herds leave as far as possible toward more favourable “open” zones.

- Mixed breeding systems:

To support the high expenses caused by the herds feed supplies, a large majority of stockbreeders, adjust their budget through resorting to a mixed strategy based on fattening and commercialization.

- Resort to news reproduction techniques:

Synchronization of heats with injection of PMSG.

- Guarding in association other people’s animals:

This option is adopted by small and medium stockbreeders. Two modes of guarding are practised: simple guarding and plural guarding. The salaries generated are used to answer the various household and herds needs.

#### **4.1.2.2 Drought mitigation for livestock**

During the 1999-2000 dry period the Ministry of Agriculture implemented a drought relief program for livestock consisting in:

- The rehabilitation and development of watering points for livestock;
- The exceptional opening of preserved pastures and forest areas;
- The implementation of a feeding livestock program;
- The implementation of a large vaccination campaign;
- A better and easier access to the credit;
- A massive importation and distribution to the stockbreeders with subsidized prices and an allocation of 400 g of barley/sheep/day;
- Setting of preserved pastures;
- A large vaccination campaign of the livestock;
- The mobilization and installation of drillings, wells and small dams;
- The improvement and diversification of income of spare: small animal breeding, craft industries.

#### **4.1.3 Morocco**

Periodic drought is a common feature of the climate of Moroccan agriculture. Given that 90% of agricultural land is not irrigated, drought poses the single greatest hazard (Skees, 2001; Swearingen and Bencherifa, 2000). This section documents farmers’

coping strategies as well as institutional, technological and policy interventions for effective and durable drought management.

#### **4.1.3.1 Farmers' coping strategies**

Historically, households have adapted to irregular rainfall quantity and timing by stockpiling grain and fodder from good years, scattering fields, moving herds in search of better forage, planting late crops such as lentils (after late rains), and liquidating animals to a minimum reproductive herd that requires less fodder (Swearingen and Bencherifa, 2000).

Since 1980, Morocco has experienced a 25% decrease in average rainfall, accompanied by an increase in the frequency and severity of droughts (Azzam and Sekkat, 2005; Barakat and Handoufe, 1998; Skees, 2001). Around the same period, in an effort to boost production, the Moroccan government raised its fixed producer price for cereals and other basic food crops from well below-to well above world prices. Predictably, farmers responded with increased production. While higher yields played a part in increasing cereal output, another significant part was enabled by an expansion in the land under cultivation (Swearingen and Bencherifa, 2000; Azzam and Sekkat, 2005). Farmers increased cropland by reducing the acreage left in fallow and by encroaching on to low-rainfall grazing lands. The government's promotion of mechanization facilitated this expansion into marginal areas (Swearingen and Bencherifa, 2000). Finally, France's colonial policy of promoting wheat over barley changed Moroccan consumer preferences; wheat replaced barley as the predominant native cereal (Swearingen and Bencherifa, 2000). At the same time that droughts have become more severe, households have abandoned many traditions that have helped keep them resilient historically (Lybbert *et al.*, 2009). Herders on their side developed the following strategies:

- an extension of the cultivation of rangelands
- a significant reduction in the numbers of ewes
- an increase in the numbers of the livestock by retention and purchase of lambs in the great herders
- a reduction of the size of the herds in the small herders
- increase of herd mobility to search zones not affected by drought
- an abandonment of the breeding in the small herders
- the practice of the supplementary feeding to compensate the rangelands production



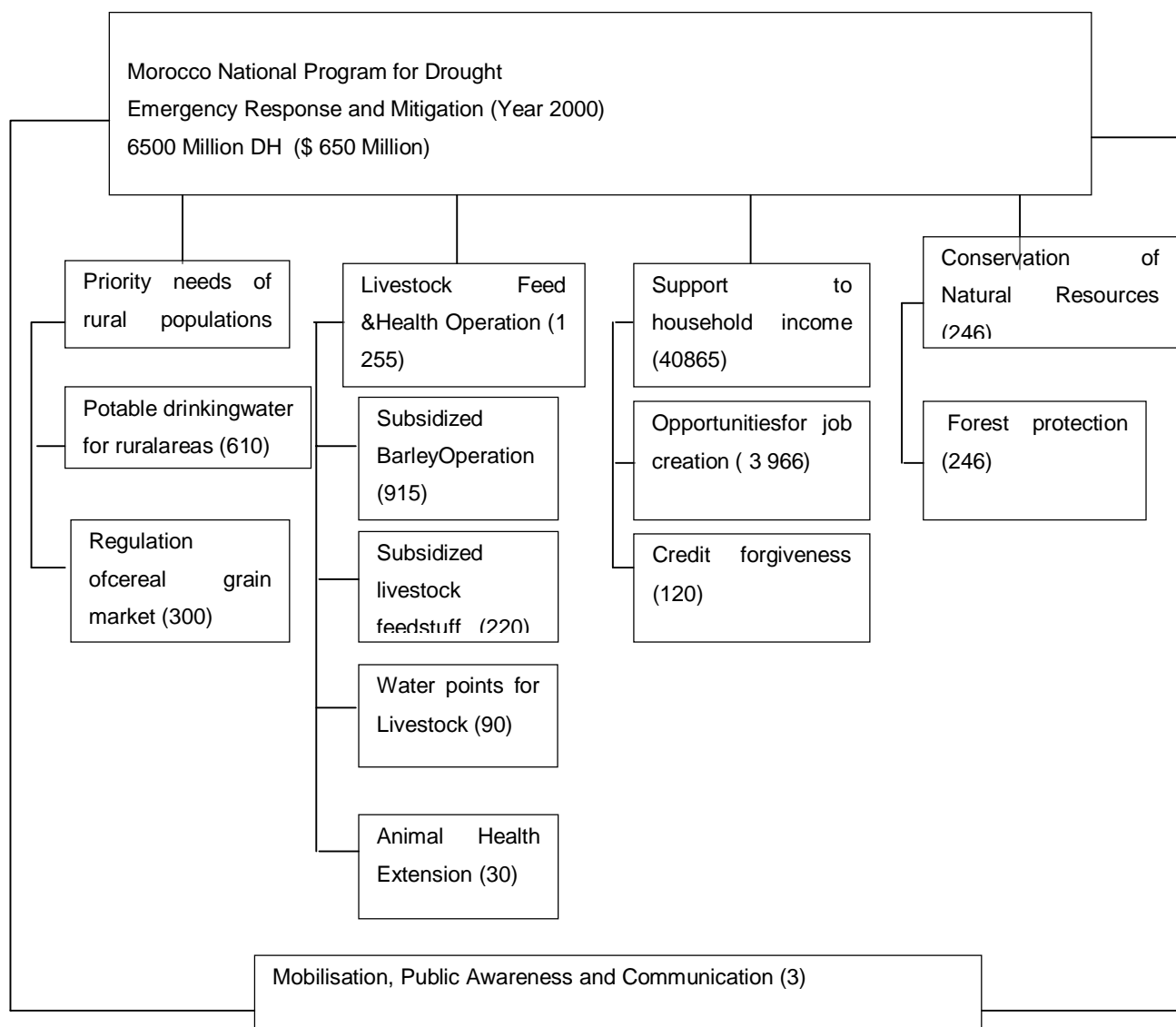
- the storage of the forage in particular in the great herders to avoid the variations of the price
- improvement of animal health for better resisting
- improvement of the marketing chains for livestock valorization

As traditional measures lose their effectiveness, many farmers have developed new ones. Swearingen and Bencherifa (2000) report that farmers increasingly use mechanization, nitrogen fertilizer, and irrigation to deal with drought. Arguably, the single most important drought-coping mechanism is mechanized plowing. Mechanized plowing affords greater flexibility in both the area planted and the timing of planting, because it can be done far faster than animal plowing and does not require that the first rains first soften the soil. Nitrogen fertilizer is also used to increase production during good years so that it may be stockpiled in preparation for drought years. To a lesser extent, households have attempted to develop irrigation systems, by digging new wells, diverting surface water onto fields, and using motorized pumps. At the same time, however, households are relying less on the farm for income (Swearingen and Bencherifa, 2000).

#### **4.1.3.2 Reactive drought mitigation programs**

Because of the severe droughts, which dominated much of the country during the 1980's, the Government adopted in 1985 a reactive action plan to mitigate the drought effects in the form of relief operations which initially focused on population drinking water and livestock relief. The policy so far applied during the major drought events that occurred in the 80's and the 90's consisted of setting up a national drought relief program, which was monitored by an inter-government committee headed by the Ministry of Agriculture and Rural Development, in close collaboration with the Permanent Inter-ministerial Council for Rural Development under Prime Minister leadership. To implement the planned activities, funds were made available to combat the deleterious consequences of drought and to assist rural populations in solving the problems associated with Livestock protection, Drinking water, Jobs creation and Agricultural credit debt relief. This is typically a **crisis-management** oriented approach whose cost is tremendous in terms of public money investment, time and human resource needs. The most important programs were implemented during the years 1995, 1999 and 2000 and mobilized respectively 4; 3.2 and 6.5 billion of Dh (approximately 400, 320 and 650 US \$ millions) (Ouassou *et al.*, 2007; Serghini *et al.*, 2003). In 2000, the total amount of 6.5 of Dh million for drought relief and mitigation activities, represented about one-third of the entire annual investment

budget of the country. The details of the public money expenditure component for the 1999 program are indicated in Figure 42.



**Figure 42: Details of the public money expenditure component for the 1999 program**

#### 4.1.3.3 Livestock protection

The program of livestock protection focused on:

- Providing supplementary feeds to safeguard livestock, with the predominant expenditure going for subsidies toward the costs and distribution of concentrates and other feeds. Barley is the most commonly subsidized feed, and the extent of the subsidy extends to as much as 50 percent in Morocco. Feed imports are also relaxed in drought years, while imports of livestock and livestock products are constrained to maintain domestic prices.

- The transport and distribution of livestock food across the drought prone areas.
- The improvement of animal health: the drought relief program have embodied veterinary prophylaxis measures, as a means of reducing losses of stock rendered more vulnerable to diseases and parasites by drought. Vaccine availability has been expanded with 8 million doses provided during the 1995 drought.
- The plantation of forage shrubs and cactus.
- The development of water points and water equipment (fixed or mobile cisterns) for livestock.

These kinds of programs have been very successful in protecting livestock numbers and production during droughts. Although the 1995 Moroccan drought was devastating with total cereal production falling to only 17 percent of that in the good 1994 season, the ruminant livestock sector was barely affected (Laamari and El-Mourid 1998).

#### **4.1.3.4 Drinking water**

The drinking water programs aimed to enable a continuous supply of water to all the urban centers and rural areas in the country. In 1994-1995, a water supply component brought clean drinking water to 196,000 rural people, and significantly improved the health of children and elderly people in particular. During the same period, special measures were taken for the city of Tanger in order to compensate for a 50% shortfall. This included the transportation of water using barges, which cost nearly 300 million Dirhams (45 Dirhams per m<sup>3</sup>).

#### **4.1.3.5 Job creation**

In order to maintain populations in rural zones, the Government has included in the national drought relief program job creation activities such as organization and construction of country roads, operations of land improvement like land stone clearing, and irrigation management operations of small and average hydraulic structures. This component of the national drought relief programme plays a key role to ensure minimum levels of revenues for the farmers and herders who lost their harvests and / or part of their animals and also to fight rural migration.

#### **4.1.3.6 Agricultural credit debt relief**

In Morocco, the evolution of the financial farm situation remains characterized by low and unstable incomes with progressively increasing debts. Data available on loan

recovery rates from farmers, by the CNCA (Caisse Nationale du Crédit Agricole), between 1968 and 2000 indicate an alarming fall, going from 75% to 100% during 1968-1981, 50% to 65% during 1982-1989, and 33% to 46% during 1990-1999. Within the framework of the campaign against the effects of the drought, the treatment of farmers' debts was carried out in two forms as follows:

- Decrease of the interest rates by 1 to 5 points;
- Cancellation of part of current unpaid loan and redistribution of outstanding credit over a long period of 15 to 20 years at lower interest rates or even debt forgiveness.

In 2007, these relief programs had benefited approximately 350,000 farmers at a cost of more than 7 billion Dirhams, 240,500 of these farmers being completely absolved of their debts.

#### **4.1.3.7 Proactive drought mitigation actions**

The more dramatic subsequent development of the droughts that occurred more frequently during the 1990's and the growing awareness from the scientific community and civil society led the policy makers to adopt a more pro-active approach to this recurrent problem after the severe droughts of 1999-2000. Drought relief programs implemented in the 80's and the 90's were mainly reactive plans but some proactive mitigation actions were also developed. In addition, following the severe drought episodes of the 80's, and the rising awareness among decision makers and the large public, the Government decided to set up a strategic drought planning and to move from the prevailing crisis management of the drought. In 1995, preliminary guidelines for a new approach to drought based on risk management principles provided the basis for a more proactive drought management approach in the country.

The National Program for Drought Mitigation has now two clear orientations, (i) an operationally oriented short term reactive program with relief operations (described in the previous point), and (ii) a broad-based drought mitigation strategy, including long term forecasting programs, water conservation measures, new agricultural techniques and new crop varieties or species, a rainfall based index insurance program, thus focusing on the long term pro-active approach to drought mitigation.

#### **4.1.3.8 Artificial rainfall program and long-term weather forecasts**

Morocco's **Al Ghait artificial precipitation program** represents a part of the proactive response to the problems posed by drought. Aviation has long had a part to

play in drought management, especially in monitoring and measuring the effects of climate change. In 1982, the Al Ghait program was launched, with aircraft taking a more active role.

The operation was a joint effort between the Government of Morocco and the United States Agency for International Development (USAID) and aimed to use weather modification techniques to augment rainfall. The program uses silver iodide as a seeding agent to increase the precipitation efficiency of cold clouds in the Central High Atlas Mountains in the upper Oum er Rbia basin. This causes snowfall, augmenting the snowpack in the mountains, which, in turn, increases snow melt runoff in summer. The silver iodide is released from ground-based seeding generators, or from aircraft (or both) when seedable clouds are in the target area.

In order to operate successfully over the mountains, the program needed an aircraft capable of operating easily and autonomously at heights in excess of 8000m. A single RMAF Alpha-Jet (No.245) was modified for the task, gaining a new Sperry/Honeywell Primus 300SL weather radar in a slightly extended and recontoured nose, and with a modified AN/ALE chaff/flare countermeasures dispenser in the rear fuselage used for launching the cloud seeding silver iodide cartridges. The weather radar is used to help the crew to identify potentially dangerous cumulonimbus clouds. The crew identifies interesting cumulus clouds, which are then penetrated. Inside each the pilot drops one or two silver iodide cartridges. These act as a catalyst for the formation of raindrops.

During the first phase of field operations conducted from 1984-1989 an average of 15-25 storm events were seeded during each season, totaling 144 seeded days during the five-year period. This resulted in a 14 to 17 per cent increase in winter precipitation. These results were viewed as 'encouraging', but it was recognized that further research would be required. The Al Ghait aircraft has also been used in a number of other African countries, including Mauritania and Burkina Faso in 1998. Since 2002 the Moroccan Al Ghait program has benefited from the involvement of the US company Weather Modification Inc (WMI) of Fargo , North Dakota . WMI has been assisting in the development of the Al Ghait national cloud seeding program and provided training. A number of African countries have now benefited from Moroccan experience and expertise in the field of weather modification.

#### **4.1.3.9 Long term drought forecasts**

The National Directorate of Meteorology uses long term weather forecast simulation models for a proactive approach to meteorological drought management:

- Al Masifa project is implemented in partnership with Météo\_France, ONM (Algeria) and INM (Tunisia) with financial support from the European Community. It aims at the prediction of the “rainfall state” (dry, normal, wet) using the relationship between SST anomalies and regional precipitation.
- Al Moubarak project is developed with Oklahoma University and aims at Climate modeling using the statistical correlation between the precipitation and the global climate patterns (NAO).

## **4.2 EXPERIENCES FROM THE EQUATORIAL LAKES REGION (BURUNDI, KENYA, TANZANIA, RWANDA)**

### **4.2.1 Tanzania**

The main mitigation actions implemented during the identified droughts are list below in Table 16:

**Table 16: mitigation actions implemented in Tanzania**

No.	Identified Droughts	Mitigation Actions Implemented	Impacts
1	2008-09 meteorological and agricultural drought particularly in the northern part of Tanzania (NBST, 2011)	Not reported	<ul style="list-style-type: none"> <li>• In 2009 the agricultural sector grew by 3.2 percent compared with growth of 4.6 percent in 2008 (National Bureau of Statistics, 2009)</li> <li>• During the same period, the growth rate of crops decreased from 5.1 percent to 3.4 percent and that of livestock decreased from 2.6 percent in 2008 to 2.3 percent in 2009</li> <li>• Drought during the 2008-2009 planting season caused these decreases in growth, particularly in the northern part of Tanzania, where there was inadequate pasture and water for livestock</li> </ul>
2	Meteorological drought during 2000/2001	<ul style="list-style-type: none"> <li>• Emergency Assistance Fund for Drought and Famine:</li> <li>• Ensure food Security through increased farm Production</li> <li>• Mitigate against drought through Irrigation</li> <li>• Facilitate rehabilitation of irrigation canals</li> <li>• Purchase and distribution of seeds for the 2000/2001 farming season</li> <li>• Production of improved seeds</li> </ul>	<ul style="list-style-type: none"> <li>• Food insecurity</li> </ul>
3	Prolonged dry spells during the 2005/2006 season: Seven regions of Tanga, Mbeya, Lindi, Kagera, Morogoro, Iringa and Manyara had surpluses of varying magnitudes but had also several pockets of food shortages. Other food self-sufficient regions that had several pockets of food shortages include Coast, Kilimanjaro, Tabora and Arusha. The other five regions of Shinyanga,	<ul style="list-style-type: none"> <li>• In order to mitigate against future food shortages amongst livestock keepers, they were advised to consider adopting better husbandry practices and keep small herds economically rather than large herds, which do not provide them with economic gains</li> <li>• FSIT recommended the Local Government Authorities (LGAs) enact and continue to enforce existing by-laws that require households that had good harvest to store adequate amounts of food to meet their requirements through the next harvest. Moreover, the LGAs should enforce by-laws requiring farmers to plant crops according to their agro-ecological suitability to reduce food shortages attributed to failure to observe crop production requirements. This was observed as one of the factors that can be remedied for improving household food security and avert the food and seed assistance dependency</li> </ul>	<ul style="list-style-type: none"> <li>• The assessment established presence of tight food situation in 29 districts even though currently the people there are still accessing sufficient food and no extreme coping mechanisms were reported among the vulnerable households. The assessment has revealed that about 651,655 people, which equal approximately 3 percent of the total population of about 21,646,632 found in the affected areas, will have difficulty to access food during the months of November and December this year. These people would require food assistance amounting to 15,622 MT over the two months period. A total of 8,952 MT</li> </ul>

No.	Identified Droughts	Mitigation Actions Implemented	Impacts
	Dodoma, Singida, Mwanza and Dar es Salaam had food deficits of varying degrees at regional level and in nearly all its districts (PMO, 2006)	<p>syndrome, which is growing among the rural communities</p> <ul style="list-style-type: none"> <li>• FSIT recommended the LGAs be mandated, and provided with capacity, to carry out the vulnerability assessments locally but maintaining strong links with the PMO and MAFC so as to have cost effective and timely in the production and dissemination of the food security information thereby handling even the small and localized food insecurity concerns, and avert delays in responses</li> </ul>	<p>of free food assistance to be sourced from current EMOP under WFP is recommended for a total of 360,000 highly vulnerable and destitute people. It is further recommended that the remaining 7,030 MT of food be sourced from the Government's Strategic Grain Reserve (SGR) for targeting a total of 293,000 affected people. This food from SGR should be distributed to these people at a subsidized price of TShs. 100 per kg.</p> <ul style="list-style-type: none"> <li>• Furthermore, the assessment established that the affected households would require seed assistance of various varieties amounting to 1,221 MT. It is recommended that most of this seed be sourced from the on-going FAO coordinated donor support, which is in response to the February 2006 Government appeal. Seed aid will enable 122,101 affected households to plant their fields during the next crop production year, starting in September/October.</li> </ul>
4	Hydrological and agricultural drought during 2009 in the northern Tanzania	Not reported	<ul style="list-style-type: none"> <li>• Pastoralist villages in the north of the country lost</li> <li>• up to 80% of their herds</li> </ul>
5	Agricultural drought during 2003-2004 (Amani and Standen, 2004)	<ul style="list-style-type: none"> <li>• FSIT carried a Rapid Vulnerability Assessment (RVA) and indicated that a total of 2 million people in 47 districts would need food assistance of 77,490 MT</li> <li>• Food security update in February 2004 indicated the area and number of vulnerable had increased since June 2003, recommended additional food assistance for severely food insecure households in uni-modal areas and bimodal areas with a poor vuli (short rains) harvest, until the end of April 2004</li> <li>• The Government conducted an RVA in February 2004 and established that about 3.5 million people would require food assistance in March 2004</li> <li>• Government drought response (sect. 4.2; Fig. 3) programmes were:</li> </ul>	<ul style="list-style-type: none"> <li>• Food deficit due to poor rains and below normal crop production in most parts of the country</li> <li>• The MAFS in May 2003 forecasted that about 50 districts were identified to experience acute food shortages between July 2003 and the next harvest season</li> <li>• A Rapid Impact Assessment (RIA) implemented in May 2004 indicated that livelihoods were negatively impacted during the drought but not to the extent that would have been if there had not been an emergence response</li> </ul>



No.	Identified Droughts	Mitigation Actions Implemented	Impacts
		<ul style="list-style-type: none"> <li>• Distribution of subsidized maize (sold at Tshs 50 per kg while market prices were above Tshs 250 per kg in some regional markets at that time) by market traders and coordinated by PMO-DMD</li> <li>• Government managed distribution subsidized food, implemented by PMO-DMD in collaboration with LGAs</li> <li>• Food for farming operation, consisting of WFP EMOP relief assistance</li> <li>• Distribution of seeds, implemented by FAO, MAFS (transport matters), PMO-DMD (guidelines), LGAs and NGOs (distribution matters) (see sect. 4.2; Fig. 5)</li> <li>• Due to the reduced quantities of food available, some of the previously targeted geographical areas were not covered, the programme finally covering 30 of the originally planned 47 districts (see sect. 4.2; Fig. 6)</li> <li>• For the drought response, the RIA done in May 2004 indicated that food assistance programmes were generally more desirable / successful than the accompanying seed distributions; with relief assistance considered more desirable / successful than the subsidized food programme</li> <li>• The food for farming/WFP EMOP programme was well received at all levels (district &amp; villages)</li> <li>• PMO-DMD chose CMTD as the targeting method to use during drought operations although it was not always adopted</li> </ul>	<ul style="list-style-type: none"> <li>• The RIA concluded that overall the response was relatively successful in meeting its objectives</li> </ul>

#### **4.2.2 Kenya**

##### **a) Pastoral communities**

During droughts, pastoralist households reduce frequency of meals (for example reducing to once a day instead of three times); switch to lower-quality, cheaper cereals; seek gifts of food; and rely on relatives, societal support and, as a matter of last resort, humanitarian assistance (Republic of Kenya, 2008).

##### **b) Government actions**

The Kenyan government implements support programs to increase pastoral-livestock production by providing water, establishing disease-free zones, improving breeding services and promoting an efficient marketing system. The utilization of drought resistant crops has been advocated; mostly through provision of subsidies by government agencies. The government tries to ensure that there is synergy of the efforts of the diverse and many actors engaged in drought interventions in Kenya.

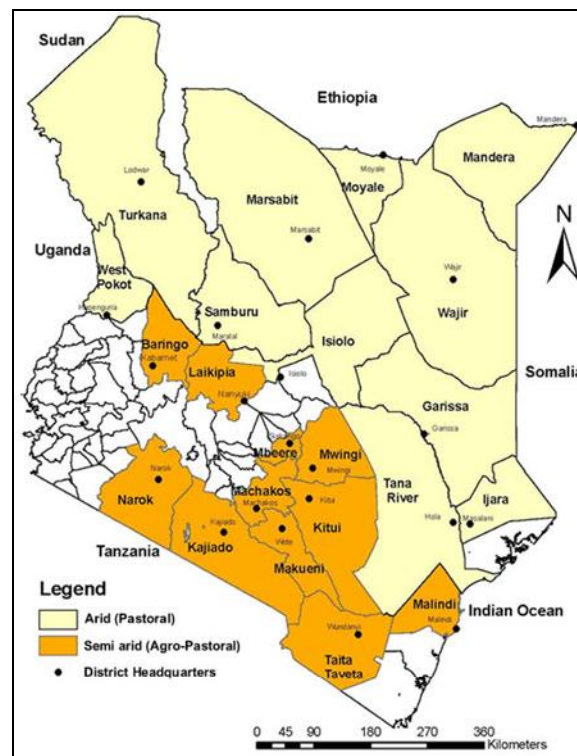
During the drought of 2004-2006, over 91% of the budget and over 94% of the actual expenditure for the response was for food aid, with the remaining spent on interventions in various other sectors, including de-stocking. It is accepted that a certain level of emergency food aid will always be necessary to save lives and to reduce suffering as a result of drought shocks. There is increasing evidence that preventive non-food aid interventions and social protection instruments can provide a more cost-effective and developmental approach to reducing poverty, social risk and build resilience, and thus lessening the long-term need for humanitarian aid in the most vulnerable communities.

##### **c) Actions by non-governmental agencies**

In the current drought (2011), the northern Isiolo, Marsabit, Moyale and Samburu districts, at least 150,000 people urgently need food aid, most of them women, children and the elderly. Long distances to relief food centres and the inability to secure manual work have added to their vulnerability. According to the Kenya Red Cross (KRCS), the situation is tough, but most families have taken different steps to cope with the hardships. Some are skipping meals; some have taken their children to school so that they can get food under the school-feeding programme. In some cases, families are eating wild fruits.

The World Food Programme (WFP) provided monthly food rations to an estimated 2.4 million persons, including 541,000 school children, through its drought emergency operation (EMOP) during the 2011 drought. Food commodities were also

made available by the Government of Kenya (7,179 tonnes of beans, maize, milk, oil, rice and Unimix). These were distributed by the KRCS, which was appointed as a lead relief agency to support government food distributions in Migori, Garissa, Machakos, Mandera, Lamu, Mpeketoni and Marsabit. The government also released an equivalent of US\$ 6.79 million to support the livestock off-take programme. Food distributions were also carried out by a number of local faith and community organizations that opened food collection centres throughout the country. The district map of Kenya is shown in Figure 43.



**Figure 43: District map of Kenya**

Ministry of Water and Irrigation allocated CHF 90,000 for water-related emergency response. The Arid Lands Resource Mobilization Programme released funding for fuel to run boreholes and the United Nations Children’s Fund (UNICEF) contributed spare parts, water storage tanks and a vehicle.

Where feasible, efforts were combined. For example, the KRCS provided support in terms of transportation and distribution of WFP and government provided food commodities. Together with the Kenya Medical Association and the National Hospital Insurance Fund (NHIF), the National Society organized medical camps to provide curative and surgical care. The Kenya Medical Association deployed a contingent of

49 physicians, surgeons and paediatricians and donated medical drugs and supplies. The NHIF donated CHF 12,712 to cover logistical costs (state year of this drought). Additionally, with a bilateral contribution from the European Commission Humanitarian Aid Office (ECHO), the KRCS rehabilitated 19 boreholes, constructed six pipeline extensions, de-silted three earth dams, equipped shallow wells, installed 60 water storage tanks and provided fuel subsidies and fast moving spares for strategically located boreholes in Turkana, Marsabit, Isiolo, Kitui, Makueni and Kwale districts.

When the alert for the 2011 drought was first raised, in consultation with the KRCS, the International Federation's regional delegation in Nairobi submitted a request and secured an allocation of CHF 427,808 from the Federation's Disaster Relief Emergency Fund (DREF) to enable the National Society to carry out a rapid assessment and start a response operation. At the request of the KRCS, the Federation launched an emergency appeal for over US\$ 17.82 million to assist some 329,000 people in 22 districts of the country. Given the scale and complexity of the operation, the Federation mobilized additional technical support by inviting the head of the Vehicle Fleet Centre in Dubai to help the KRCS establish a Transport Support Unit (TSU).

#### **4.2.3 Rwanda**

The drought mitigation measures implemented in Rwanda include the harvesting of rainwater for future use in irrigated agriculture and introduction of new adapted crops (drought resistant species) etc.

The mitigation measures against the hydrological drought impacts in Rugezi marshland included the drainage of the swamp in order to increase water level of the Lake Burera. The hydropower plant at Ntaruka empties Burerabut releases water to Lake Ruhondo after it has run through the turbines. This action was not successful and thermal power plants were used to support the hydropower plants (Hategekimana, 2007). To solve this problem, additional measures have been taken and these include among others: the prohibition of cultivation and other activities (hunting, collection of handcraft raw material, etc) in Rugezi marchland. Globally, the measures that are undertaken include the following actions: tree planting (afforestation and reforestation), erosion control (terraces), protection of wetlands, sensitization, hillside irrigation, etc.

#### **4.2.4 Burundi**

In Burundi the main mitigation actions implemented during each of the droughts identified are as follows:

- Prevention of erosion;
- Protection of the river basins;
- Reinforcement of the biodiversity;
- Contribution of forest resources to the local populations;
- Restoration of a natural forest;
- Plantation of trees;
- Agro forestry/ multi-purpose trees in particular cultural energy;
- Unproductive land recovery

#### **4.3 EXPERIENCES FROM THE EASTERN NILE REGION (ETHIOPIAN PLATEAU)**

For twenty years since 1973/74 the focus of mitigation actions was on distribution of relief supplies. In 1993 a link between the relief and development was established. In 2004, acute cases of emergency response were activated.

During the 2008 drought more than six million Ethiopians required emergency food. Food prices were very high. In recent years the value of emergency food and non-food aid to Ethiopia has reached over US \$350 million on average per year. The country also experienced a decline in crop production caused by land degradation, soil erosion, and a decline in farm sizes, and rapid population growth and increasing demand for grains as livestock feed. Although there have been massive flows of food aid into Ethiopia since the 1980s, its contribution to sustained economic development has been insignificant.

#### **4.4 EXPERIENCES FROM THE EASTERN NILE REGION DOWNSTREAM COUNTRIES (EGYPT AND SUDAN)**

##### **4.4.1 Experiences in Egypt**

Egypt has a total area of about one million km<sup>2</sup>, under arid and hyper arid climatic conditions, of which only a small portion (3% of total area) is agriculturally productive. The main threat to Egypt is desertification. The actions for mitigating the impact of desertification based on the specific attributes in each of the agro-ecological zones distinguished are shown in Table 17.

**Table 17: Drought mitigation actions in Egypt**

Agro-ecological zones	Activities	The period of execution
The Nile Valley	<ul style="list-style-type: none"> <li>Detecting and identifying the type and degree of desertification and assess its severity</li> </ul>	
North Coastal zone	<ul style="list-style-type: none"> <li>improvement of soil and water resources, hence contributing to Bedouins welfare sedentarization</li> <li>develop agricultural production by using modern agricultural methods, irrigation systems, and plastic greenhouses.</li> <li>Programme for Rehabilitation of Rangelands</li> <li>Management in the Rainfed Areas of Egypt.</li> </ul>	<p>This program was carried out in the entire Northwest Coastal areas during (1963-1973), revised from 1979 till 2005. 1965-1970, and again from 1988 till present,</p> <p>1980 - 1992</p> <p>ICARDA in collaboration with the DRC and ARC 1992 - 1998</p>
The Inland Sinai and the Eastern Desert	<ul style="list-style-type: none"> <li>A lot of efforts were conducted to develop and enhance the productivity and focused on improvement of soil and water resources cultivated areas especially in its parts located within the coastal areas north of Sinai.</li> <li>Fixation of sand dunes in North Sinai</li> <li>Utilization and fixation of sand dunes in local stakeholders</li> </ul>	<p>1950s and 1960s concerned efforts were conducted.</p> <p>1984 - 1994</p> <p>1980 –2005</p>
The Western Desert	<ul style="list-style-type: none"> <li>Finding out the most remedial measures and management practices to combat and prevent desertification for environmental improvement.</li> </ul>	1980- 1992

#### 4.4.2 Sudan

In Sudan in most cases there is agricultural and socio-economic drought. The drought mitigation measures implemented during the historical drought (1970's, 1980's and 2000's) includes:

- Harvesting of rainfall water;
- Introduction of new drought tolerant crops (drought resistant varieties);
- Restoration of a natural forest through Plantation of trees
- Agroforestry farming
- Food aid

#### 4.5 EXPERIENCES FROM SOUTHERN AFRICA – SADC AND THE LIMPOPO BASIN

##### 4.5.1 Botswana

The mitigation actions implemented in Botswana on past droughts are as follows:

- Labour intensive public works programme

- Livestock drought related programme
- Drought relief programme

a) Labour intensive public works programme

Drought Relief Programme in Botswana was able to achieve zero deaths attributable to drought-related malnutrition by coping with the 1982–86 droughts (Valentine, 1993). The main reasons cited for the success in Botswana were:

- targeting – the drought relief was targeted at the rural poor and other vulnerable groups to minimize income disparities during and after the drought;
- use of established infrastructure – established local and district-level supplementary feeding facilities and lines of communication and distribution were used;
- funds were available – there were surplus national funds available generated by the diamond resources of the country;
- willingness to learn from past experience;
- political will – good governance and drought relief seen as a high priority issue.

Following an evaluation of drought relief programmes carried out during the 1980s, the recommendations of the Government of Botswana created an Inter-Ministerial Drought Committee (IMDC) in the early 1980s to help develop and coordinate various aspects of the drought response programmes. A major intersectoral programme was the Labour Intensive Public Works Project (LIPWP), developed to relieve drought-affected people and to provide sustainable and viable projects to create employment. From 1992 to 1996, some 50 000 people were employed annually under the programme (of whom 70 percent were women). Completed projects included houses, feeder roads (see bridge in Figure 44), classrooms, daycare centres, health posts, clinics, offices, community halls and other community-based projects. The approximate annual employment of people under this drought relief employment programme is equivalent to 21 percent of Botswana's current formal economic sector employment and, therefore, provides significant employment benefit to the country.

However, the LIPWP has not been without its problems, and the Government of Botswana has acknowledged deficiencies in the programme. The “working age” group (15–64 years) was projected to increase by 42 percent between 1991 and

2001 (compared with a far lower increase of 12.4 percent in total population over the same time period). Saddled with this increasing “working” population, it will be difficult for the authorities in Botswana to withdraw completely from this public works employment programme.



**Figure 44: Weir construction in Botswana-labour intensive**

Source: [www.flicker.coM](http://www.flicker.coM)

#### b) Livestock drought-related programmes

Through the IMDC, which was set up to monitor and evaluate drought situations, the government has developed short-term programmes or subsidies for livestock owners. These short-term programmes, generally referred to as drought relief livestock projects, are assessed on an annual basis and instituted as necessary. They include:

- maintenance of breeding stock, where farmers are encouraged to sell during drought to maintain breeding and young animals;
- feed supplements for energy, protein and minerals are sold at 50 percent of the cost price during drought;
- disease prevention (e.g. botulism vaccines and vitamin A) is provided free in drought years;



- accelerating the implementation of water projects; where feasible, utilizing labour-intensive construction techniques to generate local employment, thereby enhancing local purchasing power;
- channeling financing to the district level, so that emergency measures reflect local decisions;
- targeting projects that serve the greatest population and exhibit low per-capita costs; maintaining subsidies where necessary to expedite implementation;
- continuing the provision of safe drinking water in areas with existing schemes, without concern for cost recovery;
- if capacity allows, providing one extra borehole per village as a safety margin.

#### c) Drought relief programmes

Drought relief programmes in Botswana have been essentially short-term operations and programmes, with action taken immediately after a drought. Major objectives of the drought relief programmes have been to:

- prevent human mortality through:
  - averting deterioration in nutritional status of particularly vulnerable groups,
  - setting up emergency water supplies for human survival,
  - using labour-based work programmes to compensate households for income lost;
- protect endangered rural household productive assets required to generate household and self-sustenance (e.g. cattle breeding stock and cattle for draught power);
- facilitate rural recovery and post-drought rehabilitation.

Three practical main components related to these overall objectives are:

- human relief, which means that in addition to existing and ongoing institutional programmes, human feeding strategies are geared up to include specific targeted populations;
- livestock relief, which includes the provision of free vaccinations in certain drought-related conditions, an expanded livestock water development programme (see pump in Figure 45), the facilitation of supplies of livestock feeds and requisites, and, where feasible, incentives for an increased livestock offtake;

- arable assistance packages, which include the provision of free seeds, ploughing services, and row-planting grants.



**Figure 45: Animal driven pump in Manyana 1984**

Source: [www.flicker.com](http://www.flicker.com)

- d) Actions by other governments
- Italy - In 1984: 19 tons pharmaceutical and veterinary equipment value 300,000 pula, for refugee programme: 4 trucks and 2 ambulances value lira 600 million
  - Sweden - Emergency water supply programme rural areas: s.kr. 8 million, through lutheran world federation for emergency water supply programme s.kr. 1.9 million
  - USA - In 1984: additional 2,000 tons veg. oil (total 5,000 mt). total cost including freight (for 5,000 mt), in 1985: 3,000 tons veg. oil and 8,000 tons maize, total value (maize for commercial sales, local currency generated to be used for warehouse construction), food aid through WFP

e) Actions by international agencies

Twelve drought-related projects totalling USD 1.8 million funded by UNDP, UNCDF, FAO, WFP, CIDA and Australia have been formulated. UNDRO provided additional cash grant for stock-feed covers. The WFP programme provided assistance as follows: in 1984: 1,440 tons maize and 144 tons edible oil including total cost including freight and superintendence, in 1985: 1,440 tons maize and 224 tons pulses including total cost including freight and superintendence. This was enough for 20,000 remote area dwellers for 180 days.

#### **4.5.2 Mozambique**

The mitigation actions implemented in Mozambique are as follows:

- Vegetative material
- Input fairs
- Agro-pastoral fairs
- Horticulture
- Local seed production
- Fruit production
- Irrigation systems
- Use of lowlands
- Construction of small dams and water reservoir
- Irrigation management
- Veterinary assistance
- Foment of Animal breeding
- Foment of animal traction
- Pasture management
- Milk production
- Pisciculture
- Junior farm school (JFFLS)
- School kitchen-garden
- Nutrition and HIV/AIDS
- Improved barns
- Hunger alert dossier (FAF)
- Combat against plagues and diseases

### 4.5.3 South Africa

The mitigation actions implemented in South Africa are as follows:

- Public works programme and relief efforts
- Emergency water supply
- Nutrition security and supplemental feeding
- Drought relief schemes
- Water harvesting
- Drought recovery/rehabilitation schemes

#### a) Public works programme and relief efforts

Before 1994, the commercial farming districts came under the jurisdiction of national drought relief schemes. Farmers in the communal areas of the old homeland regions were assisted by special drought relief schemes implemented by the respective governments. Such schemes usually centred on: human relief (food parcels, water drilling for distressed villagers and labour-intensive public works programmes); debt relief to farmer borrowers (mainly the write-off of short-term crop production loans); and a plethora of different livestock schemes over the years. The Nutritional Task Force coordinated transport and distribution of food, while public works programmes facilitated job creation to stabilize household income. Various state structures were involved at local and regional level in drought relief.

#### b) Emergency water supply

During the 1991/92 drought, the Water Supply Task Force provided emergency water supply by means of water tankers to 950 communities, repaired existing water infrastructure, installed some 800 emergency pipelines, drilled more than 5 000 new boreholes, protected springs, and installed packaged water treatment plants.

Boreholes and wells are drilled as a drought mitigation measure in 1991.



**Figure 46: Manually operated borehole in the Limpopo**

(Source:

<http://www.grasdk.com/News/2011/02/26/AGISToolForMappingGroundwaterDroughtVulnerabilityInTheSADCRegion.aspx> )

c) Nutrition security and supplemental feeding programmes

The Department of Health implemented three nutrition security programmes in all of South Africa's nine provinces (R. Ochse, personal communication, 1999). These are targeted at the rural poor and those living in poor crop production areas. The programmes focus on high-risk areas such as those prone to disasters. The first was known as the National Nutrition Development Programme (1991–92), subsequently renamed the National Nutrition and Social Development Programme (1994) and now called the Nutrition Development Projects. Between 1992 and 1996, the programme's objectives were to help people to become self-reliant by assisting them to establish nutrition-security-related projects. However, because of the drought, the programme became one of social relief, with different NGOs in the provinces being contracted to deliver food parcels to the needy. After 1996, it was realized that food parcels created a spirit of dependency among beneficiaries, and hence it was

decided to encourage people to start up their own nutrition development projects. Money is channelled through NGOs and community-based organizations to communities and individuals that submit business proposals for projects such as nutrition gardens, small farms, bakeries, and fish projects. The current focus by the Department of Health promotes nutrition and food security in the region, and will enable resource-poor families to better withstand the impacts of drought.

d) Drought relief schemes

- general food aid to most affected households;
- supplementary feeding programmes for:
  - children, especially under five years old,
  - pregnant and lactating mothers,
  - the elderly and disabled;
- emergency water supplies for people and animals;
- assistance in destocking livestock.

e) Water harvesting

- dam construction;
- water harvesting;
- small irrigation schemes;

f) Drought recovery/rehabilitation schemes

- seed-pack and fertilizer distribution;
- livestock restocking programmes;
- nutritional garden projects;
- subsidies and loans.

#### **4.5.4 Zimbabwe**

The mitigation actions implemented in Zimbabwe are as follows:

- Cloud seeding;
- Research and programmes for genetic improvement on crops and livestock;
- Research on climate change;
- Providing drought relief handouts;
- Drought monitoring surveys and early warning;
- Legislation /policy changes;
- Public awareness and educational programmes;



- Drought emergency preparedness.(disaster preparedness);
- Development of new water supplies (e.g. drilling of boreholes).

The actions implemented in different drought periods are listed in Table 18.

**Table 18: List of historical drought events and mitigation action in Zimbabwe**

Drought event	Mitigation action
2001/02 & 2006 & 2006/07	Cloud seeding
Every drought event in Table 1 above	Weather monitoring
2006/2007	Government and NGO input programmes.
2001/02 & 2006 & 2006/07	Research and programmes for genetic improvement on crops and livestock
2001/02 & 2006 & 2006/07	Research on climate change.
1981/82;1993/94 2006/07;2001/02 1994/95;1991/92	Providing drought relief handouts.
1981/82;1993/94 2006/07;2001/02 1994/95;1991/92	Drought monitoring surveys and early warning.
1991/92 and 1994/95	Legislation /policy changes.
1991/92 and 1994/95	Public awareness and educational programmes.
2006/2007	Drought emergency preparedness.(disaster preparedness)
1991/92	Development of new water supplies (e.g. drilling of boreholes).

At the local level some communities resort to hand-dug well in river beds as shown in Figure 47 to Figure 51 during hydrological droughts.



**Figure 47: Dug up well in the river bed in Limpopo 1991**

(Source – [www.runningdry.org](http://www.runningdry.org))



**Figure 48: Dug up wells in the river bed (Mufuku in Shona).**

Source: EMA



**Figure 49: Dry river bed in Plumtree (Human and Livestock competing for water in a dug up well in the river bed)**

Source: EMA





**Figure 50: Fetching water in a well**

Source: EMA



**Figure 51: Dry River bed**

Source: EMA

Throughout the recent drought periods in Zimbabwe, the response by the Government of Zimbabwe (GOZ), local communities and authorities, as well as donors, has focused on short-term emergency response (FAO,2004). Most local government authorities lacked the capacity to react to these disasters, let alone prepare for them in an effort to mitigate the possible impact of drought (FAO,2004).

#### **4.6 EXPERIENCES FROM WEST AFRICA - NIGER BASIN**

At national level, the events during the 1972-1973 drought led to the implementation of the following mitigation actions:

- ❖ Reaction of the population
  - Adoption of new crop varieties;
  - Farming in low lands;
  - Adoption of farming techniques;
  - Migration;
  - Return to the practice of fruit –gathering.
- ❖ Reaction of the State
  - Development of hydro-agricultural schemes ;
  - Food distributions;
  - Extension / popularization of new crop-seeds;
  - Locust control;
  - Creation of institutions.

At national level, the events during the 1984-1985 drought led to the implementation of the following mitigation actions:

- Extension/ popularization of improved varieties and suitable for the climate conditions of the main food crops (millet, sorghum, maize and rice);
- Extension/ popularization of animal and plant species more suitable for climate conditions;
- Promotion of income generating activities and development of mutual assistance associations or groups;
- Development of Aquaculture Schemes in Mali;
- Promotion of cereal banks;
- Use of meteorological information for improving agricultural production and for contributing to food security;

- Development of low lands;
- Drilling of boreholes equipped with solar or wind pumps;
- Enhancing the energy efficiency of typha australis;
- Contribution to the lifting of barriers for the promotion of energy applications in Mali;
- Harvesting of run-off waters and restoration of water-points (exbow lakes, ponds and lakes);
- Sensitization, and organization of the population for the conservation of natural resources (preparation of local reforestation and agro-forestry conventions);
- Management of bush-fires in Mali;
- Development of farming actions(WSC/SDR) and composting actions;
- Development of fodder crops;
- Preparation of a technological package for training the population in simple practices for adaptation to climate change;
- Promotion of animal- feed banks;
- Promotion of jatropha oil;
- Establishment of an information system on risks of diseases associated with climate change.

At regional level, West Africa has been experiencing chronic drought since the beginning of the nineteen-seventies (1970s). In response to this situation, a large number of attempted responses were being implemented. Among such attempted responses, the most significant one is undoubtedly the establishment of the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS). Since then, CILSS has been very active in areas such as

- a) the collection and management of hydro-hydro- climatic data
- b) the establishment of an early warning system
- c) research and training, through mainly its AGRHYMET Center ( Agro-Hydro-Meteorological Center).

Among the other initiatives are 1) PRESAO (Seasonal forecasting of rains and run-off waters in West Africa), which was launched in 1998, 2) the West and Central Africa component of the World Hydrological Cycle Observation System (HYCOS AOC), a pilot phase which is being implemented since the year 2000, 3) the West and Central Africa component of the FRIEND Project (Flow Regimes from International

Experimental and Network Data or Study of Run-offs regimes from experimental international data and networks) established since the year 1992 and more recently 4) the AIACC Programme on the assessment of the impacts of and adaptations to climate change that includes projects on West Africa. Finally, it is worth mentioning the project for support to CILSS Member countries` capacities for adaptation to climate change that started at the AGRHYMET Regional Center in October 2002.

Parallel to these research initiatives, efforts for water control have been noted. For example, Burkina Faso constructed 1,500 small water-catchments during these recent three decades and is experimenting with the cloud-seeding technique. This technique is also envisaged in other countries in the region (e.g. Sénégal). Similarly, countries such as Niger, Benin, Mali, Senegal etc...have also invested in the small water catchments policy .Thus ,as mentioned above ,the region harbours only a few big dams but hosts many projects. On the River alone, there are about ten (10) large dam projects (Fomi, Tossaye, Kandadji, Zunguru, Onitsha, etc).

Generally, the most noteworthy responses West Africa has brought to chronic drought and to the increase in climate variability having affected it for three decades now are related to research, that is data collection and analysis. Of course, this is very important but far from being enough for a significant reduction of the vulnerability of the region to variability and to climate change.

Concerning future climate, many countries in the region have, in the framework of their international communications on climate change, proposed structural and economic measures that would allow for increasing their capacity for adaptation to forecast changes. However, one notes that solutions proposed by States are often technically, financially, and/or politically achievable at countries` level, taken in isolation. Many of such measures are relevant only at regional level.

## **5 LIST OF INSTITUTIONS INVOLVED IN DROUGHT MITIGATION**

### **5.1 LIST OF INSTITUTIONS IN NORTH AFRICA – ALGERIA, MOROCCO AND TUNISIA (MAGHREB REGION)**

#### **5.1.1 Tunisia**

The institutions involved in mitigation of drought in Tunisia are listed in Table 19.

**Table 19: Institutions involved in drought mitigation in Tunisia**

<b>Ministry of Agriculture, Environment and Water Resources</b>		
<b>Institution</b>	<b>Responsibility</b>	<b>Contact details/Website</b>
BPEH (Bureau de la Planification et des Equilibres hydrauliques)	<ul style="list-style-type: none"> <li>- The BPEH is continuously connected with all organizations and institutions involved in the management of water resources in the country. Therefore, a large database of water resources is continuously collected and updated.</li> </ul>	<ul style="list-style-type: none"> <li>- cabinet du ministre, 30, Rue Alain Savary 1002 – Tunis</li> <li>- boagr@email.ati.tn</li> <li>- www.semide.tn/BPEH.htm</li> </ul>
DGBGTH (Direction Générale des Barrages et Grands Travaux Hydrauliques/General Direction of Dams and Large Hydraulic Work)	<ul style="list-style-type: none"> <li>- Elaboration of the hydraulic studies.</li> <li>- Elaboration of mastering surface water resources planning.</li> <li>- Elaboration of water mobilizations studies.</li> <li>- Making up the dams and lakes building studies.</li> <li>- Elaboration of important water planning studies for surface water resources mobilization (big dams, water transfer...).</li> <li>- Control and maintenance of dams.</li> <li>- Realization of the planning and large hydraulic works related to the rural and agricultural zones protection against floods.</li> <li>- Ensuring a platform to encompass all the areas of flood prevention and disaster management. - Supervising the drought management system.</li> </ul>	<ul style="list-style-type: none"> <li>- Ministère de l'Agriculture 30 Rue Alain Savary 1002 Tunis, le Belvédère</li> <li>- webmaster@semide.tn</li> <li>- www.semide.tn/BGTH.htm</li> </ul>
DGRE (Direction des Ressources en Eau/General Direction of Water Resource).	<ul style="list-style-type: none"> <li>- Setting up and managing of measurement and observation networks related to all country water resources components (water data and information system and flood early warning, etc.).</li> <li>- Elaboration of basic and applied studies on the water resources evaluation and setting their general balance.</li> <li>- Drawing the principal and specific methods for the water resources management, according to the supply and the demand.</li> <li>- Promotion of the research and experimentation activities related to the conventional and non conventional water uses.</li> <li>- Finalizing and perfecting the different ground (basics) of water mobilizations planning and their exploitation.</li> </ul>	<ul style="list-style-type: none"> <li>- 43, rue la Mannoubia -1008 – Tunis</li> <li>- webmaster@semide.tn</li> <li>- www.semide.tn/DGRE.htm</li> </ul>
DGACTA (Direction Générale de l'Aménagement et de Conservation des Terres Agricoles/General Direction of Planning, Management and Conservation of Agricultural Lands).	<ul style="list-style-type: none"> <li>- Elaboration of plans and orientations related to natural resources (soil, plant and water).</li> <li>- Proposition, elaboration and promotion of measures ensuring the optimization of natural resource utilization.</li> <li>- Soil resources evaluation (vocation and agricultural aptitude). The GIS and remote sensing technique are used.</li> <li>- Realization of research on soil sciences, using advanced techniques and equipped soil and water analysis laboratories.</li> <li>- Control of soil evolution under the different exploitation modes, and their</li> </ul>	<ul style="list-style-type: none"> <li>- 30 Rue Alain Savary, 1002 Tunis, Tunisie.</li> <li>- webmaster@semide.tn</li> <li>- www.semide.tn/Acta.htm</li> </ul>

<b>Ministry of Agriculture, Environment and Water Resources</b>		
<b>Institution</b>	<b>Responsibility</b>	<b>Contact details/Website</b>
CRDA (Commissariat Régional au Développement Agricole/Regional Commissary of Agricultural Development or Regional District Department of MAERH)	<p>protection against salinity, degradation, and desertification.</p> <ul style="list-style-type: none"> <li>- Application of the legislation and regulation related to soil protection, forest and water management, supervising plant protection, and caring for animal health.</li> <li>- Ensurance of forest resources development and protection, soil land water conservation and agricultural land and basin planning.</li> <li>- Regional hydraulic system and forest domain management. Conservation of natural resources.</li> <li>- Realization of hydraulic planning and hydro agricultural infrastructure valorization.</li> <li>- Hydro agricultural infrastructure management and maintenance. Achieving the water supply network management.</li> </ul>	<ul style="list-style-type: none"> <li>- 30, Rue Alain Savary 1002 Tunis</li> <li>- onagri@email.ati.tnwww.semide.tn/CRDA.htm</li> </ul>
CRDA (Commissariat Régional au Développement Agricole/Regional Commissary of Agricultural Development or Regional District Department of MAERH)		<ul style="list-style-type: none"> <li>- 30, Rue Alain Savary 1002 Tunis</li> <li>- onagri@email.ati.tn</li> <li>- www.semide.tn/CRDA.htm</li> </ul>
BIRH (Bureau de l'Inventaire et des Recherches Hydrauliques/Hydraulic Inventory and Research Bureau).	<ul style="list-style-type: none"> <li>- Establishment and updating of the national surface and groundwater resources inventories and development of prospecting for new water resources identification.</li> <li>- Mounting and management of measurement and observation networks related to all the country water resources components (surface and ground water).</li> <li>- Realization of pumping operations in order to determine the technical aquifers characteristics.</li> <li>- Computation and optimization of water information and data base management.</li> <li>- Dissemination of water data and information recorded and analysed, by publishing bulletins and technical yearbooks (annuaires).</li> </ul>	<ul style="list-style-type: none"> <li>- 43, rue La Mannoubia 1008 TUNIS – TUNISIE</li> <li>- webmaster@semide.tn</li> <li>- www.semide.tn/BIRH.htm</li> </ul>
SONEDE Société Nationale d'Exploitation et de Distribution des Eaux/Water Exploitation and Distribution National Company.	<ul style="list-style-type: none"> <li>- SONEDE is responsible for the management of fresh water quantity and quality, maintenance, transportation (transfer and pipeline), and all activities related to the field of drinking water as a treatment for water quality standard (physical, chemical, biological and bacteriological) and its equitable distribution.</li> </ul>	<ul style="list-style-type: none"> <li>- Siège social, Avenue Slimen Ben Slimen, El Manar 2, Tunis 2092</li> <li>- webmaster@semide.tn</li> <li>- www.tunisie-web.org</li> </ul>
SECADENORD	<ul style="list-style-type: none"> <li>- provides management and maintenance of the north-west water transfer system (pipes and channels) of the far Northwest for users located in the</li> </ul>	<ul style="list-style-type: none"> <li>- 30, Rue Alain Savary 1002 Tunis</li> <li>- onagri@email.ati.tn</li> </ul>



Ministry of Agriculture, Environment and Water Resources		
Institution	Responsibility	Contact details/Website
(Société d'Exploitation du Canal et des Adductions des Eaux du Nord/Company of Exploitation, Canalization and Adduction of the Canal and the Northern Water)	Northeast, Central and South of the country	- www.secadenord.com.tn
IRESA (Institution de la Recherche et de l'Enseignement Supérieur agricoles/ Agricultural Research and Higher Education Institution).	- IRESA has to sit up, to keep awake and to supervise the agricultural research programs, and to promote the agricultural higher education in order to enhance the agriculture sector.	- Ministère de l'Agriculture - 30, Rue Alain Savary - 1002 Tunis Belvédère -TUNISIE- - webmaster@semide.tn - www.iresa.agrinet.tn
NGO (GIC associations)	- GIC associations are a group of users in the rural areas that have to manage their demand on water (domestic and agricultural use). They are created by MAERH and advised by DGGREE	- 12 Rue Tantaoui El JAwhari ElOmrane 1005 Tunis - www.atpne.org - amabroug@gnet.tn
ANPE (Agence Nationale de Protection de l'Environnement/National Environment Protection Agency).	- ANPE control pollution discharged (liquid and solid) in natural systems and also their treatment plants, attends law enforcement, and promotes public awareness of the environmental protection and preservation. Each new project related to agriculture, tourism, industrial and urban areas is subject to this organization to identify its environmental impacts	- contact@anpe.nat.tn - Centre Urbain Nord 15 rue 7051 cité Essalem 2080 Ariana - www.anpe.nat.tn -
CITET (Centre International des Technologies de l'Environnement/International Centre of Environment Technologies).	- The CITET activities are hinged on 3 axes: - National and international trainings, notably on the urban cleansing, solid and liquid rejections management, industrial pollution control, urban management systems, environmental impact studies, campaign against desertification. - Conducting a research related to industrial effluents treatments, and purifying water stations, air quality, etc. - Technologies transferring, as desalinization of saline and sea waters and industrial water physical and chemical treatments. - CITET has advanced equipped laboratories, and realizes current water analysis for ANPE, ONAS, DGRE and DGBGTH.	- Boulevard du Leader Yassar Arafat Tunis 1080 - boc@citet.nat.tn - www.citet.nat.tn
DGEQV (Direction Générale de l'Environnement et de la Qualité de la Vie/General Direction of Environment and Life Quality).	- The General Direction of Environment and Life Quality (DGEQV, Direction Générale de l'Environnement et de la Qualité de la Vie) has to: formulate the general political aspects related to the environment; coordinate and attend the state operations and measures for the environment protection;	- 43, rue La Mannoubia 1008 TUNIS – TUNISIE - boc@mineat.gov.tn - www.semide.tn/DGEQV.htm -



Ministry of Agriculture, Environment and Water Resources		
Institution	Responsibility	Contact details/Website
	<ul style="list-style-type: none"> <li>- Campaign against pollution and its negative effects; and improve the quality of life. It is involved in environment aspects related to water resources.</li> </ul>	
<p>ONAS (Office National de l'Assainissement/National Service of Used Water Cleansing).</p>	<ul style="list-style-type: none"> <li>- Created in 1974, the National Service of Used Water Cleansing (ONAS, Office National de l'Assainissement) is involved in water management by the following activities: <ul style="list-style-type: none"> <li>(i) Avoiding water pollution in the urban, industrial and touristic zones.</li> <li>(ii) Management, exploitation, maintenance and construction of the network of town cleansing.</li> <li>(iii) Realization of studies projects related to the individual rural water cleansing.</li> <li>(iv) Management of water purifying stations (used water reclamation), and supplying the reclaimed water for the specified irrigation uses.</li> <li>(v) Collecting data on the rejected water and gathering information about the industrial effluents. Information related to the mapping of the industrial units are organized in "Cadrin" database.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- 32, rue Hédi Nouira - 1001 Tunis -Tunisie.</li> <li>- webmaster@semide.tn</li> <li>- www.onas.nat.tn</li> </ul>
<p>DGSV (Direction Générale des Services Vétérinaires/General Direction of Veterinary Services).</p>	<ul style="list-style-type: none"> <li>- This branch is associated in the process of fight against drought by its central departments and regional services in the CRDA</li> </ul>	<ul style="list-style-type: none"> <li>- www.onagri.nat.tn/</li> </ul>
<p>DGPCQA (Direction Générale de la Protection et du Contrôle de la Qualité des Produits Agricoles/General Direction of Agricultural Products Quality Control and Protection)</p>	<ul style="list-style-type: none"> <li>- It controls the quality of many products and certify their compliance with standards: (seeds, plants, chemical treatment products, agricultural products imported and exported, etc.).</li> </ul>	<ul style="list-style-type: none"> <li>- 30, rue Alain Savary 1002-Tunis le Belvédère</li> <li>- mag@ministeres.tn</li> </ul>
<p>DGEDA (Direction Générale des Etudes et du Développement Agricole/General Direction of Agricultural Studies and Development).</p>	<ul style="list-style-type: none"> <li>- Realization of studies and analysis for the agricultural development.</li> <li>- Elaboration and attending the development plan execution with the collaboration of the different MAERH departments.</li> <li>- Identifying the agricultural development plan components and evaluation of related programmes and projects.</li> <li>- Elaboration of the MAERH budget, realization of economics-related research topics, establishing statistical data analysis on the agricultural activities for future utilization in the economic planning programmes.</li> <li>- Attending the evolution of the agricultural circumstances, notably during the drought events.</li> </ul>	<ul style="list-style-type: none"> <li>- 30, rue Alain Savary 1002-Tunis le Belvédère</li> <li>- mag@ministeres.tn</li> </ul>

<b>Ministry of Agriculture, Environment and Water Resources</b>		
<b>Institution</b>	<b>Responsibility</b>	<b>Contact details/Website</b>
	<ul style="list-style-type: none"> <li>- Elaboration of economic analysis related to the agricultural development policy.</li> </ul>	
DGPA (Direction Générale de la Production agricole/General Direction of Agricultural Production).	<ul style="list-style-type: none"> <li>- DGPA is not involved in water management but it is associated in the drought mitigation system and contributes through its central and regional services ("Arrondissements") in the CRDAs in the different steps of drought management.</li> <li>- The General Direction of Financing, Investments and Professional Institutions (DGFIOP, Direction Générale du Financement et des Investissements et Organismes Professionnels) prepares the MAERH budget with the collaboration of DGEDA, and draws up all operations related to the financial support for the agricultural activities as well as for the drought management.</li> </ul>	<ul style="list-style-type: none"> <li>- 1002 - Tunis - le belvedere Tunisie</li> <li>- www.tunisie.gov.tn</li> <li>- mag@ministeres.tn</li> <li>- www.onagri.nat.tn</li> <li>- 30, rue Alain Savary</li> <li>- odno@mdci.gov.tn</li> </ul>
DGF (Direction Générale des Forêts/Forest General Direction).	<ul style="list-style-type: none"> <li>- Forest General Direction (DGF, Direction Générale des Forêts), is not involved in water management but contributes in the forest lands management and acts against forest fire, especially during drought events. DGF manages several rangelands that are open for farmers during drought. DGF has numerous forest lands data and maps containing numerous water resources information.</li> </ul>	<ul style="list-style-type: none"> <li>- Rue Hmida Zine El Abidine Khezama Ouest Sousse</li> </ul>
OC (Office des Céréales/Cereal Agency).	<ul style="list-style-type: none"> <li>- The Cereal Agency (OC, Office des Cereals) is in charge of the promotion and the management of the cereal production.</li> </ul>	<ul style="list-style-type: none"> <li>- 30, Rue Alain Savary 1002 Tunis</li> <li>- onagri@email.ati.tn</li> </ul>
OEP (Office de l'Elevage et des Pâturages/Animal Husbandry and Pasture Agency).	<ul style="list-style-type: none"> <li>- The Animal Husbandry and Pasture Agency (OEP, Office de l'Elevage et de du Pâturage) is entrusted with the management of all tasks related to animal husbandry and pasture.</li> </ul>	<ul style="list-style-type: none"> <li>- Av. Habib Bourguiba 7030, Mateur, BIZERTE</li> </ul>
AVFA (Agence de la Vulgarisation et de la Formation Agricoles/Agricultural Extension and Training Agency).	<ul style="list-style-type: none"> <li>- The Agricultural Extension and Training Agency (AVFA, Agence de Vulgarisation et de la Formation Agricole) is responsible for the attending the farmers to promote agricultural practices and to transfer the new agricultural technologies.</li> </ul>	<ul style="list-style-type: none"> <li>- 30, rue Alain Savary, 1002 Tunis, Tunisie</li> <li>- bo.avfa@iresa.agrinet.tn</li> </ul>
<b>Others</b>		
MPH (Ministry of Public Health).	DHMPE	Ministère de la Santé Publique, Bab Saâdoun, 1006 - Tunis. webmaster@semide.tn www.semide.tn/DHMPE.htm
Prime Ministry	Media	contact@mediatunisie.com
NGO	UTAP	Rue 8451 Avenue Alain Savary Tunis Tunisie 1003 utap.tunis@email.ati.tn

<b>Ministry of Agriculture, Environment and Water Resources</b>		
<b>Institution</b>	<b>Responsibility</b>	<b>Contact details/Website</b>
Ministry of Finance	Ministry	30, rue Alain Savary, 1002 Tunis mag@ministeres.tn.
Ministry of Economic Development	Ministry	Place Ali Zouaoui 1000 Tunis mde@ministeres.tn
Ministry of Interior	Ministry	Avenue Habib Bourguiba, 1000 Tunis, Tunisie
Ministry of Commerce	Ministry	Avenue Kheireddine Pacha tunis
Ministry of Agriculture and Water Resources- National Observatory of Agriculture	Public Institution	Tel: 18 73 - 71 78 68 33 Fax: 71 76 61 07 mag@ministeres.tn <a href="http://www.onagri.nat.tn/">http://www.onagri.nat.tn/</a>
National Institute of Meteorology (INM)	Public Institution	Tel : 71 773 400 Fax: 71 772 609 admin@meteo.tn <a href="http://www.meteo.tn/default.htm">http://www.meteo.tn/default.htm</a>
Ministry of Agriculture and Water Resources- National Observatory of Agriculture	Public Institution	Tel: 18 73 - 71 78 68 33 Fax: 71 76 61 07 mag@ministeres.tn <a href="http://www.onagri.nat.tn/">http://www.onagri.nat.tn/</a>
National Institute of Meteorology (INM)	Public Institution	Tel : 71 773 400 Fax: 71 772 609 admin@meteo.tn <a href="http://www.meteo.tn/default.html">http://www.meteo.tn/default.html</a>
National Center of remote sensing (CNCT)	Public Institution	BP. 200, 1080 Tunis Cedex Tél : +216 71 761 333 Fax : + 216 71 760 890 e-m@il :cnt@defense.tn <a href="http://www.cnt.nat.tn/Fr/index.php?m=904">http://www.cnt.nat.tn/Fr/index.php?m=904</a>
Ministry of Economic Development	Ministry	Place Ali Zouaoui 1000 Tunis mde@ministeres.tn

## 5.1.2 Algeria

The institutions involved in mitigation of drought in Algeria are listed in Table 19.

**Table 20: Institutions involved in drought mitigation in Algeria**

Institution	Responsibility	Contact details/Website
Ministry of Planning, Environment and Tourism (MATET)	Environment and fight against desertification, Planning and Tourism Coordination of environmental conventions	Rue des quatre canons Alger www.mate.gov.dz
Algerian Space Agency (ASAL)	The Agency is the instrument design and implementation of national policy for the promotion and development of space activities on the technological, scientific and application for and contribute to the economic, social and cultural development and ensure the safety and well-being of the national community.	14 rue omar aissaoui el hammadia - bouzareah alger algerie info@asal.dz www.asal-dz.org
National Agency of Water Resources	The exploration for and evaluation of water resources and soil of the country The collection, processing and updating information on water resources and soil The monitoring of the resource quantity and quality The preservation, protection and preservation of the resource against all forms of degradation	40 Avenue Mohammedi clairbois Bir Mourad Rais Alger dhyl@anrh.dz www.anrh.dz
National Meteorological Office (ONM)	weather stations form a professional network to ensure national weather watch. Observation functions are complemented by functions of concentration, control, analysis and dissemination of learning.	BP 153 avenue Khemisti Dar el Beida Alger www.meteo.dz  Tel : 021 50 73 93  Fax:021 50 88 49  contact@meteo.dz
Institut National des Sols, de l'Irrigation et du Drainage (INSID)		bp 148 oued smar el harrach insid@insid.dz www.insid.dz
Direction du Développement Agricole des Zones Arides et Semi Arides (DDAZASZ)		

### 5.1.3 Morocco

The institutions involved in mitigation of drought in Morocco are listed in Table 21

**Table 21: Institutions involved in drought mitigation in Morocco**

Institution	Responsibility	Contact details/Website
<b>Ministry of Agriculture and Maritime Fisheries</b>		
Directorate of Plant Production (DPV)	Agricultural and Rural Development Horizontal control, promotion, production and food processing, agricultural, industrial and other	Direction de la Production Végétale MADRAP, Rabat
Water and Ag-Engineering Administration (AGR)	Hydro-agricultural development. Administration: Agriculture and Agrarian Reform	avenue Hassan II, Dar Dbagh +212 537 69 11 01
National Institute Agronomic Research (INRA)	"INRA" mission is to undertake research for agricultural development.	INRA Avenue Ennasr Rabat, Maroc BP 415 RP Rabat, Maroc Tél: 0537 77 26 54 webmaster@inra.org.ma / www.inra.gov.ma
Agronomic and Veterinary Institute Hassan II (IAV HII)	Higher Education, Research and Development	
<b>Regional Office of Agricultural Development</b>		
Marrakech (ORMVAM)	The regional agricultural development (ORMVA), expected agricultural policy framework of the state, confined in the role of water vendors. Drowning in debt and a heavy payroll, they continue to gobble up huge budgets	Avenue Hassan II B.P. 2411 Marrakech Tél : 0524 43 10 09
Tadla (ORMVAT)	The same than previous line	B.P 244 Fqih Ben Salah Tel.:+ 212 5 23 43 50 23/35/48 Fax.:+212 5 23 43 50 18/22 E-mail : ortadla@menara.com   contact@ormvatadla.com web: <a href="http://www.ormvatadla.com">http://www.ormvatadla.com</a>
Gharb (ORMVAG)	The same than previous line	BP 79 Kénitra 14000 Tél. 05 37 37 45 02. Fax 05 37 37 43 86 web: <a href="http://www.ormvag.ma">http://www.ormvag.ma</a>
Doukkala (ORMVAD)	The same than previous line	Avenue Mohamed VI, BP 58, El Jadida Tél. 0523-34-36-19, 0523-35-00-94, 0523-34-22-75/74/70/71/76, 0523-34-23-75, 0523-34-34-30, 0523-35-33-44 Fax 0523-34-22-72
Haouz (ORMVAH)	The same than previous line	Av Hassan II, Gueliz BP 2411, Marrakech Tél. 0524-44-95-97, 0524-44-96-50, 0524-43-14-09, 0524-43-19-23, Fax 0524-44-97-93
Souss Massa (ORMVAS)	The same than previous line	Rue des Administrations, BP 21, Agadir Tél. 0528-84-08-16/84, 0528-84-01-12/71, 0528-84-67-86/87, 0528-84-08-27, Fax 0528-84-65-21
Loukkos (ORMVAL)	The same than previous line	BP 48, Ksar El Kébir Tél. 0539-91-86-76, 0539-91-90-28, 0539-91-81-97, 0539-91-89-29,

Institution	Responsibility	Contact details/Website
		Fax 0539-91-82-03
Moulouya (ORMVAM)	The same than previous line	BP 463, Berkane Tél. 0536-61-25-32, 0536-61-26-28, 0536-61-27-28, 0536-61-28-28, 0536-61-34-68, Fax 0536-61-29-28
Ouarzazate (ORMVAO)	The same than previous line	BP 29, Ouarzazate Tél. 0524-88-26-87, 0524-88-26-14/02/70, 0524-88-25-61, Fax 0524-88-34-42
National Drought Observatory (NDO)	Drought management	IAV Hassan II. B.p. 6202 Instituts. Rabat Maroc www.iav.ac.ma
National School of Forest Engineers (ENFI)	Engineering education in State of Water and Forests.	BP : 511, Tabriquet – Salé www.enfi.ac.ma eauxetforets@iam.net.ma
<b>Secretary of State to the Minister of Energy, Mines, Water and Environment</b> Rue Hassan Bencheikroun. Agdal Rabat. Chellah. Tel. +212537778727. <a href="http://www.water.gov.ma">www.water.gov.ma</a> see@water.gov.ma		
Superior Council for Water and Climate (SCWC)	The national strategy of knowledge of climate and its impact on water resources, * The national plan for water * Plans for integrated management of water resources with particular emphasis on the distribution of water between different users, transfers of water and provisions for the use and protection of water resources.	
National Council for Environment (NCE)	Coordination and consultation, provides a forum for discussion and exchange on topics related to environment and sustainable development, and includes all departments, non-governmental organizations (NGOs), professional associations, scientific institutes and the private sector.	National Council for Environment (NCE)
General Direction of Hydraulics	Public Department	General Direction of Hydraulics Tél : 212 037 778715 Fax : +212 7 778696 e-mail : dgh@mtpnet.gov.ma/http://www.mtpnet.gov.ma/dgh
Oum Er Rbia Basin	is to ensure the planning and management, integrated and collaborative water resources with a view to ensure sustainable development of the basin of the Oum Er Rbia through: harmonious management, planned, rational and sustainable water; decentralized management based on cooperation and partnership; solidarity among water users;	Agence du Bassin Hydraulique de l'Oum Er Rbia BP: 511 Beni Mellal Téléphone: +212 23 48 23 55/28.55/37.13 Fax: +212 23 48 94 15 agence@abhoer.ma

Institution	Responsibility	Contact details/Website
	A master of the resource and the recognition of its economic value.	
Tensift basin	Coherent and coordinated planning across the river basin; Integrated, decentralized and coordinated water resource and public water; Protection and conservation quantity and quality of water resources; Optimum and rational utilization of water.	Av. Jnane El Harti Bp : 2388 - Marrakech - Maroc Tél. : +212 (0) 24 44 89 64 Fax : +212 (0) 24 43 56 20 E-mail : info@eau-tensift.net
Bouregreg basin	Hydraulic Basin Agency Bouregreg and Chaouia is a public institution, endowed with legal personality and financial autonomy. Having a central role in the management and protection of public water, it initiates and implements the policy of water in its area of action.	Adresse : Agence du Bassin Hydraulique du Bouregreg et de la Chaouia Route de Casablanca B.P. 262 Benslimane TEL : (212)523290821 ou (212)523290283 ou (212)661685523 FAX : (212)523290999 Email : abhbc@abhbc.ma
Sebou basin	The Agency is governed by a Board chaired by the government authority responsible for water resources are represented and in which all actors in the field of water at the river basin.	Adresse: BP 2101 Fes Tel: +212535642998/97 Fax: +212535640444 direction@abhsebou.ma
Iokkous basin	Assessment, planning, resource management, exploitation of hydraulic works, etc. ...	Adresse : Avenue Al Massira, B.P. 616 Tétouan-Maroc Tél : +212 5 39.99.45.67 / +212 5 39.99.45.72 Fax : +212 5 36 68 38 48 Email : abloukkos@iam.net.ma
Moulouya basin	Assessment of water resources and their use of state Development of water resources of the basin Project preparation PDAIR Basin Moulouya	Adresse : BP 703, Bd Hassan Loukili Oujda-Maroc Tél : +212 5 36 68 45 13 / +212 5 36 68 68 99 Fax : +212 5 36 68 38 48 Email : abhm@menara.ma Web : http://www.eaumoulouya.ma/
Massa Agadir basin	Overexploitation of groundwater increased, the increasing urbanization of the area regional emergence of new needs for water, and good governance in the management of water resources.	Adresse : Avenue MY Abdellah BP 432 80000 Agadir-Maroc Tél : +212 5 28 84 25 51 / +212 5 28 84 39 59 Fax : +212 5 28 84 20 82 Email : abhsm@menara.ma Web : http://www.abhsm.ma/
DPCC : Partnership and Communication Department. Climate Change service	Coordination of policies, plans and programs of regional planning, environment and water and Partnership Coordination of Environmental Action UNFCCC Focal Point	4 place Abou Baker Esseddik. Avenue Fal Ould Amir – Agdal - RABAT dpcc@minenv.gov.ma www.ccmoroc.ma
National Office for Drinking Water (ONEP)	Planning del'approvisionnement drinking water (EPA) across national -Production of drinking water -Distribution of drinking water	Station de Traitement Avenue Mohamed Belhassan El ouazzani BP.Rabat-Chellah 10002 Rabat Maroc onepbo@onep.ma +212 5 37 75 96 00

Institution	Responsibility	Contact details/Website
	for the local -Management of liquid waste disposal on behalf of CL - Monitoring water quality	
Directorate General of Hydraulics, (DGH)	The evaluation and monitoring of water resources; Planning their development; Management; The control and protection of their quality; The construction and maintenance works for mobilization and transfer of water.	dgh@mtpnet.gov.ma +212 7 778696 212 037 778715
Direction de la Recherche et de la Planification de l'Eau (DRPE)	Development and implementation of government policy planning, mobilization, management and conservation of water resources.	Rue Hassan Ben Chekroun Rabat Agdal –Maroc-see@water.gov.ma www.water.gov.ma
Direction de la Météorologie (DMN)	Drought long term forecast and artificial rain program	contact@ marocmeteo.ma www.marocmeteo.ma
<b>High Commissariat of Water, Forests and Fight Against Desertification</b>		
HCEFLCD: High Commissariat of water, forests and fight against desertification	Coordination of the implementation of the LCD Preparation programs in watershed management and soil conservation Preparation of development plans of parks and wildlife reserves Defining strategies to protect forests, integrated development programs and ecotourism	B.P : 605 Rabat-Chellah Tél:(212) 5 37.76.00.38/41 Fax: (212) 5 37.76.84.96 contact@eauxetforets.gov.ma http://www.eauxetforets.gov.ma/fr/index.aspx



## **5.2 LIST OF INSTITUTIONS IN THE EQUATORIAL LAKES REGION (BURUNDI, KENYA, TANZANIA, RWANDA)**

### **5.2.1 Tanzania**

The institutes involved in drought mitigation in Tanzania are listed below in Table 22:

**Table 22: Institute involved in drought mitigation in Tanzania**

Institutions	Roles in Mitigating Droughts	Contact Details
Prime Minister's Office (PMO), Disaster Management Department (DMD)	<ul style="list-style-type: none"> <li>The National Operational Guidelines for Disasters (2003) and National Disaster Management policy of 2004 outlines national goals and objectives for hazard risks and emergency management</li> <li>The National Disaster Management Policy (2004) describes roles and responsibilities of all stakeholders (government entities &amp; civil society)</li> <li>The National Operational Guidelines for Disaster Management (2003) aim to develop adequate capacity for coordination and cooperation for comprehensive disaster management among key players at all levels. Other objectives are to promote research, information generation and dissemination as well as mainstreaming disaster management issues into development plans and other sector policies and programmes at all levels.</li> </ul>	Address: P.O. Box 3021 Dar es Salaam, Tanzania Telephone: +255 2221172266; +255 22 2111249/50/51/52 Fax: +255 2221172266 <ul style="list-style-type: none"> <li>Website: <a href="http://www.pmo.go.tz">http://www.pmo.go.tz</a></li> </ul>
Ministry of Agriculture, Food Security and Cooperatives	<ul style="list-style-type: none"> <li>Develop and execute a strategy on food security, natural resource and industrial regulations</li> <li>The food security Act (1991), which monitor the country's food situation at all stages and provide early warning services on food security</li> <li>Ensure food availability in the country</li> <li>Increase food production in drought prone areas</li> <li>Develop and supply drought-resistant high yielding seed varieties</li> <li>Educate and train people to harness and utilize runoff water</li> <li>Exploit groundwater to increase food production</li> <li>Promote soil and water conservation</li> <li>Create irrigation schemes at all relevant levels</li> <li>Emergency food security</li> </ul>	P.O Box 9192 Dar es Salaam General Lines Telephones: +255 22 2862480 +255 22 2862481 <ul style="list-style-type: none"> <li>Website: <a href="http://www.agriculture.go.tz/">http://www.agriculture.go.tz/</a></li> </ul>
Ministry of Lands, Housing and Human Settlements Development	<ul style="list-style-type: none"> <li>National Land Policy (1995)</li> <li>The village Act No. 5 of 1999 requires village councils to designate and prepare Village Land Use Plans for various uses e.g. agriculture, pastoralist, forestry, water, minerals and conservation</li> </ul>	P.O. Box 9132, Dar es Salaam, Tanzania Tel: +255 22 2121241-9, 2120209, 2113165, 2118506 Fax: +255 22 2113224 <ul style="list-style-type: none"> <li>Website: <a href="http://www.ardhi.go.tz/">http://www.ardhi.go.tz/</a></li> </ul>
Vice President's Office (VPO)	<ul style="list-style-type: none"> <li>The National Environmental Policy (1997)</li> <li>The Environmental Management Act, of 2004 which prepare guidelines for possible environmental emergencies like climate change, which may result into disasters;</li> </ul>	P.O Box 5380, Dar es Salaam, Tanzania Tel: +255 22 2113857 <ul style="list-style-type: none"> <li>Fax: +255 22 2113856</li> </ul>
UNICEF lead One UN Joint Programme on strengthening National Disaster preparedness and response capacity	<ul style="list-style-type: none"> <li>To enhance national capacity to reduce vulnerability and mitigate disasters in three areas: disaster risk assessment; disaster preparedness planning and early warning mechanisms on all administrative levels and building response capacities</li> <li>The focus is on strengthening institutional, organizational and individual capacities of the</li> </ul>	P.O. Box 4076 Dar es Salaam, Tanzania Tel.: +255 22 2196600

Institutions	Roles in Mitigating Droughts	Contact Details
	<p>government to disaster risk</p> <ul style="list-style-type: none"> <li>The PMO in collaboration with Tanzania Red Cross Society (TRCS) are managing the process of decentralizing pre-positioning relief items (improving early action at community levels (District and Regional levels))</li> </ul>	<p>Fax: +255 22 2151603 / +255 22 2151593</p> <p>Website:</p> <ul style="list-style-type: none"> <li><a href="http://www.unicef.org/infobycountry/tanzania.html">http://www.unicef.org/infobycountry/tanzania.html</a></li> </ul>
<p>Food Security Information Team (FSIT) comprises: Government Institutions, UN agencies (FAO, UNICEF and WFP), higher learning institutions, International NGOs (FEWSNET, OXFAM and World Vision) and Local NGOs, Disaster Management Department (DMD)</p>	<ul style="list-style-type: none"> <li>Conduct Rapid Vulnerability Assessment twice a year and the outcomes/evidence from the assessments fed into the Integrated Phase Classification (IPC) analysis templates, which presents an approach to vulnerability assessments and analysis (SADC, 2009)</li> </ul>	<p>Address: P.O. Box 3021 Dar es Salaam, Tanzania</p> <p>Telephone: +255 2221172266; +255 22 2111249/50/51/52</p> <p>Fax: +255 2221172266</p> <ul style="list-style-type: none"> <li>Website: <a href="http://www.pmo.go.tz">http://www.pmo.go.tz</a></li> </ul>
<p>FEWS NET is a USAID funded project</p>	<ul style="list-style-type: none"> <li>Dedicated to strengthening the abilities of countries/ governments and national/ regional organizations to manage threats of food insecurity and famine through the generation and provision of information about food security to a wide range of users</li> <li>FEWS NET main focus is early warning through providing the earliest possible information on food security outcomes to decision makers</li> </ul>	<p>Tanzania Country Office</p> <p>Tel: +255 22 21-28-693</p> <p>Fax: +255 22 21-28-521</p> <ul style="list-style-type: none"> <li>USAID/Tanzania 686 Old Bagamoyo Road Msasani P.O.Box 9130, Dar es Salaam Tanzania Tel: +255 22 266 8482/8489/8490 Fax: 255 22 266 8421</li> </ul>

### **5.2.2 Kenya**

With the exception of a few projects in arid and semi arid land areas, drought is managed as a crisis and focus is on food aid with little consideration of environmental implications. A list of some institutions which were involved in implementing drought mitigation is presented in Table 23. Depending of the severity of a drought the President of Kenya may declare a drought a national disaster. This enables quick mobilisation of resources to avoid starving large number of people.

Coordination is essential to respond effectively and efficiently to the unfolding situation. The KRCS worked in partnership with the Government of Kenya, UN agencies and other organizations that responded to the government's call to come to the aid of thousands at the risk of famine in Kenya. All relief operations were coordinated by the National Disaster Committee through the Kenya Food Security Steering Group (KFSSG). Members of this group included the Kenyan government, UN agencies and international non-governmental organizations, among others. At the district level, coordination was undertaken by the District Steering Group. The KRCS was a member at both levels. In April 2006, the regional delegation called for a meeting of the regional drought review committee. The meeting was attended by all National Societies of drought-affected countries in the region to discuss the food security situation as well as Red Cross/Red Crescent response strategies.

**Table 23: Institutions involved in drought mitigation in Kenya**

Institution	Roles in Mitigating Drought	Contacts
Ministry of Special Programmes	<ul style="list-style-type: none"> <li>• Coordinate the formulation and implementation of Policies and Institutional Framework for Drought Mitigation.</li> <li>• Coordinate the mobilization of resources for Drought Mitigation.</li> <li>• Coordinate all stakeholders in Drought Risk Reduction and Mitigation.</li> <li>• Monitoring and Evaluation of the Drought Mitigation Programme.</li> </ul>	Comcraft House, 5th Floor, Haile Selasie Avenue P. O. Box 40213 - 00100 Nairobi Tel: +254-20-2250645 Email: info@sprogrammes.go.ke <ul style="list-style-type: none"> <li>• Website: www.sprogrammes.go.ke</li> </ul>
Ministry of State for Development of Northern Kenya and other Arid Lands	<ul style="list-style-type: none"> <li>• Coordinate the formulation and implementation of Policies and Institutional Framework for Drought Mitigation in Kenyan Arid Lands.</li> <li>• Coordinate the mobilization of resources for Drought Mitigation in Kenya Arid Lands.</li> <li>• Coordinate, monitor and evaluate all stakeholders in Drought Risk Reduction and Mitigation in Arid Lands.</li> </ul>	KICC Building, 13th Floor Harambee Avenue, <ul style="list-style-type: none"> <li>• P.O.Box 53547 - 00200 Nairobi Kenya</li> </ul> E-mail: alrmpqh@africaonline.co.ke <a href="http://www.aridlands.go.ke">http://www.aridlands.go.ke</a>
Ministry of Water and Irrigation	<ul style="list-style-type: none"> <li>• Water resources mitigation policy.</li> <li>• Water storage implementation programs.</li> <li>• National irrigation planning and implementation programs.</li> </ul>	Maji House, Off Ngong Road P. O. Box 49720 Nairobi, Kenya Tel. +254 020 2716103 <ul style="list-style-type: none"> <li>• <a href="http://www.water.go.ke">http://www.water.go.ke</a></li> </ul>
Ministry of Regional Development Authorities	<ul style="list-style-type: none"> <li>• Coordination of regional (basin) development policy.</li> <li>• Coordinate, monitor and evaluate basin mitigation authorities.</li> </ul>	N.S.S.F Building 21st Floor, Eastern Wing, P.O. Box 10280 - 00100 GPO, Nairobi <ul style="list-style-type: none"> <li>• Tel. 2724646</li> </ul> Website: <a href="http://www.regional-dev.go.ke">www.regional-dev.go.ke</a>
Ministry of Public Health and Sanitation	<ul style="list-style-type: none"> <li>• To provide prompt health services in drought areas.</li> <li>• Create an enabling environment, regulate, set standards and policy for health service delivery in drought risk areas.</li> </ul>	<ul style="list-style-type: none"> <li>• Afya House, Cathedral Road                      P.O. Box 30016, Nairobi                      Tel. 2717077 Fax: 2713234                      Website: <a href="http://www.health.go.ke">www.health.go.ke</a></li> </ul>
Ministry of Medical Services		Afya House, Cathedral Road P.O. Box 30016, Nairobi Tel. 2717077. Fax: 2713234 Website: <a href="http://www.medical.go.ke">www.medical.go.ke</a>
Ministry of Livestock Development	<ul style="list-style-type: none"> <li>• Guiding Livestock Policy and Services (National Food Policy)</li> <li>• Assist in Crop Production and Marketing.</li> <li>• Provide agriculture extension services in farm practice, pests and diseases control.</li> </ul>	<ul style="list-style-type: none"> <li>• Kilimo House, Cathedral Road                      P.O. Box 30028, Nairobi                      Tel. 2718870. Telex: 22766                      Website: <a href="http://www.livestock.go.ke">www.livestock.go.ke</a></li> </ul>
Ministry of Agriculture	<ul style="list-style-type: none"> <li>• Guiding Agricultural Policy and Services (National Food Policy).</li> <li>• Assist in Crop Production and Marketing.</li> <li>• Provide agriculture extension services in farm practice, pests and diseases control.</li> </ul>	<ul style="list-style-type: none"> <li>• Kilimo House, Cathedral Road                      P.O. Box 30028, Nairobi  <a href="http://www.kilimo.go.ke">www.kilimo.go.ke</a></li> </ul>
ISDR	<ul style="list-style-type: none"> <li>• Drought risk reduction strategy policy through</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://www.unisdr.org/africa">www.unisdr.org/africa</a></li> </ul>

Institution	Roles in Mitigating Drought	Contacts
	<ul style="list-style-type: none"> <li>• Forum within the United Nations system for devising strategies and policies for the reduction of drought as a natural hazard;</li> <li>• Identifying gaps in drought risk reduction policies and programmes and recommend remedial action;</li> <li>• Provision of policy guidance to the isdr secretariat; and</li> <li>• Convening ad hoc meetings of experts on issues related to disaster reduction.</li> </ul>	
UNOCHA		<a href="http://ochaonline.un.org/Kenyaochaonline.un.org/Kenya">ochaonline.un.org/Kenyaochaonline.un.org/Kenya</a>
ICPAC	<ul style="list-style-type: none"> <li>• Process data and develop baseline risk scenarios and other applications;</li> <li>• Monitor, predict and provide early warning information of the space-time evolutions of weather and climate extremes over the sub-region;</li> <li>• Hazards and climate risk mapping of the extreme climate events thresholds;</li> <li>• Networking with WMO, the National Meteorological and Hydrological institutions as well as regional and international centers for data and information exchange;</li> <li>• Applications of climate tools for specific climate sensitive sector risk reduction, environment mitigation , and sustainable development, including integration of indigenous knowledge;</li> <li>• Monitor, assess, detect and attribute climate change and associated impacts, vulnerability, adaptation and mitigation options;</li> <li>• Develop relevant tools required to address the regional climate challenges through research and applications in all climate sensitive socio-economic sectors including addressing linkages with other natural and man-made disasters; and</li> <li>• Networking and exchange of information regarding disasters in the sub-region</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://www.icpac.net/">http://www.icpac.net/</a></li> </ul>
Oxfam		<a href="http://oxfam.org">http://oxfam.org</a>
World Vision	<ul style="list-style-type: none"> <li>• Training and equipping community health workers and establishing drug supply chains to facilitate their work</li> <li>• Rehabilitating and constructing shallow wells and boreholes to meet the water needs of pastoralists and their livestock.</li> <li>• Promote rain water harvesting.</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://www.worldvision.org">http://www.worldvision.org</a></li> </ul>
ASARECA	<ul style="list-style-type: none"> <li>• Promoting research and growing of drought resilient crops (Millet and sorghum)</li> <li>• Promoting appropriate farming methods.</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://www.asareca.org/">http://www.asareca.org/</a></li> </ul>
Action Aid	<ul style="list-style-type: none"> <li>• Non-Governmental</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://www.actionaid.org">www.actionaid.org</a></li> </ul>
Practical Action	<ul style="list-style-type: none"> <li>• Training and equipping community animal health workers and establishing drug supply chains to facilitate their work</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://practicalaction.org">practicalaction.org</a></li> </ul>

Institution	Roles in Mitigating Drought	Contacts
	<ul style="list-style-type: none"> <li>• Rehabilitating and constructing shallow wells and boreholes to meet the needs of over 25,000 pastoralists and their livestock</li> <li>• Strengthening the capacity of water user associations to manage the water resources on a sustainable basis</li> <li>• Catalyzing the formation of peace and grazing committees and supporting their work in cross-border peace initiatives and proper mitigation of rangeland resources</li> </ul>	
Kenya Red Cross	<ul style="list-style-type: none"> <li>• Carry out humanitarian work in times of peace or conflict. Natural disasters such as drought, famine, floods.</li> <li>• Promote pilot intervention on resilience.</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://www.redcross.org">http://www.redcross.org</a></li> </ul>
Care International	<ul style="list-style-type: none"> <li>• Non-Governmental</li> </ul>	www.careinternational.org or <ul style="list-style-type: none"> <li>• <a href="http://www.careclimatechange.org">www.careclimatechange.org</a></li> </ul>
Plan International	<ul style="list-style-type: none"> <li>• Non-Governmental</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://plan-international.org">plan-international.org</a></li> </ul>
World Food Program	<ul style="list-style-type: none"> <li>• Coordinate the formulation and implementation of Policies and Institutional Framework for Drought Mitigation.</li> <li>• Coordinate the mobilization of resources for Drought Mitigation.</li> <li>• Coordinate all stakeholders in Drought Risk Reduction and Mitigation. Monitoring and Evaluation of the Drought Mitigation Programme.</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="http://www.wfp.org/countries/kenya">www.wfp.org/countries/kenya</a></li> </ul>

### **5.2.3 Rwanda**

The institutions listed in Table 24 are the main ones which were involved in implementing the drought mitigation measures in Rwanda.



**Table 24: Institutions involved in drought mitigation in Rwanda**

Institution	Roles in Mitigating Drought	Contacts
Ministry of Infrastructure especially its department "Rwanda Meteorological Service"	<ul style="list-style-type: none"> <li>Meteorological data collection, analysis and dissemination. This service helps in the monitoring of meteorological records that helps in predicting drought events.</li> </ul>	Contact: P. O. Box 24 Kigali. Tel. : +250252585503 ; Fax : +250252585755 Website www.mininfra.gov.rw, www.meteorwanda.gov.rw <ul style="list-style-type: none"> <li>Email: info@mininfra.gov.rw</li> </ul>
Ministry of Local Government:	<ul style="list-style-type: none"> <li>Interdiction of cultivation around lakes and rivers and agro-forestry trees planting in buffer zones. This action was implemented in all districts of the country for the sustainability of water and wetlands.</li> </ul>	Website: www.minaloc.gov.rw . Email: secretariat@minaloc.gov.rw <ul style="list-style-type: none"> <li></li> </ul>
Rwanda Environmental management Authority (REMA):	<ul style="list-style-type: none"> <li>Sensitization and implementation of environmental protection policy</li> </ul>	<ul style="list-style-type: none"> <li>.www.rema.gov.rw Tel. +250252580101, Fax +250252580017. P.O.Box 7436 Kigali Rwanda. Email: remainfo@rema.gov.rw</li> </ul>
Ministry of Agriculture and Animal Resources (MINAGRI):	<ul style="list-style-type: none"> <li>o This is helping in implementation of various projects aiming at promoting irrigated agriculture. This ministry in collaboration with its authorities and partners intervene in implementation of agricultural policy, introduction of new and resistant seeds through its research institutes and authorities like ISAR (Rwanda Agricultural Research Institute), RHODA (Rwanda Horticulture Development Authority), etc. Another example is the project of MINAGRI on Land Husbandry, Water Harvesting and Hillside Irrigation (LWH). One of the objectives of this project is the construction valley-dams reservoirs of in the following districts: Gatsibo, Kayonza, Karongi, Nyanza and Bugesera.</li> <li>• Among MINAGRI partners, we can mention the Japan International Development Agency (JICA) which is helping in improvement of farming techniques in Bugesera District to combat poverty often caused by frequent drought in the region.</li> </ul>	Contact: Website: www.minagri.gov.rw , Email: info@minagri.gov.rw <ul style="list-style-type: none"> <li>o</li> </ul>
Ministry of Disaster Management and Refugee Affairs (MIDIMAR)	<ul style="list-style-type: none"> <li>This ministry is in charge of management of all kind of disaster likely to occur in Rwanda. It intervene both in policy of disaster management in building capacity of stakeholders. This ministry is also in charge of refugee affairs including the management of transitional camps</li> </ul>	<ul style="list-style-type: none"> <li>Contact:P.O.Box 4386 Kigali www.midimar.gov.rw email : info@midimar.gov.rw</li> </ul>
The Ministry of Natural Resources (MINIRENA)	<ul style="list-style-type: none"> <li>Natural resources management including land, water, soil and forest.</li> </ul>	Sensitization and implementation of environmental protection policy P.O.Box 3502 Kigali Rwanda. Tel +250 252 582 628 <ul style="list-style-type: none"> <li>Website: www.minirena.gov.rw , Email: info@minirena.gov.rw</li> </ul>
Ministry of Health:	<ul style="list-style-type: none"> <li>Control of diseases' outbreak during drought periods like the control of malaria among other diseases</li> </ul>	Contacts: P.O.Box 84 Kigali Rwanda. Tel: +250 252 577 458, Fax: +250 252 576 453

Institution	Roles in Mitigating Drought	Contacts
		<ul style="list-style-type: none"> <li>Website: <a href="http://www.moh.gov.rw">www.moh.gov.rw</a></li> </ul>
Institute of Scientific and Technological Research (IRST).	<ul style="list-style-type: none"> <li>Research institutes help in searching other sources of energy as alternative to firewood (biogas, solar energy, bioenergy, combustible nuts, peat, etc), biodiversity conservation and land management. Among these research institutions, the following are examples among others:</li> </ul>	<ul style="list-style-type: none"> <li>P.O.Box 227 Butare-Rwanda. Website: <a href="http://www.irst.ac.rw">www.irst.ac.rw</a></li> </ul>
National University of Rwanda.		P.O.Box 117 Butare-Rwanda. Website: <a href="http://www.nur.ac.rw">www.nur.ac.rw</a>
Kigali Institute of science and Technology (KIST).		P.O.Box 3900 Kigali-Rwanda. Website: <a href="http://www.kist.ac.rw">www.kist.ac.rw</a>
Kigali Institute of Education.		P.O. Box 5039 Remera Kigali-Rwanda Website : <a href="http://www.kie.ac.rw">www.kie.ac.rw</a>
Institute of Agriculture, Technology and Education of Kibungo (INATEK).		P.O.Box 06 Kibungo-Rwanda. Website: <a href="http://www.inatek.ac.rw">www.inatek.ac.rw</a>

## 5.2.4 Burundi

In Burundi the main responsible organization is the Ministry of Water, Environment, Land and Urban Management through the agencies shown in Table 25. The institutions above are supposed to cover the whole country especially in the western, northern and eastern part of the county.

**Table 25: Institutions involved in drought mitigation in Burundi**

Institution	Roles in Mitigating Drought	Contacts
The Department of Forests:	<ul style="list-style-type: none"> <li>• Management of forests</li> </ul>	NGENDABANYIKWA Felix , E-mail: felixngenda@yahoo.fr •
The Department of Environment:	<ul style="list-style-type: none"> <li>• Implementation of National Environment Policy</li> </ul>	NSABIYUMVA Capitoline, E-mail: nsabicappy@yahoo.fr •
National Institution of Environment and Natural Conservation (INECN):	<ul style="list-style-type: none"> <li>• Development of Forestry &amp; Agroforestry,</li> <li>• Development of Plant Production &amp; Protection</li> </ul>	P.o.Box 56 Gitega, BURUNDI T: +257 403031 F: +257 403032 MUGISHAWIMANA Jean ' E-mail: <a href="mailto:jonh_mugisha2002@yahoo.com">jonh_mugisha2002@yahoo.com</a> • <a href="mailto:inecn.biodiv@cbinf.com">inecn.biodiv@cbinf.com</a>
Geographic Institute of Burundi:	<ul style="list-style-type: none"> <li>• Collection, analysis and dissemination of meteorological information</li> </ul>	<ul style="list-style-type: none"> <li>• NINDAMUTSA Astere, E-mail: <a href="mailto:nindamutsaastere@yahoo.fr">nindamutsaastere@yahoo.fr</a></li> </ul>

## 5.3 LIST OF INSTITUTIONS IN THE EASTERN NILE REGION (ETHIOPIAN PLATEAU)

A significant shift in policy direction 2008-2009, through the Disaster Management and Food Security Sector (DMFSS) took place towards proactive ex-ante disaster risk management.

The Food Security Coordination Bureau (FSCB) responds to fast-on set disasters or unpredictable events through safety nets program, other food security-related projects that attempted to enhance assets and livelihoods, and a voluntary resettlement program. Other institutions identified were as follows:

- Relief and Rehabilitation Commission (RRC)
- Disaster Prevention and Preparedness agency (DPPA)
- Disaster Prevention and Preparation Commission (DPPC)
- Productive Safety Net Program (PSNP)
- National Meteorological Services Agency (NMSA)
- Contingency planning and financing
- Ministry of Finance
- Ministry of Agriculture

- Office of the Prime Minister
- Ministry of Defense
- Ministry of Planning and Economic Development and External Economic Cooperation
- Emergency Food Security Reserve Administration
- National Disaster Prevention and Preparedness Fund
- National Early Warning Committee (replicated at the provincial, zone and ward levels)
- Crisis Management Group

The national office is replicated at the other levels and contains a similar membership composed of the following representatives:

- A chairperson designated by the government;
- Ministry of Finance;
- Ministry of Agriculture;
- The head of the regional affairs sector in the office of the Prime Minister;
- Ministry of Health;
- Ministry of Defense;
- Ministry of Planning and Economic Development and External Economic Cooperation.

Other members include the presidents of regional councils (or provincial, zone councils at subordinate levels) and the Disaster Prevention and Preparation Commission (DPPC). Other agencies drawn from donors and civil society are included on an ad hoc basis depending on the nature of the disaster. Four other government bodies are also associated with the work of the NDPPC at national level:

- Emergency Food Security Reserve Administration; National Disaster Prevention and Preparedness Fund;
- National Early Warning Committee (replicated at the provincial, zone and ward levels);
- Crisis Management Group (replicated at the provincial, zone and Woreda levels).

## **5.4 LIST OF INSTITUTIONS IN THE EASTERN NILE REGION DOWNSTREAM COUNTRIES (EGYPT AND SUDAN)**

### **5.4.1 Institutions in Egypt**

The institutions involved in mitigation of identified droughts are listed in Table 26:

**Table 26: Institutions involved in drought mitigation in Egypt**

Institution	Roles in Mitigating Drought	Contacts
Ministry of Agriculture and Land Reclamation, (MALR)	<p>Front role in combating desertification and environmental protection in general and in assessing, monitoring and rehabilitating the degraded land on particular. These responsibilities are explicitly or implicitly undertaken through many of the MALR affiliated administrations, authorities and research institutes. Among these;</p> <ul style="list-style-type: none"> <li>• Desert Research Center (DRC) DRC, is the focal point of UNCCD in Egypt. It is established in 1950 to undertake scientific and applied research for exploring, evaluating, and developing the natural resources in the Egyptian deserts. It is also concerned with studies of the desertification process and drought phenomena and their environmental consequences , and proper means for alleviating and preventing their hazards.</li> <li>• Agriculture Research Center (ARC) Which aims at establishment and conduct research extension and implementation programmes in order to increase the productivity of the different agricultural area. ARC has 16 research institutes, 10 central labs. and more than 50 experimental research stations.</li> <li>• The Executive Authority of Land Improvement Projects (EAIP) EAIP is vested with overall responsibility to implement land amelioration programs in Nile Delta and Valley. The applied ameliorating treatments include: land leveling by laser beam, and gypsum additions to prevent alkalization.</li> </ul>	Not available (NA)
State Ministry of Environmental Affairs (MSEA)	Studies, legislations, national strategy , national action plan, preparing programs of all projects related to the protection of environment. It is also responsible for preparing proposals, measures, action instructions that should be undertaken by the concerned authorities to ensure the protection and improvement of environment. MSEA embraces the Executive Environmental Affairs Agency (EEAA), Departments of Nature Conservation, Forestry and Administrative Affairs (EAA)	Climate Change Unit Dr. Ezzat Louis <a href="http://www.eeaa.gov.eg/ecc">http://www.eeaa.gov.eg/ecc</a>
Ministry of Water Resources and Irrigation (MWRI):	Irrigation and drainage water of the agricultural lands. Therefore, it is responsible for management and improvement of water resources utilization of River Nile and water protection from pollution, regulating the discharge of water, design, implementation and maintenance of drainage system as well as the re-use of drainage water. These responsibilities and tasks have an explicit relationship with desertification issues. The MWRI comprises of National Water Research Center (NWRC) which embrace research institutes, training center and many of other authorities and departments, including High Dam Authority, Planning and Follow Dept, Maintenance Dept. and Drainage Contractors... etc	NA
Ministry of High Education and Scientific Research, (MHESR)	Supporting scientific research and applying modern technologies in all fields of development. It is also responsible of formulation a national policy for scientific research and generating adopted technologies necessary for supporting the national development plan. The academy comprises 13 disciplinary Councils and four interdisciplinary division comprising eminent scientists so as to ensure proper linkage among the different disciplines and various sectors of production and services. Among the important Councils, are, i) the Food, Agriculture and Irrigation and, ii) Environment Res. Council, which are concerned with the preparation, formulation and execution of resort programmes for management and efficient use of natural resources as well as those related to the environmental protection	NA

Institution	Roles in Mitigating Drought	Contacts
National Research Center (NRC)	Undertakes basic and applied scientific research, particularly in the fields of agriculture industry, public health and most of the essential elements of the national economy. The center comprises 15 disciplinary research branches including agricultural and environmental research branch, which undertake studies on the effect of production practices on environment and propose the technologies for preserving the ecosystems and avoiding environmental hazards	NA
Remote Sensing Center (NSC)	Studies and application of modern space-technologies in preparing and follow-up the development projects in Egypt. It is also interested in detecting and monitoring many aspects of desertification, e.g., sand encroachment, plant cover and polluted areas	NA
Governmental and non-governmental Universities	undertake education, scientific studies and researches related to the desertification issues. They also participate and organize workshops, seminars and meetings for raising public awareness of these issues on the national, regional and international levels	NA
Non-governmental organizations	There are about 50 out of 2000 NGO`s in Egypt, interested in the environmental affairs, in general and desertification issues in particular. Among these are, the Egyptian Society for Environmental Science, Soil Science, Environmental Protection and Human Rights...etc. These societies can contribute to conferences, seminars and meetings to raise the public awareness and to support the private sector for joint implementation projects to combating desertification	NA

## 5.4.2 Sudan

The institutions which were involved mitigating identified droughts and their roles are shown in Table 27.

**Table 27: Institutions involved in drought mitigation in Sudan**

Institution	Roles in Mitigating Drought	Contacts
Dry Lands Section, Forestry Research Centre (FRC), Agricultural Research Corporation Agricultural Research Corporation (ARC)	Covers dry land in Darfur, Kordofan, Gedarif and Red Sea States, the section actively involved in National Adaptation Program of Action (NAPA) Activities, Agroforestry Farming system, and improving traditional framing system (western Sudan, Improving <i>Acacia Sengal</i> tree)	Soba-Khartoum, Sudan Tel: +249-122047407 or +249-917232979 <a href="http://www.arcsudan.sd/">http://www.arcsudan.sd/</a>
Dams implementation unit, Ministry of Electricity and Dams (DIU)	cover the whole country, involved in construction of water harvesting dams for agriculture and for domestic uses	P.O. Box 12843 Khartoum Tel: +249 83235719 or + 249 83230028 Fax: +24983235719 / +249183240001 Website: <a href="http://www.diu.gov.sd/">http://www.diu.gov.sd/</a> E-Mail: <a href="mailto:info@merowedam.com">info@merowedam.com</a>
Rain-fed Crops Research Centre for Arid and Semi-Arid areas (RCRCASA), Faculty of Agricultural Science, University of Gezira,	Cover central and eastern part of Sudan. Actively involved in plant breeding for producing drought tolerant varieties for sorghum, Millet and Sesame	P.O. Box 20, Wad Medani_Sudan
Practical Action Organization- Sudan	Covers three region; eastern Sudan (Kassala, Gedarif state); Western Sudan (North Darfur), and Blue Nile State	PO Box 4172 Khartoum Central Block No. 4 street 49, off PioYokwan Road Khartoum W Tel: +249 183 460 419, + 249 183 578 821 or + 249 183 578 827 Fax: +249 183 472002 Website: <a href="http://practicalaction.org/sudan">http://practicalaction.org/sudan</a> E-mail: <a href="mailto:sudan@practicalaction.org.sd">sudan@practicalaction.org.sd</a>
Water Management and Irrigation Institute (WMII)	Covers central and eastern part of the country, they are active in implementing research and development program of the eastern Sudan (Gash Delta	University of Gezira, P.O. Box 20 Wad Medani, Sudan; Phone/Fax: +249511 842810 Email: <a href="mailto:amadeeb@yahoo.com">amadeeb@yahoo.com</a>
Forestry National Cooperation	Covers the whole country	P. O. Box : 658, Khartoum Tel: +249 183 471575 Fax: +249 183 472659 <a href="http://www.fnc.gov.sd">http://www.fnc.gov.sd</a>



## 5.5 LIST OF INSTITUTIONS IN SOUTHERN AFRICA – SADC AND THE LIMPOPO BASIN

Table 28 lists institutions involved in mitigating droughts at the level of SADC based on review of available literature on past droughts:

**Table 28: List of institutions involved in implementing drought mitigation actions obtained from available literature - SADC**

Drought Period		Name of Institution	Spatial Coverage
From	To		
1981	1984	U.S. Agency for International Development	SADC
1987	1988	U.S. Agency for International Development, Food and Agriculture Organisation, World Food Programme	SADC
1991	1995	U.S. Agency for International Development, Red Cross, WHO, WFP	SADC
2002	2005	Famine Early Warning System Network, Red Cross	SADC

### 5.5.1 Botswana

The institutions involved in mitigating identified droughts are listed in Table 29:

**Table 29: List of Institutions in Botswana**

Institution	Responsibility	Contact details/Website
Department of Crop Production and Forestry	<ul style="list-style-type: none"> <li>crop production, horticulture, plant protection, land use planning, soil conservation, forestry, range ecology, beekeeping, and for providing technical extension services</li> </ul>	<a href="http://www.moa.gov.bw">www.moa.gov.bw</a> <ul style="list-style-type: none"> <li></li> </ul>
Department of Animal Health and Production	<ul style="list-style-type: none"> <li>Prevention and control of animal diseases, the operation of the National Veterinary Laboratory, and for providing extension and advisory services to farmers.</li> </ul>	<a href="http://www.moa.gov.bw">www.moa.gov.bw</a> <ul style="list-style-type: none"> <li></li> </ul>
Department of Integrated Agricultural Research	<ul style="list-style-type: none"> <li>Research focuses on the areas of crop and livestock improvement, sustainable utilization of range resources, soil and water management, optimizing utilization of locally available animal feed resources, crop pests and disease management, and pasture and forage crop improvement.</li> </ul>	<a href="http://www.moa.gov.bw">www.moa.gov.bw</a> <ul style="list-style-type: none"> <li></li> </ul>
Department of Cooperatives	<ul style="list-style-type: none"> <li>consist of producer cooperatives, consumer cooperatives, multipurpose cooperatives, marketing cooperatives, savings and credit cooperatives, and secondary cooperatives</li> </ul>	<a href="http://www.mti.gov.bw">www.mti.gov.bw</a> <ul style="list-style-type: none"> <li></li> </ul>
National Master Plan for Arable Agriculture and Dairy Development (NAMPADD)	<ul style="list-style-type: none"> <li>target active traditional and commercial farmers, and thus enable traditional farmers to transform to commercial farming and assist commercial farmers to upgrade their technologies and management levels;</li> <li>encourage more involvement of the private sector and civil society in both farming and the provision of supporting services - this will promote and facilitate smart partnerships between investors and landowners and among farmers themselves;</li> <li>promote the establishment of agro-industries such as cotton gins, agro processing plants and other enterprises such as transportation to service the agriculture industry and create additional employment opportunities in</li> <li>depart from the present welfare-oriented approach to a business approach to farming - instead of relying on grants and subsidies, farmers and other participating entrepreneurs will be encouraged to access finance from the Citizen Entrepreneurial Development Agency and other financial institutions;</li> <li>establish with private sector involvement a contributory insurance scheme to cover agricultural production losses in years and in specific regions declared as eligible for compensation (this is expected to be a confidence-building measure that will encourage investment in agriculture and improve access to credit);</li> <li>provide an enabling environment for agricultural production, including the development of infrastructure to and in production areas with high potential.</li> </ul>	<a href="http://www.moa.gov.bw">www.moa.gov.bw</a> <ul style="list-style-type: none"> <li></li> </ul>
Department of Meteorological Services Botswana	<ul style="list-style-type: none"> <li>monitors and analyses Botswana &amp; regional weather, providing weather forecasts, bulletins and an extensive range of meteorological and climatological data and reports.</li> </ul>	Dept. of Meteorological Services P.O. Box 10100 Gaborone, Botswana Tel. (+267) 395 6281 Fax (+267) 395 6282 E-mail: meteo@gov.bw <a href="http://www.botswanacraft.bw/~m">http://www.botswanacraft.bw/~m</a>

Institution	Responsibility	Contact details/Website
Botswana Water Affairs	National planning, assessment, development and protection of water resources, and distributing water to major villages	<p>ettest/index.html</p> <p>Private bag 0029, Gaborone  Tel: +267 3607 100  Fax: +267 3903 508  Email: dwa.enquires@gov.bw  http://www.water.gov.bw/aboutus.html</p>
Botswana Disaster Management Unit	<p>The major responsibility of the Office is to ensure a high state of disaster preparedness and capacity at national and district level and community to ensure effective, appropriate and timely response to any disaster strike. The National Disaster Management Office (NDMO) oversees activities of government sectors to ensure that all elements of disaster management are integrated into the National Development Plans.</p> <p>The NDMO coordinates with and through the National Committee on Disaster Management, the National Disaster Management Technical Committee and the District Disaster Management Committee</p>	<p>Contact Person: Ms Seadimano Oefile</p> <p>Private Bag 001, Gaborone  Phone: +267 395 0800  Phone: +267 3950910  Fax: +267 395 0858  Email: op.registry@gov.bw  Email: soefile@gov.bw</p>

### **5.5.2 Mozambique**

The institutions involved in mitigating identified droughts in Mozambique are listed in Table 30.

**Table 30: List of Institutions in Mozambique**

Institution	Responsibility	Contact details/Website
<p><b>National Institute for Disaster Management (INGC)</b> – (CCGC – Coordinator committee of disasters management, CTGC – Technical committee for disasters management)</p>	<p>Responsible for all issues related with mitigation of disasters in the country, with focus on natural disasters like cyclones, drought. Coordinates disaster management efforts with and receives support from public and private institutions. Conducts mitigation efforts (such as collection and analysis of data); Undertake preparedness measures (e.g. awareness campaigns); Coordinates disaster response (including distribution of food, tents, and other supplies)</p>	<p>Marta Manjate (coordinator) Address: Maputo Mozambique Telephone: +25801490222 Fax: +25801490222 Mobile: +258825929546 Email: <a href="mailto:martamanjate@yahoo.com">martamanjate@yahoo.com</a> <a href="http://www.ingc.gov.mz">http://www.ingc.gov.mz</a></p>
<p>National Meteorological Institute (INAM)</p>	<p>Weather monitoring throughout the country and responsible for early warning on imminent tropical storms or meteorological changes that potentially threaten the country.</p>	<p>Mr. Berino Francisco Silinto Address: Rua de Mucumbura Nr. 164 P.O.Box 256 Maputo Mozambique Phone: + 25821493193 Fax: +25821491150 Mobile: +258842263890 Email: <a href="mailto:berino_s@inam.gov.mz">berino_s@inam.gov.mz</a> <a href="http://www.inam.gov.mz">http://www.inam.gov.mz</a></p>
<p><b>Ministry for Coordination of Environmental Affairs (MICOA)</b> – (DNGA – National Directorate of Environmental Management)</p>	<p>Development of appropriate policies and laws that will ensure the sustainability of resource use. Coordinating and fulfillment the intersectorial view of correct use of natural resources (Implementation of the strategy and action plan for prevention Drought). Strategy and Mitigation Action Plan for Biodiversity Conservation in Mozambique under the Biodiversity Convention; Strategy and Action Plan for Preventing and Combating Soil Erosion Preparation of National Action Programme for Adaptation (NAPA) under United Nations Convention on Climate Change; Assessment of National Needs and Capacity; Self-assessment of overall management of the environment; Action Plan to Combat Drought and Desertification in the Framework of the United Nation together on combating drought and desertification and establishment of youth organizations aimed to conserve the environment</p>	<p>Mr. Custodio Mário - DNGA .Av Acordos de Lusaka No. 2115 Maputo - C.P. 2020 Mozambique Teephonel: + 258 21466495 Fax: + 258 21465849</p> <p>Mobile: +258828632120 Email: <a href="mailto:custodiomaphossa@yahoo.com.br">custodiomaphossa@yahoo.com.br</a></p>
<p>Ministry of Agriculture (MINAG)</p>	<p>Farmers awareness on possible occurrence of droughts and promotions of relief and mitigation actions.</p> <p>Acquisition and distribution of seeds (tolerant/resistant to drought), movement of animals from highly drought risk zones to better locations.</p>	<p>Mr. Eusébio M. Tumuitikile Praca dos Herois Mocambicanos Maputo- C.P. 1406 Mozambique Telephone: +250-21-49-1785; +258-21-46-0011 Fax: +258-21-49-9673; +258-21-46-0055</p>

Institution	Responsibility	Contact details/Website
		Mobilr: +2588206003 Email: <a href="mailto:muitikile@gmail.com">muitikile@gmail.com</a> <a href="http://www.minag.gov.mz">http://www.minag.gov.mz</a>
Ministry of Public Works and Housing (MOPH) – (DNA – National Directorate of Water)	Development and implementation of the water resources management plans and enforcement tools.  Management of the Water Sector in the country.	Av. Karl Marx 606, Maputo-C.P. 268 Mozambique Telephone: +258-21-430028 Fax: +258-21-421369 <a href="http://www.mop.gov.mz">www.mop.gov.mz</a>
Ministry of Transport and Communications (MTC)	NA	Av. Martires de Endereco Inhaminga.336- Maputo- C.P. 276, Mozambique Telephone: +258-21-430152/5 Fax: +258-21-431028/424109 <a href="http://www.mtc.gov.mz">http://www.mtc.gov.mz</a>
Red Cross Mozambique (CVM)	Assists vulnerable groups in collaboration with Government agencies (MINAG, MISAU and INGC), Implements, but prior to disaster, plans activities and focuses on promoting access to water and food; In post-disaster phases, supports the provision of health care The CVM is responsible to improve the living conditions of vulnerable populations; Preventing and alleviating human suffering wherever it exists; Mobilize the strength of a growing number of volunteers, particularly young people	Av. Agostinho neto 284 – Maputo Telephone:+258214977/490943/498139 Fax: + 25821497725 Email: <a href="mailto:cvm@redcross.org.mz">cvm@redcross.org.mz</a>
Technical Secretariat for Food Security and Nutrition (SETSAN)	Working group comprising professionals from various ministerial sectors, including nongovernmental organisations. Supports the establishment of food and nutritional security in the country.	Mrs: Francisca Cabral Av. das FPLM nº 2698 - Recinto do IIAM (Pavilhão novo), Maputo, Moçambique Telephone: (+258 - 21) 461874 – Fax: (+258 - 21) 462403 / 461850 Mobile: +258823943820 Email: <a href="mailto:fcabral@setsan.org.mz">fcabral@setsan.org.mz</a> <a href="http://www.setsan.org.mz">http://www.setsan.org.mz</a>
Famine Early Warning System Network FEWSNET	Improvement of the early warning system (droughts and floods); Support to contingency plans for response preparations to disasters; Improvement in use of information for disasters prevention. Improved early warning system; Improved access and use of integrated information notice to disaster risk reduction; Identification and correction of gaps in information on vulnerability and	FEWSNET Mozambique Maputo Av. das FPLM nº 2698 - Recinto do IIAM Tel : + 25821460588 Mozambique@fews.net <a href="http://www.fews.net">http://www.fews.net</a>

Institution	Responsibility	Contact details/Website
	disasters; Support for contingency plans for disaster preparedness and response and providing information and analysis of disaster with a view to an effective emergency planning strategies.	
World Food Programme (WFP)	Have interventions in provinces more vulnerable to droughts and floods: WFP activities are oriented to: <ul style="list-style-type: none"> <li>▪ Food distribution;</li> <li>▪ Provision of supplementary food to children with less than 5 years of age;</li> <li>▪ Food distribution in schools and;</li> <li>▪ Implementation of emergency programmes, including</li> <li>▪ Issues related to HIV/AIDS.</li> </ul>	Avenida do Zimbabwe, 1302 Maputo, Mozambique Tel:+258-21-482200 Fax:+258-21-491719 Email: <a href="mailto:WFP.Maputo@wfp.org">WFP.Maputo@wfp.org</a>
United Nations Development Programme - Mozambique (UNDP)	Involved mainly in the field of capacity building oriented to emergency situations associated to natural disasters (drought). Some of UNDP activities are: <ul style="list-style-type: none"> <li>• Preparation of a national plan for disasters and establishment of a support network through NGOs and local governments, for strengthening of community initiatives for disasters prevention;</li> <li>• Establishment of a fund for local and community support for mitigation of natural disasters;</li> <li>• Improvement of geographic and demographic information in risk areas.</li> </ul>	Mr. Gustavo Mahoque Mobile: +258 82 483 5680 Email: <a href="mailto:gustavo.mahoque@undp.org">gustavo.mahoque@undp.org</a> Av. Kenneth Kaunda, 931; P. O. Box 4595, Maputo Tel: +258 21 481 400 Fax: +258 21 491 691 E-mails: <a href="mailto:registry.mz@undp.org">registry.mz@undp.org</a> or <a href="mailto:undpmz@undp.org">undpmz@undp.org</a> or
United Nations Children's Fund – Mozambique (UNICEF)	Coordinates assistance on health care for children and teenagers. Through: <ul style="list-style-type: none"> <li>• Training provision to distrital and provincial directorates in matters related to planning, management and improvement of the health care services;</li> <li>• Establishment of a structure which enables community participation in health assistance; and</li> <li>• Dissemination of the appropriate approach about the necessary assistance to children and teenagers.</li> </ul>	Mr. Arild Drivdal Email: <a href="mailto:adrivdal@unicef.org">adrivdal@unicef.org</a> Tel: +258-21 481 121 1440, Zimbabwe Avenue P.O.Box 4713 Maputo – Mozambique Tel: +258-21 481 100 Fax: +258-21 491 679 Email: <a href="mailto:maputo@unicef.org">maputo@unicef.org</a> <a href="http://www.unicef.org">http://www.unicef.org</a>
Ministry of Health (MISAU)	Provides access to preventative and curative health services in drought and flood prone areas as well as relief assistance.	Mrs. Julaya Mussa (Técnico) Av. Eduardo Mondlane 1008 Maputo-C.P. 264 Mozambique Telephone: =258-1-427131/2/4 Mobile: 828526780 Email: <a href="mailto:juhamica@yahoo.com.br">juhamica@yahoo.com.br</a> <a href="http://www.misau.gov.mz">www.misau.gov.mz</a>

### **5.5.3 South Africa**

The institutions involved in mitigating identified droughts are listed in Table 31:



**Table 31: List of institutions in South Africa**

Institution	Responsibility	Contact details/Website
Department of Agriculture Limpopo Provincial Government	<ul style="list-style-type: none"> <li>• Agricultural risk management</li> <li>• Farmer settlement</li> <li>• Agricultural finance and cooperative development</li> <li>• Food security and rural development</li> <li>• Domestic marketing</li> <li>• International trade</li> <li>• Business and entrepreneurial development</li> <li>• Water use and irrigation development</li> <li>• Land use and soil management</li> <li>• Scientific research and development</li> <li>• Animal and aqua production</li> <li>• Plant production</li> <li>• Education and training</li> <li>• Agricultural information services</li> <li>• International relations</li> <li>• Land redistribution; land use planning; resource conservation; control of pests and noxious weeds; infrastructure; policy development; empowering small emerging farmers; agricultural statistics</li> <li>• Trade and industry; tourism; economic planning, research and policy</li> <li>• District health systems; social welfare programmes; poverty alleviation</li> </ul>	Ms N. Vutula Chief Director: Communication and Information Room K FF 10 012 319 7348 CDCI@daff.gov.za  Dr M. Visser Chief Director: Agricultural Production Room 234 012 319 6506 CDAP@daff.gov.za <a href="http://www.nda.agric.za/">http://www.nda.agric.za/</a> Dr P P PHEME, Private Bag X9487, Pietersburg 0700. Tel. (015) 295 7048/295 7090. Fax: 015-2913740. • E-mail: PHEMEPP@agrinfo.vorprov.gov.za
North West Provincial Government	Sustainable natural resource management	Ms Ingrid Coetzee Private Bag X2039, Mmabatho 2735. Tel. (018) 389 5688. Fax: (018) 389 5070. E-mail: malambo@nwpg.gov.za
Gauteng Provincial Government	Sustainable agriculture; household food security; farmer settlement and support; commercial farming; resource conservation and development	Dr Steven Cornelius P.O.Box 8769, Johannesburg 2000. Tel. (011) 355 1900. Fax: 011-3330667.

Institution	Responsibility	Contact details/Website
Agricultural Research Council	<ul style="list-style-type: none"> <li>• Research and technology exchange on all aspects of the cultivation of tropical and subtropical crops, potatoes, vegetables, hydroponic production, indigenous vegetables and indigenous flowers</li> <li>• Research and technology exchange on all aspects of the cultivation of grain and industrial crops (maize, sunflower, dry beans, sorghum, groundnut, soybeans, cowpeas, millets, lupins, bambara, cotton, tobacco, hemp, flax, sisal, kenaf and indigenous fibre crops). Included are: cultivar evaluation, plant breeding, improvement of crop quality, weed control, tillage, plant nutrition, water utilization, plant pathology, entomology and nematology.</li> </ul>	<ul style="list-style-type: none"> <li>• Dr. Mphekgo Maila Email: MailaM@arc.agric.za Tel: +27 (0)12 310 2501 Fax: +27 (0)12 323 1157</li> </ul>
Department of Water Affairs and Forestry	<p>Water resources planning and management; policy formulation; international projects; geohydrology; hydrology; catchment management; water conservation; water quality management; water utilization; Working for Water Sanitation management; commercial and community forestry; indigenous forests; water development (construction).</p>	<p>Dr Beason Mwaka Director Private Bag X313, PRETORIA, 0001 Sedibeng Building, 185 Schoeman Street, PRETORIA Tel: (012) 336 8733 Fax: (012) 336 7817 MwakaB@dwaf.gov.za www.dwaf.co.za</p>
Water Research Commission	<p>Sustainable water resource management; balancing the competing demands of domestic needs, agriculture, industry and the environment Sustainable utilization of the aquatic environment and biota Management of waste and other water-polluting products; integrated solutions Efficient use of water for production of food, fibre, fuelwood and timber; water efficient production technologies, models and information systems Knowledge-sharing and dissemination</p>	<p>Marumati Building c/o Frederika Street and 18th Avenue, Rietfontein, Pretoria Telephone: +27-12-330-0340 Fax: +27-12-331-2565 E-Mail: info@wrc.org.za http://www.wrc.org.za</p>
Department of Environmental Affairs and Tourism	<p>Systems of environmental monitoring and reporting; environmental management and planning; environmental education and capacity building; environmental legislation and implementation; environmental conflict management and conciliation; preventing and/or limiting pollution and environmental degradation Conservation of biodiversity; transfrontier conservation areas; protected areas.</p>	<p>Mr Albi Modise Private Bag X447 Pretoria 0001 Telephone: +27 12 310-3123 Fax: +27 12 322-2476 Mobile: +27 83 490 2871 Email:AModise@environment.gov.za</p>

Institution	Responsibility	Contact details/Website
Department of Land Affairs	Promoting equity for victims of dispossession by the State, particularly the landless and the rural poor; facilitating development initiatives by bringing together all stakeholders relevant to land claims; promoting reconciliation through the restitution process; contributing towards an equitable redistribution of land rights; farmer settlement; commonages; equity schemes; non-agricultural enterprises	<a href="http://www.environment.gov.za/">http://www.environment.gov.za/</a> Old Building, 84 cnr Jacob Mare and Paul Kruger streets, Pretoria Telephone:+27 12 312 8911 Fax:+27 12 312 8066 <a href="http://www.land.pwv.gov.za">www.land.pwv.gov.za</a>
Department of Health	Hospital services; disease prevention and control; non-personal health services; health and welfare Health information evaluation and research; medicines regulatory affairs; pharmaceutical services; district health systems; HIV/AIDS; maternal, child and women's health	Private Bag X828, PRETORIA, 0001 Street: Civitas Building, Cnr Andries and Struben Streets, PRETORIA Tel: (012) 395 9150 Fax: (012) 395 8422 E-mail: <a href="mailto:mqadin@health.gov.za">mqadin@health.gov.za</a> <a href="http://www.doh.gov.za">http://www.doh.gov.za</a>
Department of Education	Development and regulation of the higher education system	Mokhosi Joe Tel: (011) 8436694 Fax: (011) 355 5546 Email : <a href="mailto:Joe.Mokhosi@gauteng.gov.za">Joe.Mokhosi@gauteng.gov.za</a> <a href="http://www.education.qpg.gov.za">http://www.education.qpg.gov.za</a>
	Agricultural and environmental sciences; health sciences; computational and mathematical sciences; molecular and life sciences; physical and mineral sciences.	University of Limpopo Turfloop Campus P/B X1106 Sovenga 0727 Tel:+27 (0)15 268 9111 Fax:+27(0) 15 267 0152
	Natural and agricultural sciences; veterinary science; humanities; health	University of Pretoria, Private bag X20 Hatfield, Pretoria 0028  Tel+27 0 12 420-3111 Fax +27 0 12 420-4555 E-mailcsc@up.ac.za <a href="http://www.up.ac.za">www.up.ac.za</a>
	Geography and environmental studies; information science; agricultural management; animal health; horticulture; nature conservation; tourism management; water care	P O Box 392 UNISA 0003

Institution	Responsibility	Contact details/Website
National Disaster Management Framework (NDMF)		<a href="http://www.unisa.ac.za">http://www.unisa.ac.za</a> 87 Hamilton Street Arcadia Pretoria Senior Manager : Wiseman Mkhonza Tel : 012 334 0422 Fax : 012 334 0810 Email: wisemanM@ndmc.gov.za <a href="http://contacts.ndmc.gov.za/">http://contacts.ndmc.gov.za/</a>
Council for Scientific and Industrial Research (CSIR) - Natural Resources and the Environment		Dr Jean-marc Mwenge Kahinda PO Box 395 0001 Pretoria, South Africa Tel: +27 12 841-3105 Email: jmwengekahinda@csir.co.za <a href="http://www.csir.co.za/nre/water_resources/mwenge_kahinda.html">http://www.csir.co.za/nre/water_resources/mwenge_kahinda.html</a>
World Vision	World Vision identifies places at risk of disaster, prepares resources and staff in high-risk zones, and builds capacity and resilience among communities to help them protect themselves before an emergency and rebuild afterwards.	Email: stanley_maphosa@wvi.org P. Bag x 12 Florida 1710  5 Main Avenue, Florida: Gauteng- Johannesburg South Africa. Phone: +27116711300 \Direct Line: +27116711419 Fax: +27114724885 Fax to Email: <a href="http://www.worldvision.co.za">www.worldvision.co.za</a>
World Bank	The World Bank is a vital source of financial and technical assistance to developing countries around the world. Our mission is to fight poverty with passion and professionalism for lasting results and to help people help themselves and their environment by providing resources, sharing knowledge, building capacity and forging partnerships in the public and private sectors	442 Rodericks Street Lynnwood Road Tshwane 0081 South Africa Telephone: +27 12 742 3100 Fax number: +27 12 742 3134  <a href="http://web.worldbank.org">http://web.worldbank.org</a>
Food and Agriculture Organisation (FAO)	Achieving food security for all is at the heart of FAO's efforts - to make sure people have regular access to enough high-quality food to lead active, healthy lives. FAO's mandate is to raise levels of nutrition, improve agricultural	Viale delle Terme di Caracalla 00153 Rome, Italy Telephone: (+39) 06 57051 Fax: (+39) 06 570 53152

Institution	Responsibility	Contact details/Website
	productivity, better the lives of rural populations and contribute to the growth of the world economy	Email: <a href="mailto:FAO-HQ@fao.org">FAO-HQ@fao.org</a>  <a href="http://www.fao.org">http://www.fao.org</a>
World Food Programme (WFP)	WFP is the food aid arm of the United Nations system. Food aid is one of the many instruments that can help to promote food security, which is defined as access of all people at all times to the food needed for an active and healthy life. The policies governing the use of World Food Programme food aid must be oriented towards the objective of eradicating hunger and poverty. The ultimate objective of food aid should be the elimination of the need for food aid	1st Floor, Lilunga House, Somhlolo Road, Mbabane, Swaziland Fax: +268 - 2404 - 7880 Phone: +268 - 2404 - 4962/3 <a href="http://www.wfp.org">http://www.wfp.org</a>

#### **5.5.4 Zimbabwe**

The institutions involved in mitigating identified droughts are listed in Table 32.

**Table 32: List of Institutions in Zimbabwe**

Institution	Responsibility	Contact details/Website
FAO(Food and Agricultural Organization)	<ul style="list-style-type: none"> <li>Promoting activities and projects that foster food security for communities.</li> <li>Promotion of soil and water conservation.</li> </ul>	Block 1, Tendeseka Office Park, Corner Samora Machel and Renfrew Drive, Eastlea, Harare, Zimbabwe  <ul style="list-style-type: none"> <li>Phone: +263 4 252021-3</li> </ul>
Ministry of Agriculture, Mechanization and Irrigation Development	<ul style="list-style-type: none"> <li>Agricultural extension, land use planning, soil and water conservation.</li> <li>Irrigation rehabilitation and development.</li> <li>Soil and water conservation.</li> </ul>	No. 1 Borrowdale Road, Ngungunyana Building. Harare, Zimbabwe. <ul style="list-style-type: none"> <li>Tel:702015</li> </ul>
WORLD VISION	<ul style="list-style-type: none"> <li>To provide emergency relief to victims of disasters.</li> </ul>	<ul style="list-style-type: none"> <li>59 Joseph Road, off Nursery Road Marlborough East. Box 2420, Harare, Zimbabwe. Phone: +2634729467</li> </ul>
EMA(Environmental Management Agency)	<ul style="list-style-type: none"> <li>Provide for the sustainable management of natural resources and protection of the environment; the prevention of pollution and environmental degradation.</li> </ul>	Makombe Complex, Block 1, Harare St/H.Chitepo, Box CY385, Causeway, Harare, Zimbabwe. <ul style="list-style-type: none"> <li></li> </ul>
ZINWA-Mzingwane	<ul style="list-style-type: none"> <li>Water planning quasi-government agency advising Catchment Councils and Sub-catchment Councils. Management of the water permit system and the operationalization of water pricing systems, planning, coordination, management of water resources and the delivery of water</li> </ul>	Corner 10 <sup>th</sup> Av & Batsch Street, <ul style="list-style-type: none"> <li>Bulawayo, Zimbabwe.</li> </ul>
Ministry of Local Government ,Urban and Rural Development	<ul style="list-style-type: none"> <li>Coordination of stakeholders at involved in drought mitigation.</li> </ul>	Makombe Building, Bag 7706, Causeway, Harare, Zimbabwe. <ul style="list-style-type: none"> <li>Tel: +263 4 727906.</li> </ul>
Meteorological Services Department.	<ul style="list-style-type: none"> <li>Monitoring and interpretation of regional climate systems.</li> </ul>	<ul style="list-style-type: none"> <li>Corner Bishop Gaul &amp; Hudson, Box BE150 Belvedere, Harare, Zimbabwe.</li> </ul>
ZimVac	<ul style="list-style-type: none"> <li>Assessing vulnerability status of communities and recommending to the government the need for intervention.</li> </ul>	<ul style="list-style-type: none"> <li>1574 Alpes Road , Hatcliffe , Harare Telephone 263-4-860320/9</li> </ul>
Zimbabwe Regional Disaster Alleviation Trust (ZRDAT)	<ul style="list-style-type: none"> <li>To educate and alert the population of Zimbabwe to be prepared and take preventive measures against natural disasters and the damage they cause, in</li> </ul>	<ul style="list-style-type: none"> <li>Satcoy House, 125 Robert Mugabe Road, Harare, Zimbabwe. Telephone: +2634792728</li> </ul>

Institution	Responsibility	Contact details/Website
	order to avoid or minimise human suffering and environment devastation.	
World Food Programme.	<ul style="list-style-type: none"> <li>• Providing relief to drought victims.</li> </ul>	<ul style="list-style-type: none"> <li>• Takura Hs67-69 Corner Kwame Nkrumah Avenue and first Street, Box 4775.</li> </ul>
Civil Protection Unit.	<ul style="list-style-type: none"> <li>• Provide emergency relief to drought affected communities.</li> </ul>	P.Bag 7706 Causeway , Zimbabwe Phone: +263 4 727906 Fax: +263 4 703715 <ul style="list-style-type: none"> <li>• Email: eprzim@africaonline.co.zw</li> </ul>
Swedish Cooperative Centre	<ul style="list-style-type: none"> <li>• Promoting conservation agriculture and providing relief.</li> </ul>	70 Livingstone Avenue, 1 Verona Gardens Harare Zimbabwe Phone +263-4-795865/ <ul style="list-style-type: none"> <li>• 707494/737 492.</li> </ul>
ICRISAT(International Crops Research Institute for the Semi-Arid Tropics)	<ul style="list-style-type: none"> <li>• Crop research and plant breeding.</li> <li>• Development of soil and water conservation technologies.</li> </ul>	<ul style="list-style-type: none"> <li>• Matopos Research Station, PO Box 776, Bulawayo, Zimbabwe</li> </ul>
DDF(District Development Fund)	<ul style="list-style-type: none"> <li>• Provision of relief aid and development of water resources.</li> </ul>	<ul style="list-style-type: none"> <li>• Mukwati Building Harare. Tel: +263 4 793655</li> </ul>
Forestry Commission	<ul style="list-style-type: none"> <li>• Ensuring preservation of plant tree species.</li> </ul>	<ul style="list-style-type: none"> <li>• 1 Orange Groove Drive, Highlands, Harare, Zimbabwe</li> </ul>



NGOs tend to have specific areas where they undertake mitigation activities as illustrated in Figure 52.

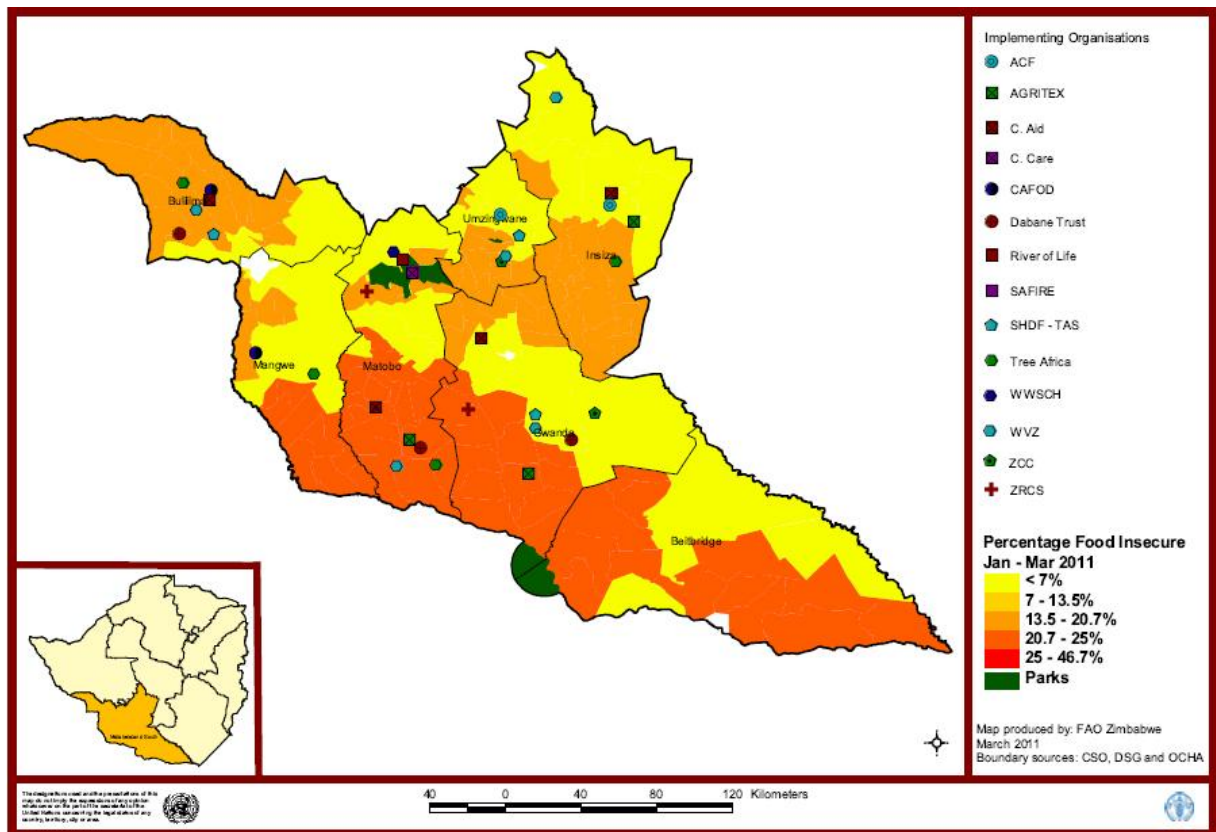


Figure 52: Current NGOs involved in drought mitigation in the project area.

## **5.6 LIST OF INSTITUTIONS IN WEST AFRICA – NIGER BASIN**

The institutions involved in mitigating identified droughts are listed in Table 33:

**Table 33: Institutions involved in drought mitigation in Mali-Niger Basin**

Institution	Responsibility	Contact details/Website
CILSS (Inter-State Committee for Drought Control in the Sahel );		03 BP 7049 OUGADOUGOU 03 (Burkina Faso) Tel : +226 50 37 41 25/26 - 50 49 96 00 - Fax : +226 50 37 41 32 Email : cilss.se@cilss.bf www.cilss.bf
AGRHYMET(Agro-hydro-Meteorology Center Centre agro-hydro-météorologique)		BP 11011 Niamey, NIGER. Tél (227) 20 31 53 16 / 20 31 54 36 Fax : (227)20 31 54 35 Email : admin@agrhyet.ne Site Web : www.agrhyet.ne
INSAH (Institut du Sahel		INSTITUT DU SAHEL BP 1530 Bamako, MALI. Tél : (223) 222 21 48 / 223 02 37 Fax : (223) 222 23 37 / 222 59 80 Email : dginsah@agrosoc.insah.ml www.insah.org
ICRISAT (International Crops Research Institute for the Semi Arid Tropics)		BP 320 Bamako, Mali Tel +223 223375, 227707 Fax 228683 icrisat-w-mali@cgiar.org
PRESAO (Prévision saisonnière des pluies et des écoulements en Afrique de l'Ouest);	consortium including the African Center for Meteorological Applications to Development (ACMAD), AGRHYMET and the Niger Basin Authority (NBA). PRESAO aims at building capacities in the area of seasonal climate forecasting	
HYCOS-AOC (West and Central Africa component of the World Hydrological Cycle Observation System)	Niger Basin Authority and the Agrhyet Center have been implementing the pilot phase of HYCOS-AOC which is the West and Central Africa component of th World Hydrological Cycle Observation System (WHYCOS) of the World Meteorological Organization	
FRIEND (Flow Regimes from International Experimental and Network Data );	promotion of scientific research related to the water cycle through the establishment of a network for researchers working in this field	

Institution	Responsibility	Contact details/Website
AIACC (Assessment of impacts and adaptations to climate change including projects on West Africa)	objective is to make climate change research advance in developing countries, with special emphasis on adaptation	
AMMA AMMA Programme (Multi-disciplinary Analysis of the African Monsoon and its impacts);	research programme which is being implemented by an international scientific community.	
IRD Mali (French Research Institute for Development )	research programme which is being implemented by an international scientific community.	www.mali.ird.fr BP 2528 Bamako Mali + 223 20-210 501 +22320-216 444
IER (Institute for Rural Economy )	research programme which is being implemented by an international scientific community.	Adresse:: BP 258 - Rue Mohamed V - Bamako - Mali. Email: info@ier. ml Tel: (223) 20 22 26 06 /20 23 19 05 Fax: (223)223775 URL: <a href="http://www.ier.ml/ier">http://www.ier.ml/ier</a>

## **6 INVENTORY OF INSTITUTIONAL FRAMEWORKS FOR DROUGHT MITIGATION**

### **6.1 NORTH AFRICA – ALGERIA, MOROCCO AND TUNISIA (MAGREHB REGION)**

#### **6.1.1 Tunisia**

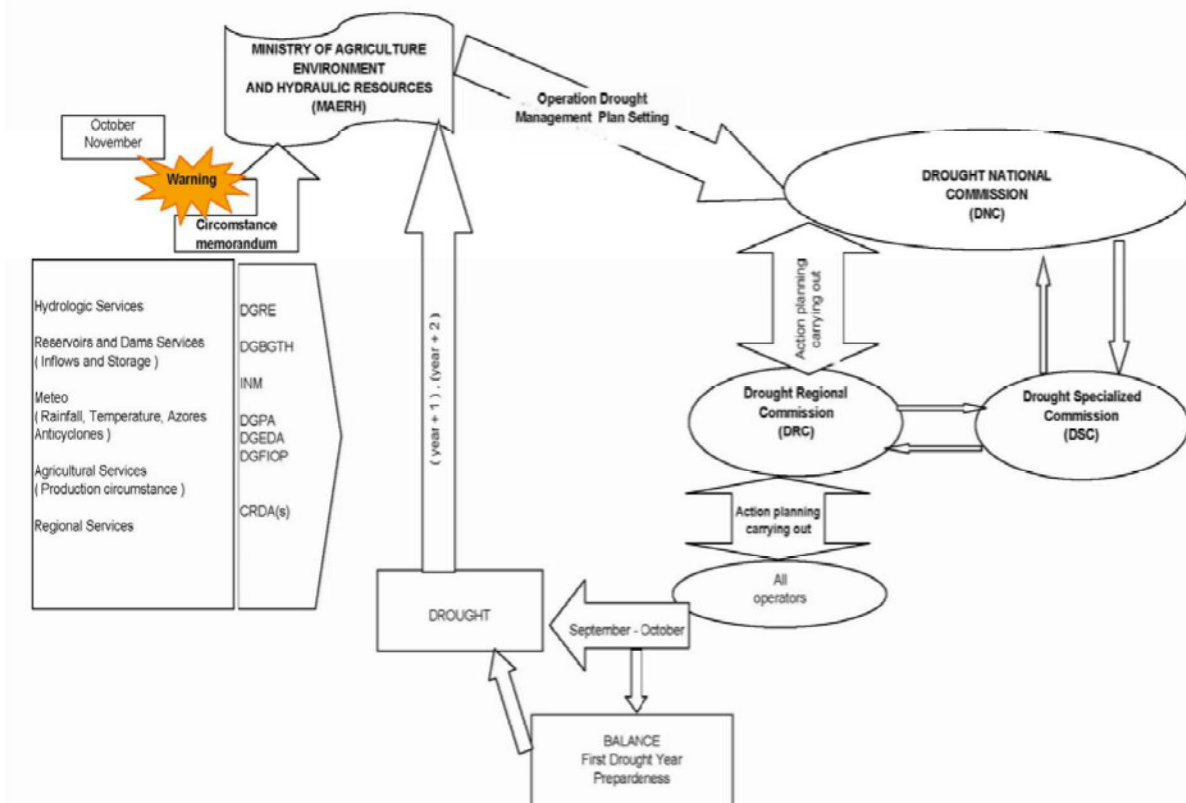
The drought management system in Tunisia is based on drought announcement and MAERH Minister decisions to cope with drought and the duties loaded to the National Commission, which is charged by the supervision of the execution of all the operation actions related to the 3 drought management phases: (i) before–drought preparedness; (ii) during–drought management; and (iii) after–subsequent drought management. This process has a strong collaboration of the regional and sectorial or specialized committees. The MAERH, promulgates several decisions related to the different drought committees and the operations programme for the drought mitigation instead of its crisis management. The Tunisian Central Bank (BCT, Banque Centrale de Tunisie), delivers a circumstance circular establishing easiness in the credits delivery for farmers. Special decisions are taken in order to exempt the importation from the custom duties.

In order to reduce the resulting effects of the drought in Tunisia, a related management system was developed and adopted for the drought events that occurred during 1987-1989 and 1993-1995.

The drought management system in Tunisia consists of 3 major successive steps as follows:

- Drought announcement: Referring to rainfall, hydrologic and agricultural indicators observed in the different regions affected by drought and transmitted by the agricultural, economic, and hydrologic districts (services) relevant to MAERH, a drought announcement is established by a circumstance memorandum.
- This announcement, qualified as a warning note, is transmitted to the MAERH Minister, who proposes a scheduled operations plan to the National Commission, which is composed by decision makers and beneficiaries.
- The National Commission is in charge of the supervision of the execution of all the operation actions, with strong collaboration of the regional and specialized committees. The National Commission also supervises all operations when the drought is over.

These steps are also illustrated in Figure 53.



**Figure 53: Drought preparedness and management in Tunisia (from Louati et al., 2007)**

In order to ensure an efficient drought management, three types of committees are established namely:

- the Drought National Commission (DNC)
- the Drought Regional Commissions (DRC) and
- the Drought Specialized Commissions (DSC)

a) The Drought National Commission (DNC)

The DNC includes representatives of MAERH and of ministries of Interior, Economic Development, Finances, Commerce, Transport, and Public Health. Its main missions are to: (i) to keep track of the drought circumstance; (ii) to elaborate the measures and provisions against the drought situation (intensity, duration, etc.); and (iii) to coordinate the execution of drought mitigation operation programs.

b) The Drought Regional Commissions (DRC)

For each one of the 24 Tunisian Governorates, there is a Drought Regional Commission (DRC). The members belong to the Regional Departments of all Ministries involved in drought mitigation. The UTAP is associated. The main task of DRCs is to present the

situation of the different sectors and inform the national authorities about the necessary measures for drought management if observed in their regions.

c) The Drought Specialized Commissions (DSC)

The drought Specialized Sectors Commissions (DSC(s)) are responsible for the preparation of the drought indicators observed in each field. They propose an operation planning and scenarios for mitigation of the different eventual drought events. The DSC(s) are as following:

- Water Resources Management Committee. This Committee regroups representatives of all departments involved in the water management in MAERH. The INM (relevant of Ministry of Transport) and the Ministries of Interior and Public Health are also associated in this committee. Referring to the data collected by the DRC, this committee has to analyse the water resources situations, to establish the drought indicators related to water resources and to elaborate diverse water management scenarios that should be adopted. The DSC submits a measures programme to the approbation and decision making by DNC.
- Livestock Safeguard Committee: Organizations and institutions not involved in water management but that are associated in drought mitigation, are represented in the Livestock Safeguard Committee. The latter is formed by representatives of organizations and institutions that are involved in the animal husbandry within MAERH. The UTAP is associated in the activities of this committee, and the Ministries of Commerce, Transport, Interior, Finances and Economic Development. In collaboration with the DRC, the committee identifies the forage stocks and reserves, analyses the fodder crop fields and fits the livestock health situation. Depending on the drought intensity, this committee has to elaborate an intervention programme and to establish the eventual importations needs in order to make up for the eventual forage deficit.
- Cereal Sector Management Committee: This committee is organized by the cereal sector intervening parties. Its members are representatives from different departments of the MAERH and also the Ministries of Finances and Economic Development. This committee has to quantify the cereal production stocks and seeds reserves, to propose a programme in order to promote the irrigated cereal production, to enhance the production collecting, with a principal preoccupation of satisfying the seeds demand for the next year. In the case of insufficiency in cereals, an importation programme is elaborated.

- **Arboriculture Sector Committee:** The members of this committee work in the arboriculture departments of MAERH and are concerned with the situation of all trees and aim the arboriculture heritage (patrimony) safeguard.

### **6.1.2 Algeria**

On the basis of very deep internet search, there was no information regarding how institutions involved in drought mitigation work together during drought episodes.

### **6.1.3 Morocco**

This section describes the overall model for drought management in terms of decision making, coordination and implementation processes (see Figure 54). Most ministerial departments dealing with water management including agriculture, water and environment, forestry, interior, health, energy and mines, and finance, are also concerned with drought management. Overall coordination of drought management issues is the responsibility of the Permanent Interministerial Council for Rural Development (PICRD), which is headed by the Prime Minister and has ability to officially declare the onset of drought. The technical secretariat of this Council is under Ministry of Agriculture and Rural Development, which heads the weekly meetings of the Interministerial Technical Commission once a drought episode is declared. Figure 55 to Figure 57 present how institutions work together during meteorological, hydrological and agricultural droughts (Ouassou et al., 2007)



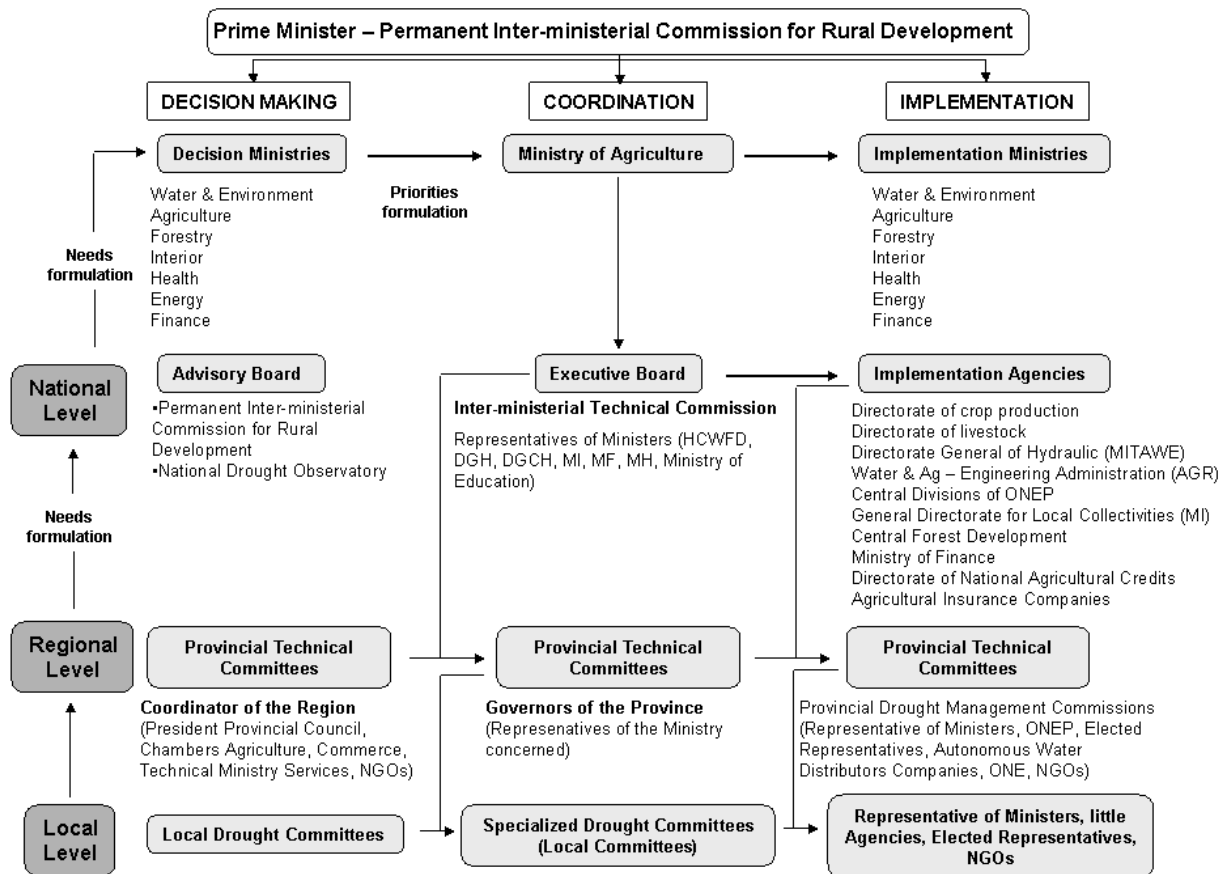


Figure 54: Drought management in Morocco (Ouassou et al, 2007)

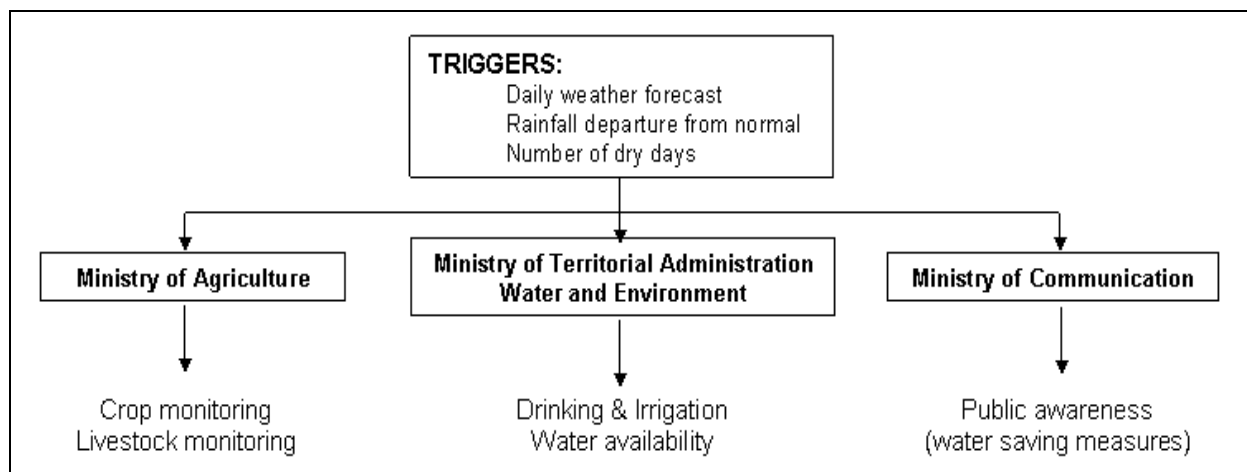
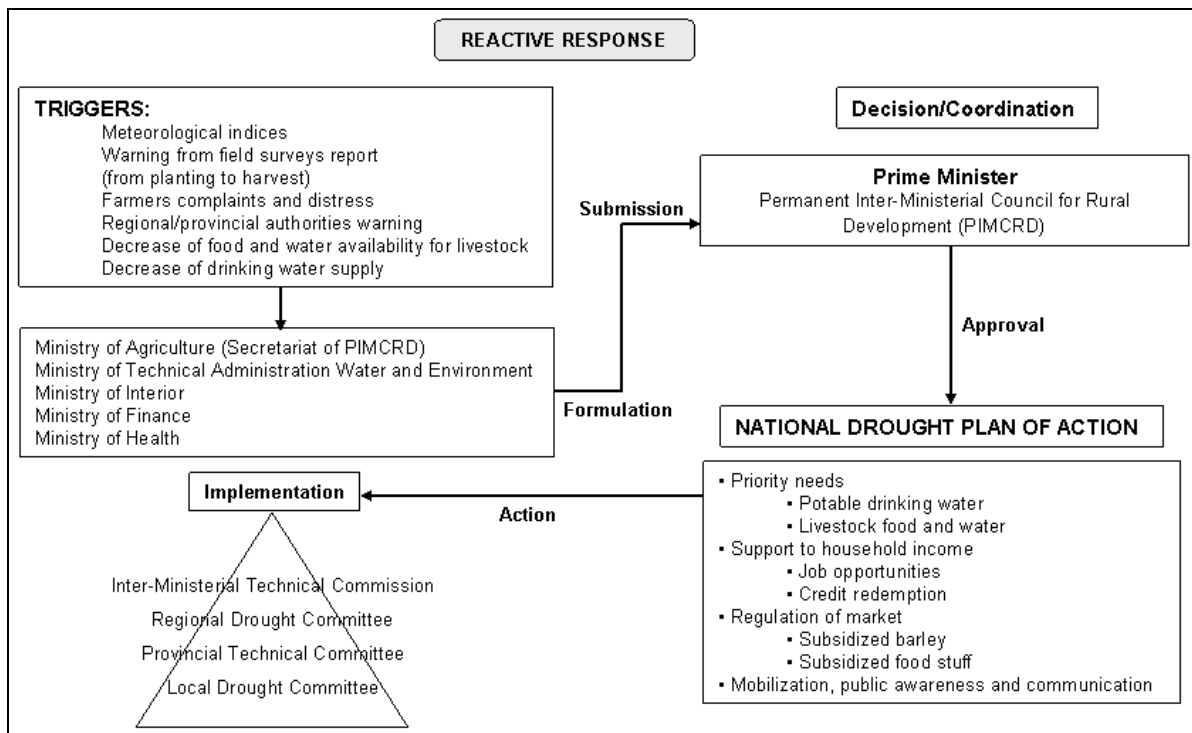
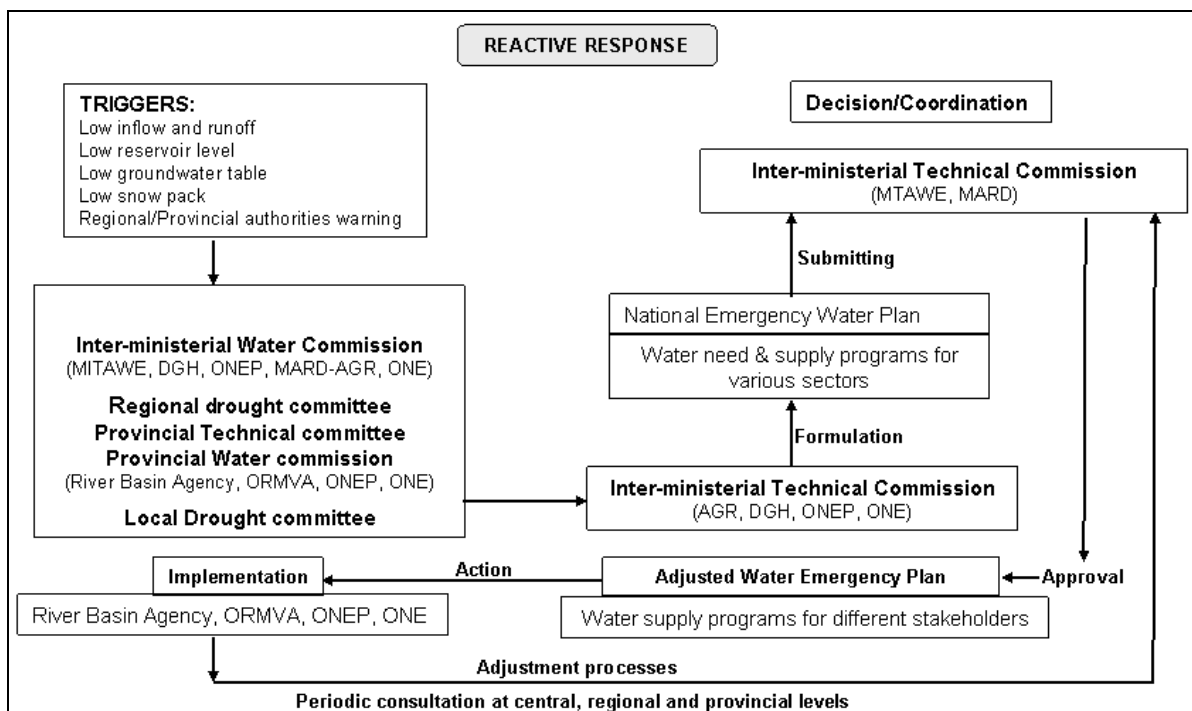


Figure 55: Meteorological drought in Morocco (Ouassou et al, 2007)



**Figure 56: Agricultural drought in Morocco (Ouassou et al, 2007)**



**Figure 57: Hydrological drought in Morocco (Ouassou et al, 2007)**

In addition to the political board represented by the Permanent Interministerial Council for Rural Development the other members of the **National Advisory Board** on drought are the National Drought Observatory, the National Meteorology Office, the Superior Council for Water and Climate and the National Environment Council. The first two structures have

advisory role to their respective ministry on a continuous basis while the last two others have much less frequent consultative role on drought issues.

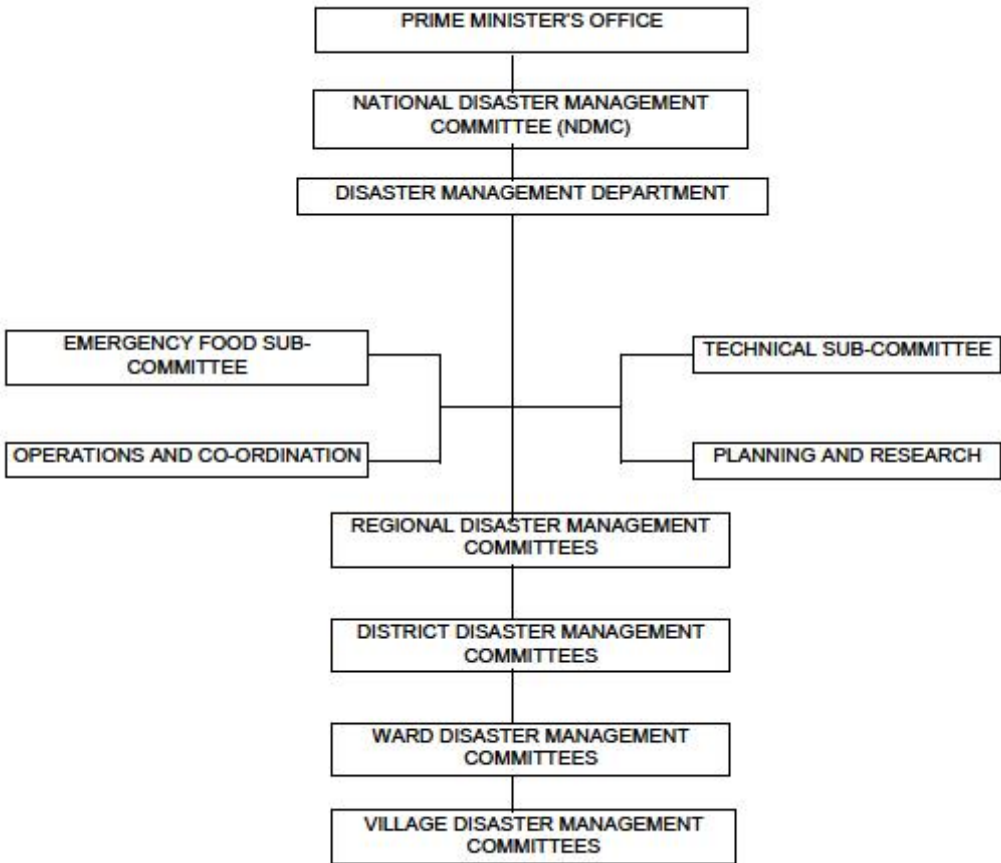
The Interministerial Technical Commission (ITC) is the basis of the **National Executive Board**. It includes ministry representatives of Agriculture (MADR), Forestry (HCFWFD), Water (DGH, ONEP), Energy (ONE), Interior (MI), Health (MH), Finance and Credits (MF, CNCA). The ITC meets weekly to report to the Permanent Inter-Ministerial Council for Rural Development, which, based on the Commission report and the information provided by the advisory bodies, may or may not declare drought and drought affected regions. If drought is declared nationwide, then the National Drought Mitigation Plan is set for execution. This is basically the reactive relief dimension of the plan that has to be implemented and supervised at the national, regional / provincial and local levels.

The **Regional Drought Committee** is headed by the Wali of the Economic Region, who normally supervises more than one province in the Region while the Province is headed by a Governor. The regional drought committee is responsible for all decisions pertaining to the national drought mitigation plan related measures and actions to be implemented in the region. This committee includes representatives of key ministries (ONEP, ORMVA, DPA) and elected members of the rural and urban collectivities of the region, in addition to active NGO's operating in the region. The coordinating role and the composition of the **Provincial Technical Committee** at the province level are similar to those of the regional drought committee at the region level. At the local level, a number of **Local Drought Committees / Specialized Drought Committees** representing ministry line agencies and NGO's are responsible for detailed examination of the content of the proposed measures in order to match the needs of the local drought affected population, livestock and environment. At the different levels of implementation of the national drought mitigation plan, political pressure groups and elected members of the local communities become actively involved.

**6.2 EQUATORIAL LAKES REGION (BURUNDI, KENYA, TANZANIA, RWANDA)**

**6.2.1 Tanzania**

A formal structure exists nationally for disaster preparedness, response and recovery management (see Figure 58). The central decision making body of executive government that address disaster management is National Disaster Relief Committee (TANDREC). TANDREC is chaired by the Permanent Secretary of Prime Minister’s Office. TANDREC has been in operation since 1990 when the law was enacted. The committee is composed of Permanent Secretaries from Ministries together with heads of early warning institutions namely: Tanzania Meteorological Agency (TMA), Food Security Department, and Fire and Rescue Department. Its main function is to oversee and coordinate activities of the government designed to secure effective prevention of disasters, preparedness and operational affairs in an event of disaster.



**Figure 58: Current Disaster Management Structure (Amani and Standen, 2004)**

The functions of the DMD are set up in the Disaster Management Act No 9 (1990). Paraphrased in an action form for the purpose of guidelines, these functions for emergency situations are (Amani and Standen, 2004):

- Assume a coordination role for disaster response upon the government's declaration of a state of disaster-induced emergency until the national crisis ends;
- Set up the provision of early warning predictions and other information required, and consult widely and prepare an appeal for donor assistance;
- Implement the appropriate national disaster relief plan to meet current emergency requirements, assisting to mobilize the strategic reserves, other internal resources and external assistance;
- Assist with the establishment of a national disaster relief budget to meet the requirements of the current emergency, to manage the budget, and to allocate funds for emergency disaster relief program;
- Coordinate the implementation of a national reconstruction and rehabilitation plan during the current emergency, thus ensuring the country's full post-disaster recovery, and to assist with the funded plan's integration within government's mainstream national development plan; and
- Review and evaluate the response to the emergency, recording lessons learnt, conclusions drawn and recommendations made in the national post-disaster review report.

The initial composition of FSIT is presented in Table 34.

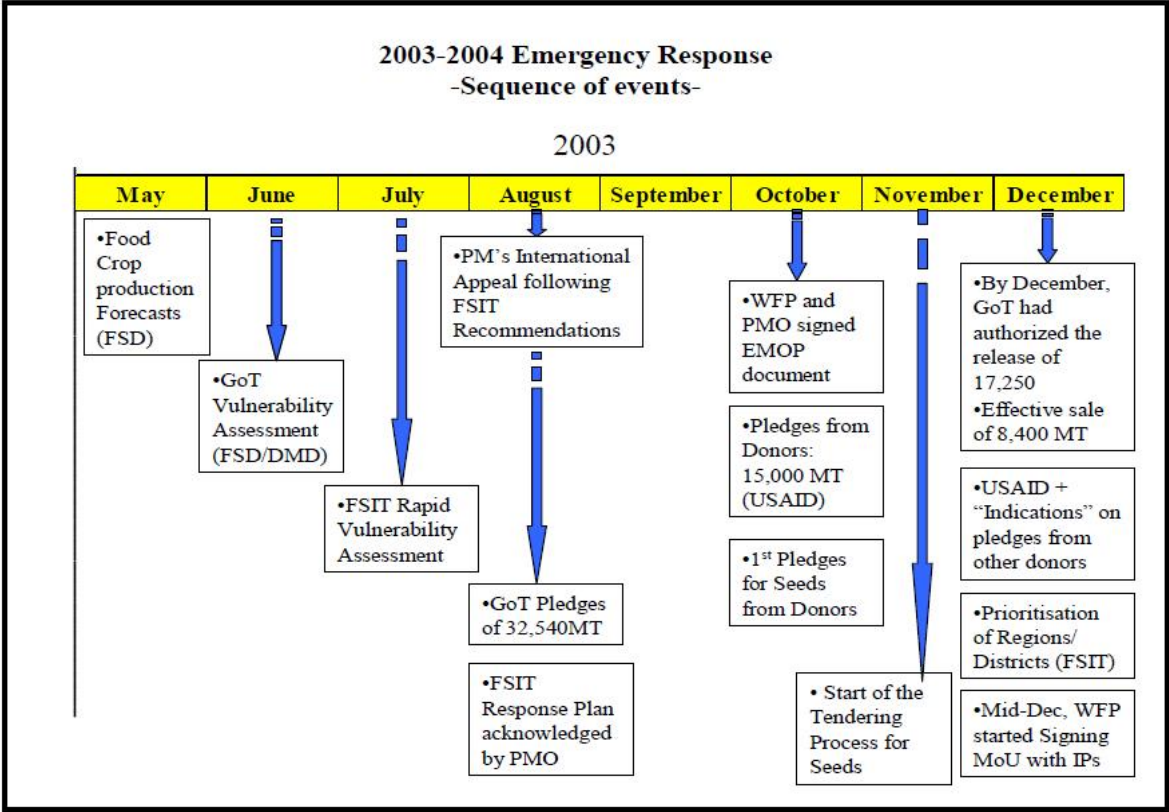
**Table 34: The initial composition of the FSIT**

Institutions	Specific Organization / Department
Government of Tanzania	Disaster Management Department (DMD), Prime Minister's Office (PMO)
	Food Security Department (FSD), Ministry of Agriculture, Food Security and Cooperatives (MAFC)
	National Bureau of Statistics (NBS), Planning Commission – Office of the President
	Tanzania Food and Nutrition Center (TFNC), Ministry of Health
	Tanzania Meteorological Agency (TMA), Ministry of Infrastructure Development
	Regional Coordination Department (Ministry of Regional Administration & Local Government)
International Agencies	DFID
	EU
	FAO
	UNICEF
	USAID/FEWS
	WFP/VAM
NGOs	CARITAS
	NPA
	OXFAM-GB
	Save the Children (SC-UK)
	Rural Food Security Team (IDS)

Organization and interaction of institutions in mitigating the 2003-2004 droughts

An operational plan was developed jointly by WFP and PMO-DMD (Figure 59). In order to secure the required quantity of maize for the first phase of the operation, WFP planned to use in country stocks borrowed from other projects, and use cash donations to purchase maize locally. However, WFP was unable to effect local purchases of food, as previously

planned, reportedly due to high local prices. The second phase of the operation, January to March 2004, was targeted to the unimodal rainfall areas, WFP planning to source food assistance for this part of the operation through a combination of international/ local purchases, and in-kind donor contributions (Amani and Standen, 2004).

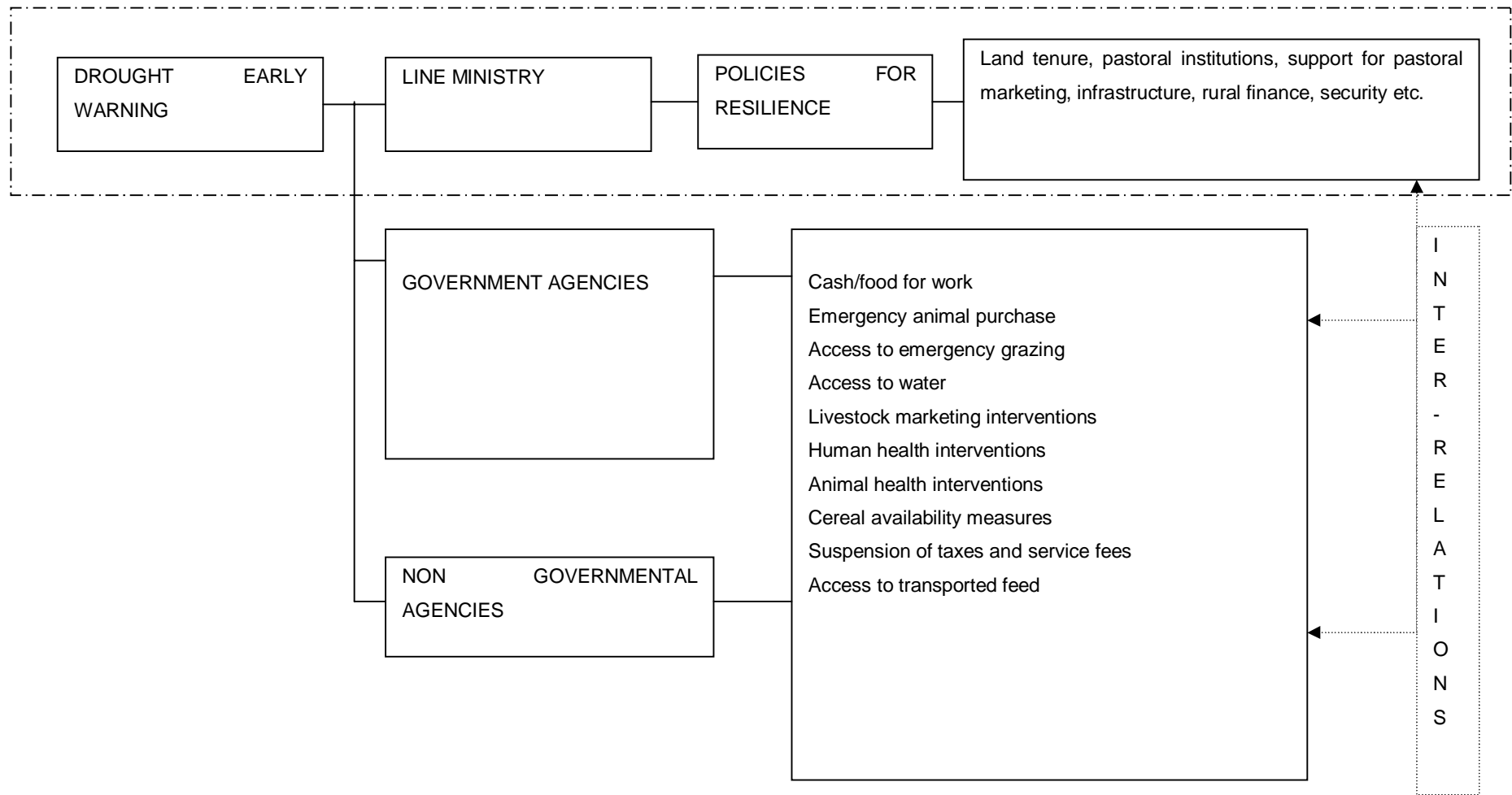


**Figure 59: Sequence of events and institutions interactions during May to December 2003**

Source: Amani and Standen, 2004

**6.2.2 Kenya**

Despite the recurrence of drought s and their devastating effects in the country, Kenya has yet to put its national disaster management plan/policy into operation. The early drought were coordinated by emergency inter-ministerial committees coordinated by the office of the president. A basic model of the drought management framework is presented in Figure 60.



**Figure 60: Components of Drought Management**

### **6.2.3 Rwanda**

In Rwanda, the involved institutions collaborate between each other and with local people. People are involved either in work (manpower), or in direct assistance (food, seeds, fertilizers, infrastructures, etc). In many cases, they are also trained in order to build their capacity for the follow up and ownership spirit in order to ensure the sustainability of the taken measures and infrastructures established. Other institutions intervene in monitoring and their data can be used by other institution. In this regard, we can mention Rwanda Meteorological Service for meteorological data monitoring; MINAGRI and Ministry of Health, which introduced additional agro-climato-meteorological stations for monitoring and preparedness. We can also mention the USAID (United State Agency for International Development), which monitors food security/insecurity through the Famine Early Warning System Network (FEWSNET). Other institutions intervene for funding like the World Bank who is funding the project on Land Husbandry, Water Harvesting and Hillside Irrigation (LWH), African Development Bank, local banks, which support various initiatives, etc.

Research Institutions have been also intervening in terms of research on alternative sources of energy in order to preserve forests and avoid desertification. These research institutions include the Institute of Scientific and Technological Research (IRST), National University of Rwanda (NUR), Kigali Institute of Science and Technology (KIST), etc.

### **6.2.4 Burundi**

In Burundi the framework for mitigation is different between the different institutions as below:

For the Department of Forests, the mitigation actions are implemented as follows:

- Adoption of National forestry Programmes such as reforestation, agro-forestry... in order to reduce the Carbone emission...);
- Adoption of national Projects on capacity building in the sustainable management of lands;
- Forest community management.

For the Department of Environment, the mitigation actions are implemented as follows:

- Contribution in the national capacity building for better implementation of the environmental protection and preservation;
- Contribution in the evaluation of actual GHG emissions in comparison of the baseline situation in order to know how far in term of percentage we can protect or preserve the environment;
- Contribution in searching of fund to produce report related on climate change mitigation actions measures,



- Contribution in the preparation of projects related on reduction of GHG emissions.

For the National Institution of Environment and Natural Conservation (INECN), the mitigation actions are implemented as follows:

- To ensure the safeguard of the environment and the nature conservation;
- Baseline control of the environment;
- To make respect of the environmental standards to fight against pollution of any kind by an administrative and legal monitoring;
- Creation, installation and management of the national parks and natural reserves to ensure sustainability and the exploitation of it for tourist issues;
- To undertake and encourage research and accompanying measures for the maintenance of biological diversity;
- To contribute to the promotion of environmental education in collaboration with the organizations and institutions concerned.

For the Geographic Institute of Burundi the mitigation actions are implemented as follows:

- Coordination of all activities related on mitigation as focal point institution on Climate change to ensure that the synergy between involved institutions is implemented.

Those institutions should interact with communities by Public involvement and participation in the implementation of actions presented within the mitigation plan. The public may be involved through:

- locally organized community meetings;
- Newspaper article updates;
- Local news and other media relations;
- Written document reviews and other ways deemed appropriate by planning personnel.

When the plan is completed and implementation started, the public may benefit from regular updates and opportunities to learn about the progress made with regard to the implementation of mitigation actions outlined within the plan. By keeping the public involved throughout the entire process, it will ideally foster a sense of ownership and community, hereby resulting with public support of future needed actions. Those institutions should also interact with communities by educating and informing them about the “ongoing activities” and progress made with the implementation of the plans proposed recommendations and mitigation strategies.

### **6.2.5 Eastern Nile Region (Ethiopian Plateau)**

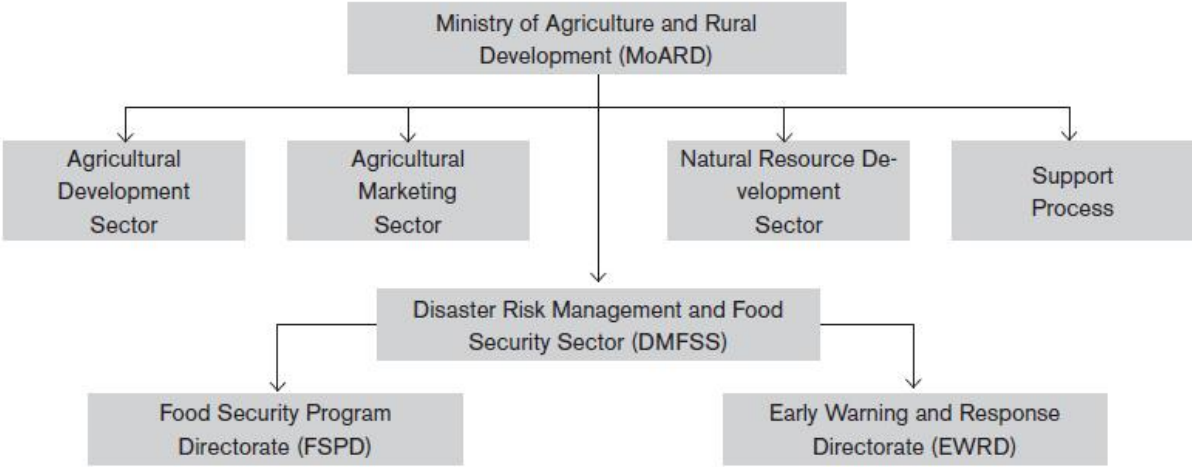
In 2005-2006 drought affected an estimated 1.7 million pastoralists and agro-pastoralists in southeastern Ethiopia (OCHA, 2006). The worst affected areas in pastoral regions were Afder and Liben zones and parts of Gode zone in Somali Region and southeastern parts of Oromiya Region (OCHA, 2006). The drought response in most pastoral areas was largely late and less effective than it might have been. The default emergency intervention was food relief and livelihoods protection and emergency livelihoods interventions were limited. Response to drought situation in Ethiopia was as follows:

- The 4th Borena zone emergency coordination meeting was held in the zonal's capital city of Yabello on 6th of March 2008. WHO was represented by Dr. AmanuGisso, a National Consultant;
- Many assessments were conducted by the Regional government to identify the requirements within specific sectors;
- The regional disaster prevention and preparedness bureau (DPPB) distributed 621 MT of hay for 5,920 heads of cattle in Moyale and Miyo districts;
- CARE using fund from ECHO has provided 80 MT and 2.5 MT of local produced the rapeutic food to Moyale district. In addition CARE distributed 900 MT of hay and concentrated animal feeds for 9,200 heads of livestock in Dhas, Dire Miyo and Moyale districts;
- World Vision is implementing an emergency livestock programme in Borena Zone;
- To date of weekly report, (10-16 March 2008) 1227 out of 58,000 animals in need received feeds in 19 selected sites. Save the Children US is currently feeding 3,000 cattle in two districts since February 2008;
- The Liben Pastoral Development Association is undertaking one month water tankering intervention in the Liben district of guji Zone, which will phase out shortly;
- Currently Danish Church Aid is ensuring water supply to 2,700 households in Borena Zone;
- Norwegian Church Aid supports water supply in Liben district of Guji Zone;
- Oxfam USA is undertaking water tinkering programme in Dhas and Dilo districts;
- GOAL has deployed 2 truck to Dhas district to facilitate water tankering activities;
- So far 103,355 out of 165,492 people in need benefited from water supply at the rate of only 0.4 to 1.4 litres per person and per day. Drugs and medical supplies provided to the RHB last December by WHO is being allocated to the zone;
- Finalization of agreement between UNOCHA and WHO in order to release USD 700,000.00 to undertake measles vaccination campaign in Guji and Borena zones is in progress.

Merlin has been working in Ethiopia since 2003, improving health care for vulnerable people in some of the most under-served areas of the country. Currently more than 100 Merlin health and support staff work in coordination with the Ethiopian Ministry of Health in nine districts of two regions, all of which are heavily affected by poverty, drought and internal conflict. Merlin provided immunisation programmes through outreach and mobile clinics in Oromiya Region, vaccinating 8,088 children between December 2007 and March 2008. A program for children under 5 years old in Somali Region will be implemented with a similar full vaccination. It will also provide information on pre-natal care, malaria, tuberculosis, and common childhood illnesses. 39,566 people benefited from these health promotion sessions in Oromiya Region between December 2007 and March 2008.

**6.2.5.1 The institutional framework for drought management in Ethiopia**

There is a Task Force on DRM, led by DMFSS, that is supposed to bring together all of the Ministries that deal with DRM at the sectoral level: Additional ministries and agencies with relevance to DRM include the Ministry of Federal Affairs, Ministry of Transport and Communication, Ministry of Works and Urban Development, Ministry of National Defense, Ministry of Mines and Energy, and Environmental Protection Authority Ministry of Water Resources, Ministry of Health, Ministry of Agriculture and Rural Development, Ministry of Environment, and NMA. This forum and other similar working groups and platforms, including the Early Warning Working Group (EWWG), Rural Economic Development – Food Security (RED-FS) Group, and the Sustainable Land Management (SLM) national platform, need to be better coordinated and integrated, with the clear establishment of roles and responsibilities. However, during and immediately after the BPR, this Taskforce has not been functioning. It is important to re-establish a functioning Taskforce on DRM to help finalize the new DRM Policy and to help lead the process for developing a detailed operational strategy and implementation plan. This framework is illustrated in Figure 61.



**Figure 61: Institutional framework for disaster management**

## 6.3 EASTERN NILE REGION DOWNSTREAM COUNTRIES (EGYPT AND SUDAN)

### 6.3.1 Institutional frameworks in Egypt

In 2002, EEAA formulated a vision for EEAA, which included economic and social aspects in sustainable development. EEAA formulated the first National Egyptian Action Plan NEAP. A Climate Change Unit was established to be a focal point. In 1985 Ministry of water resources and Irrigation has implemented the planning sector for Nile forecasting and High Aswan Dam Operations. The forecasting center activities expanded and now it was developing a regional climate model supported by UK MetOffice. In 1994 the national water Research center was established, a research institute focusing on environmental and climate changes issue and its relevance to the water resources.

Most of the previous sectors and ministries are mentioned and are coordinating with the other sectors. The institutional framework is presented in Figure 62:

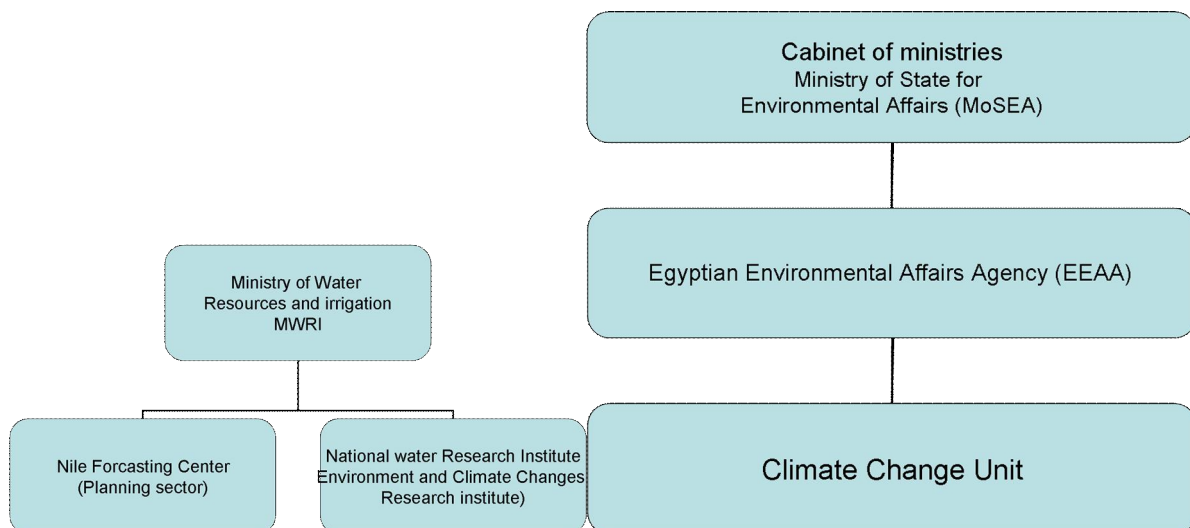


Figure 62: Institutional framework for drought management

### 6.3.2 Sudan

Different institutes implement many actions that can be summarized in the following points

- Provide technical packages for the farmers and local communities (such as best crop varieties, land preparation, planting methods, and fertilizer application);
- Increase productivity and production by introducing water harvesting techniques (Terracing) and increase rain water use efficiency;
- Distribute necessary tools and equipments;
- Training of local communities and farmers on mitigation measures;
- Improve crop diversity through awareness-raising;
- Community seed saving;

- Construction of grain storage;
- Establishment of seedling nurseries;
- Identify communities most affected by drought;
- Provide access to research finding to the policy makers and communities leaders;
- Tree Planting;
- Around 130,000 seedlings were produced and distributed during 2007 by practical action organization in Sudan;
- Village Development Committees and Animal Loan Committees were set up selected community in North Darfur, to build their managerial, organizational and technical capacities;
- Building small scale water harvesting dams and terraces;
- Support regeneration of vegetative cover;
- Improve pasture through supporting establish trees nurseries;
- Community Forest and Agroforestry Farming.

## **6.4 SOUTHERN AFRICA – SADC AND THE LIMPOPO BASIN**

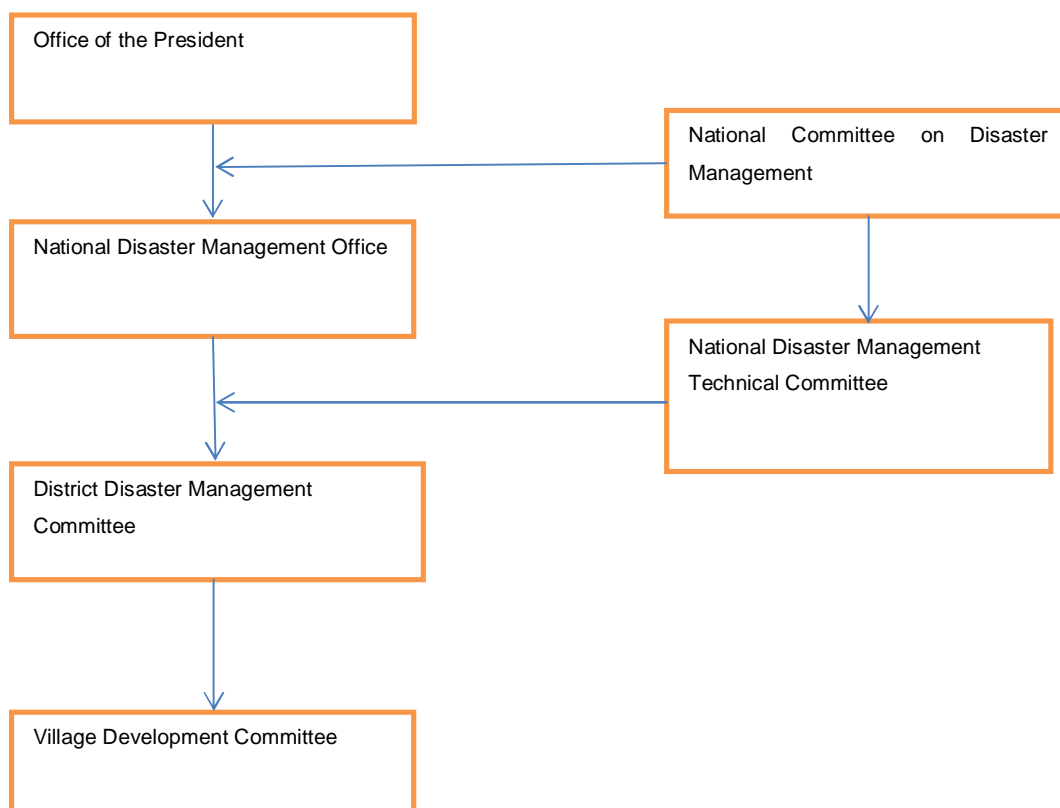
### **6.4.1 Botswana**

The machinery of local government in Botswana reflects a long tradition of democratic consultation and devolved decision-making, and plays a crucial role in development processes, particularly in rural areas. There are four different types of local authorities as follows:

- District and urban councils have stipulated functions by law and their responsibilities include provision of primary education, primary health care, tertiary and access roads and water supplies, as well as related issues such as sanitation, social and community development, the administration of self-help housing agencies, municipal abattoirs and markets.
- Tribal administration is composed of chiefs, subchiefs, headmen, administrative staff and the local police force. Apart from holding office in the traditional house of chiefs, the chiefs preside over customary courts that handle 85 percent of criminal cases and 90 percent of civil cases in Botswana. There are 361 customary courts and 2 courts of appeal. Chiefs also take care of the kgotla, an important traditional meeting place where cases are tried, information disseminated on government policies, and where public participation is encouraged. Elections to the village development committees are held at the kgotla every two years, and these committees coordinate development activities within districts.

- Tribal land boards, of which there are 11, have statutory powers to allocate tribal land for residential, commercial, industrial, arable and grazing use. Some 50 percent of the land board members are elected, the remaining members being appointed by the Minister of Local Government, Lands and Housing. The land boards, which may grant customary and common law land rights in accordance with the Tribal Land Act, hold tribal land in trust. They can also cancel land use rights and impose restrictions on land use.
- District administration in Botswana is divided into 10 administrative districts and 15 subdistricts, with 9 district councils. The larger districts are divided into subdistricts for ease of administration. A district commissioner coordinates the range of development activities carried out at district level by central government, local authorities and other agencies. The district commissioner chairs the district development committee, which is an advisory body that addresses development issues that affect the district. It is made up of senior representatives of central government, the district council, the land board, the tribal administration, parastatal and other government development agencies at the tribal level.

The institutional framework is illustrated in Figure 63.



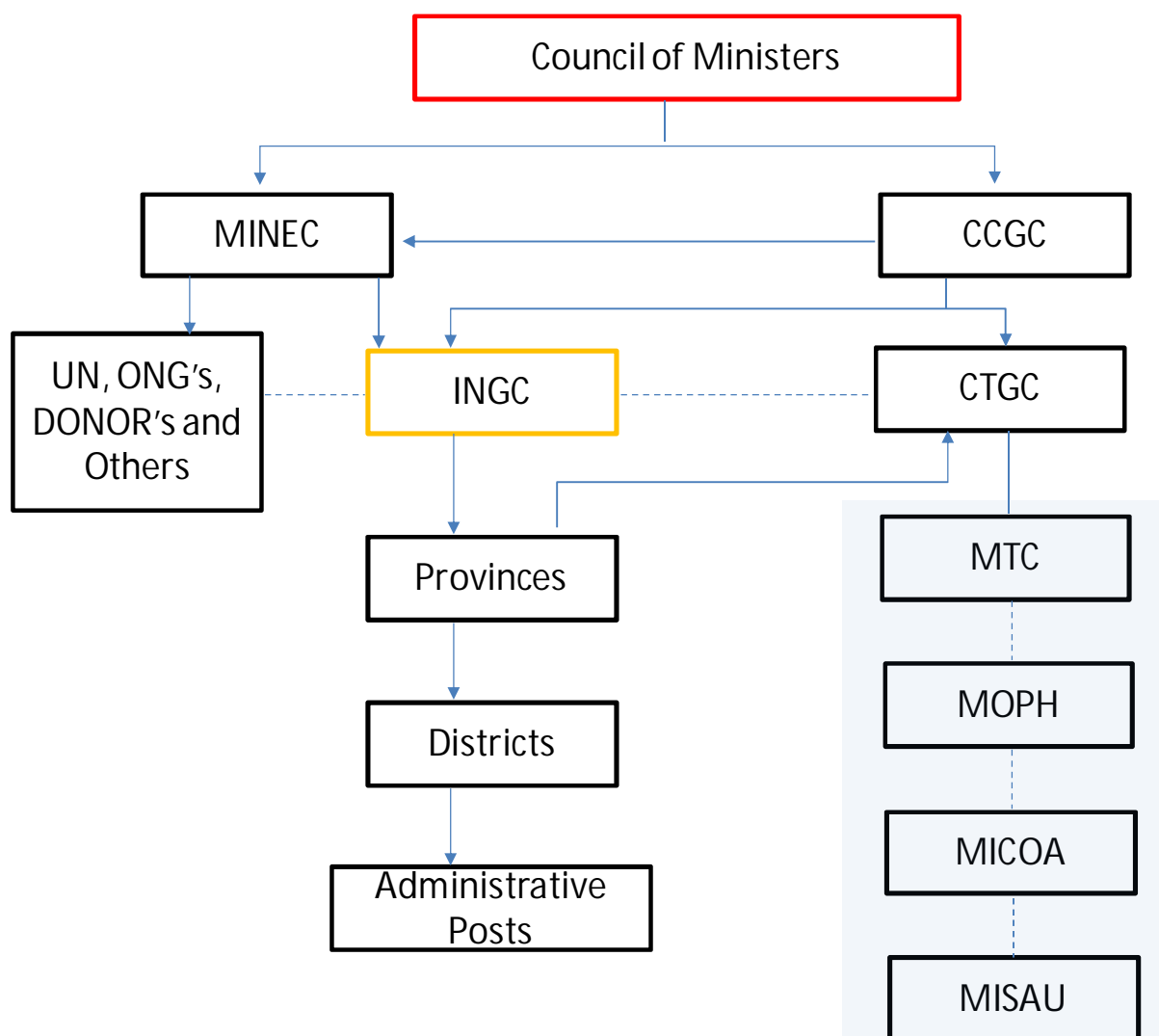
**Figure 63: Disaster management framework in Botswana**

Source: [www.gov.op.bw](http://www.gov.op.bw)

### 6.4.2 Mozambique

According to MICOA (2006), in Mozambique there is not a specific Institutional Framework for droughts, there is only a Framework for mitigation which is used for all disasters phenomena. The Ministry of Agriculture (MINAG) and the Technical Secretariat of Food Security and Nutrition (SETSAN) with support of FAO have developed a preliminary Mitigation Action Plan. The purpose of the action plan is to establish basic means to overcome the adverse drought conditions by improving the ability of households to cope and adapt, based on local recommendations and experiences. Although the plan does not contemplate direct food assistance, some activities are implemented through *food-for-work* and other intervention programs in coordination with local authorities (FEWS NET, 2005).

The institutional framework is illustrated in Figure 64.



**Figure 64: Institutions of coordination and management of disasters in Mozambique**

Source: MICOA, 2006

### 6.4.3 South Africa

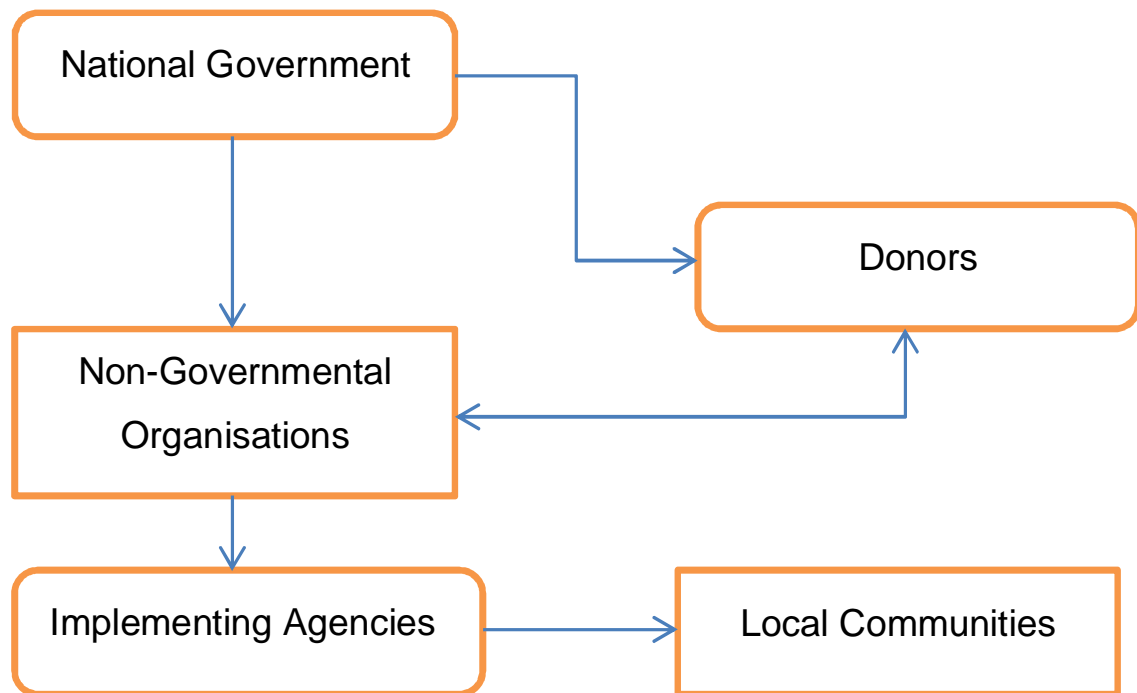
During the 1992 drought, a large number of NGOs and government departments launched the National Consultative Forum on Drought (NCFD) to coordinate a response to the drought crisis in the country. This initiative represented the broadest grouping of forces in the history of drought response in the country (AFRA, 1993). The objective of the NCFD was to ensure that relief reached the worst affected sectors and to promote the cause of the rural poor.

Serious problems emerged in the implementation of the drought relief activities. The problems included: inadequate funding, rigid geographical jurisdictions, poor coordination, lack of personnel, lack of drought relief experience, poorly publicized relief measures, lack of legitimacy, poor community relations, and rigid “top-down” approaches. Owing to the absence of a common national approach to relief, most state structures at local and regional level had to act ad hoc through the drought period. The absence of meaningful community representation on any of the drought relief structures meant lack of accountability and the communities were excluded from the process of drought relief (AFRA, 1993). Additional shortcomings of past drought relief programmes included:

- Inefficient delivery mechanisms made it easier to deliver aid to communities that had better access (e.g. communications, social and physical infrastructure) than to the really disadvantaged rural dwellers.
- Ineffective credit schemes prevented farmers from developing better farm management capacity or understanding a constructive credit culture. By writing off production credit, the main aid recipients were the government-controlled banks and development corporations, which were protected from risk, rather than the farmer borrower.
- Ineffective livestock schemes, such as feed provision, subsidizing purchased feeds, subsidizing and encouraging farmers to offload surplus stock, and even operating State feedlot schemes, failed to be equitable. Moreover, they encouraged livestock owners to expect government to bear the full risk.

The institutional framework is illustrated in Figure 65.



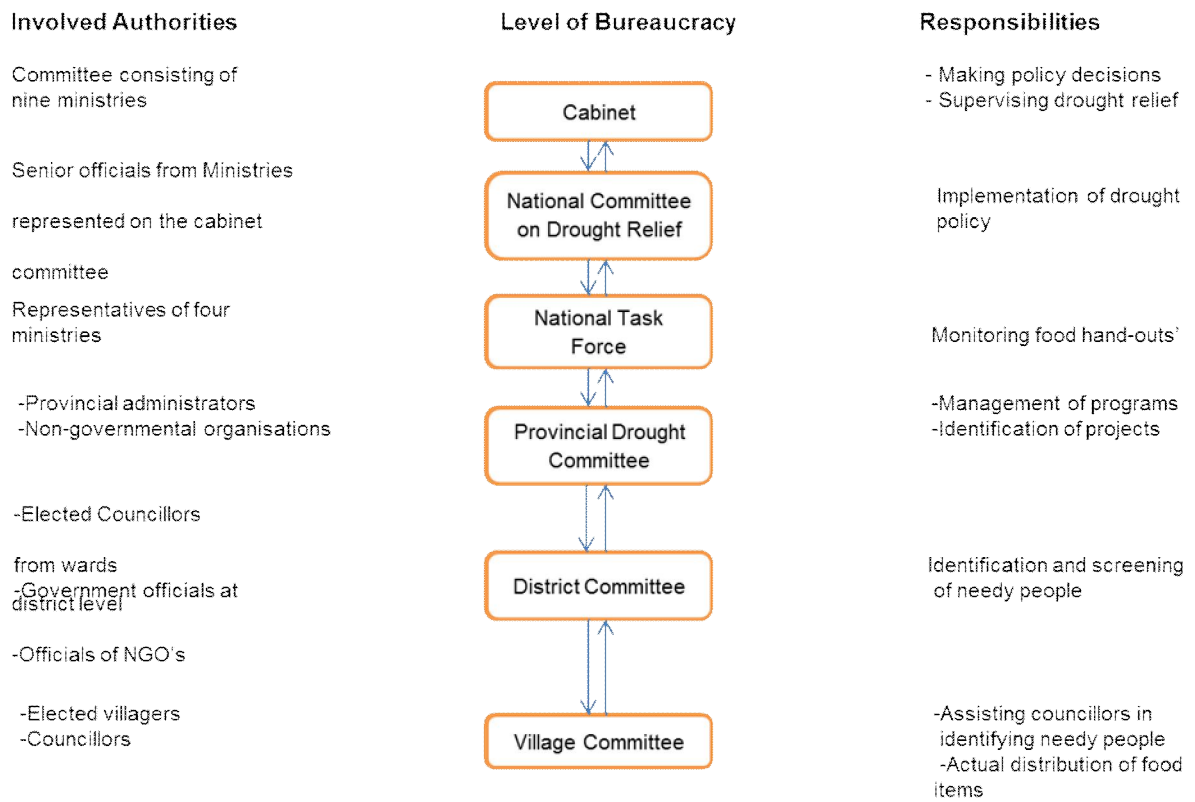


**Figure 65: Drought Institution coordination framework in South Arica**

#### **6.4.4 Zimbabwe**

The National and Provincial institutional setup was put in place to tackle the 1992 drought in Zimbabwe. The National Drought Consultative Council, chaired by the Vice President, consisted of representatives from Ministries as well as international agencies directly involved in drought relief. The Drought Relief Programme carried out to relieve the impacts of 1991/92 drought was a major success as it helped to avert famine for half of the population severely affected by drought (Munro 2006; World Bank 1995).

The institutional framework is illustrated in Figure 66.



**Figure 66: Drought Institution coordination framework in Zimbabwe**

## 6.5 WEST AFRICA - NIGER BASIN

During the 1973-1973 drought in the Niger Inner Delta: the institutions were not in direct contact with the population. The 1984-1985 drought had less impact in the Niger Inner Delta than the 1972-1973 drought. For coping with these droughts the Mali Government set up a number of mechanisms specific to each type of drought and which evolved in time. The current configuration of this mechanism is made up of the following:

- An Inter-Ministerial Commission on droughts management, led by the Prime Minister
- A Technical Committee including Ministries, the United Nations Agencies, Embassies and international organizations;
- National cells including a forecasting component, an emergency/ rehabilitation action component, and an evaluation component, depending on the category of disaster;
- Monitoring cells attached to key-Ministries involved, with monitoring committees at the regional level, circle (Territorial Division) level and at the level of communes, depending on the nature of the disaster.
- The State` structures and/ or sectorial Departments in charge of the day-to-day management of risks and disasters prevention and management, with lead institutions, depending on the nature of the disaster (Epidemics, Epizootics, locust invasions, floodings, drought , etc.).

Institutions interact with impacted communities as follows:

- Meeting with the councils of villages in their localities;
- Animation and sensitization campaigns for making the population understand the stakes of climate and their implications for the rural population;
- Defining jointly with the population the best mitigation strategies or actions;
- Workshop with communities, local services , and proximity supervisory personnel;
- Media (Proximity Radio);
- Support to the implementation of mitigation strategies and to fund-raising / fund-seeking of fundings.

## 7 IDENTIFICATION OF DROUGHT ADAPTATION ACTIONS

### 7.1 NORTH AFRICA – ALGERIA, MOROCCO AND TUNISIA (MAGHREB REGION)

#### 7.1.1 Tunisia

##### 7.1.1.1 Interventions by farmers

Water harvesting and mulching are practiced by **farmers** as drought adaptation measures. These two interventions are described in more details in this section.

##### a) Water harvesting

Water harvesting techniques have been developed in the region since antiquity to cope with climate variability in the dry areas. They played a major role in the development of rainfed agriculture in addition to providing other ecosystem services. With climate change, those systems/techniques are becoming more useful. Figure 67 shows the two main methods for water harvesting namely the micro-catchment, which is at the scale of the field, and the macro-catchment which is at the external field area scale.

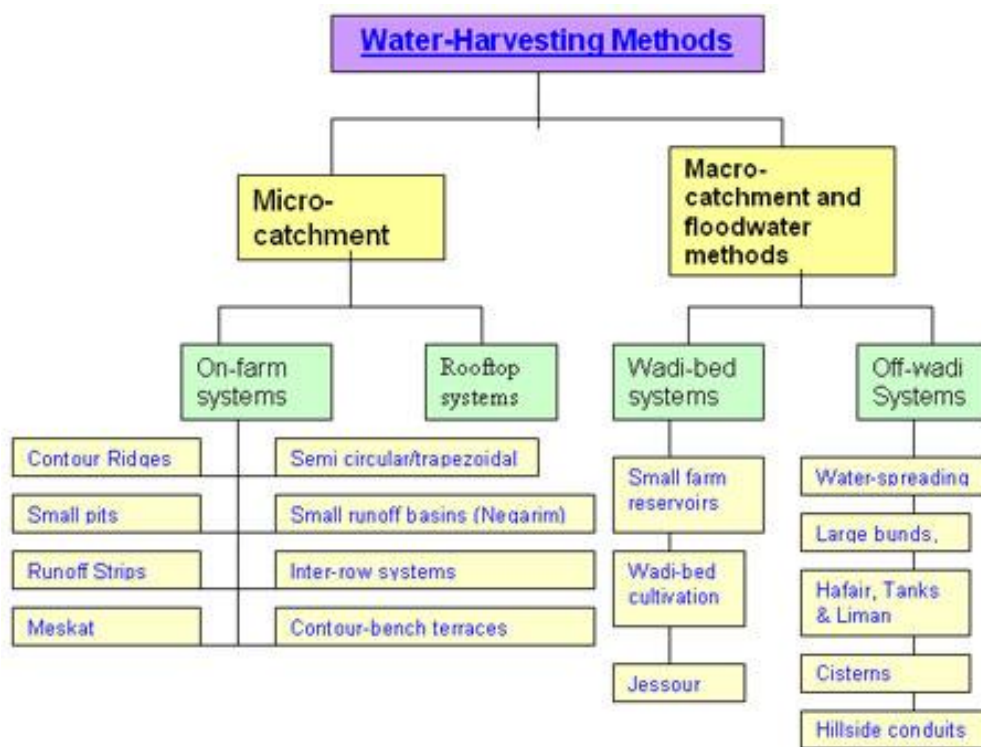
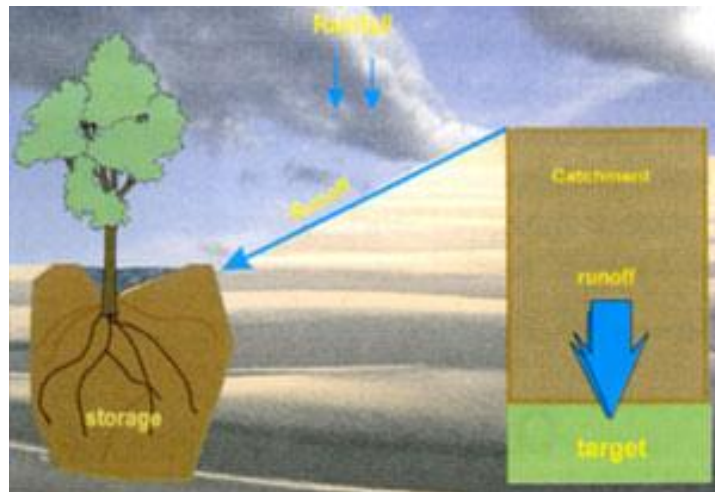


Figure 67: Water harvesting methods

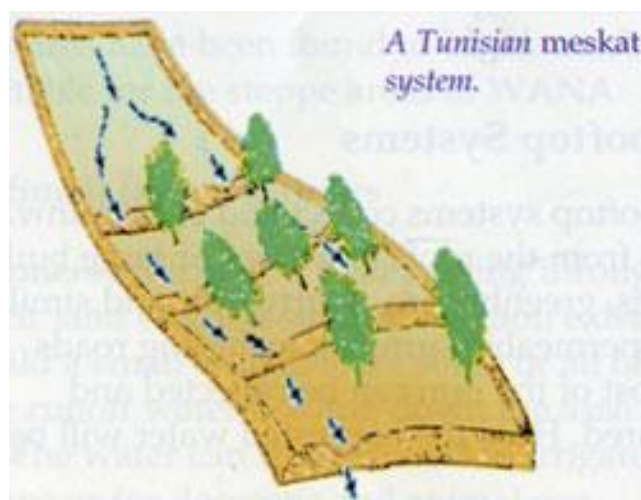
**Micro-catchments** deprive part of the land of its share of rain, which is usually small and non productive, and add it to the share of another part in order to bring the available water amount closer to the water requirements of crops (Oweis et al., 2001). Indeed, water gathers from runoff is usually applied to the cultivated area where it is

stored in the root zone for direct use by the plants (Figure 68). These systems are simple to design and cheap to install and can contribute to erosion control.



**Figure 68: Infield storage system**

The Meskat is the most used system in the micro-catchment in Tunisia. This is illustrated in Figure 69. Slopes are re-arranged by construction of terraces, contour bunds or runoff farms so that runoff is conserved and can be used for agriculture. Erosion is controlled and enhanced infiltration of water contributes to aquifer recharge.



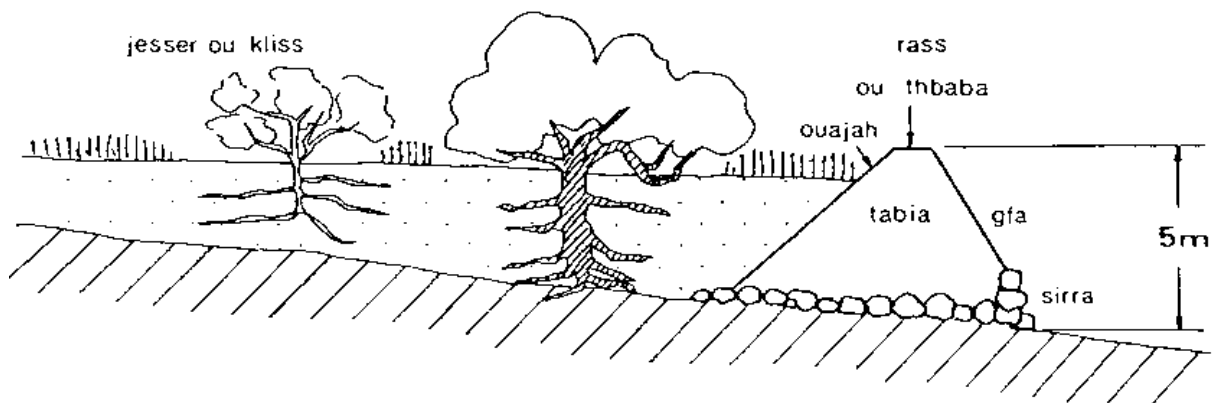
**Figure 69: The Meskat system**

Macro-catchments and flood water harvesting systems (Oweis et al, 2001) collect runoff from a relatively large catchment. Often the catchment is a natural rangeland or a mountainous area. Generally, runoff captured is much lower than for micro-catchments, ranging from a very low percentage to around 50% of the annual rainfall.

Depending on natural conditions, different land use systems can be recognized (Prinz and Malik, 2002):

- The Jessour is an old runoff farming technique. It is widely encountered in the arid highlands (100 to 750 m elevation), south-eastern part of the country. The Matmata mountainous chain is known by this typical system. El Amami (1984) estimated that 400,000 ha are treated in jessour.

Jessour system is practiced in valleys where floods are diverted or tapped for supplementary irrigation of agricultural land (also referred to as runoff farming -Jessour); The Jessour (Figure 70 and Figure 71) system is a terraced wadi system with earth dikes which are often reinforced with dry stone walls ("sirra"). Soil accumulates in front of these dams and terraces with a soil depth of 1 to 2 m are formed. On the terraces flood water is impounded and infiltrates into the soil. This supplementary water makes agriculture in these arid regions possible. On the terraces different fruit trees, olives, almonds, dates, figs, grains and legumes are cultivated.



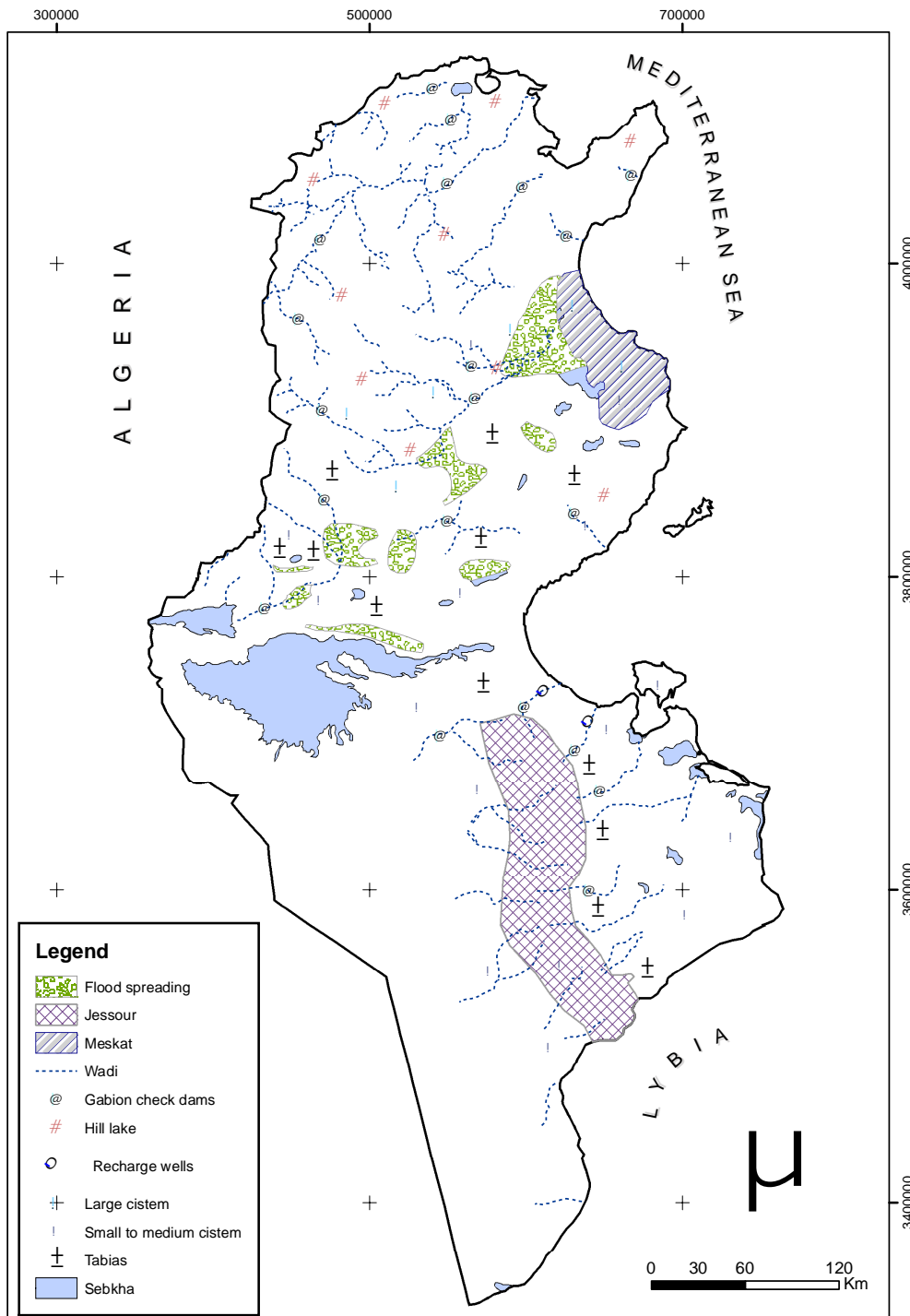
**Figure 70: An illustration of the Jessour system**

One of the techniques to increase the efficiency of water use in the jessours is the buried stone pocket for the localized, underground irrigation of fruit trees.



**Figure 71: A picture of the Jessour system**

Whereas the "Meskats" are mainly found in the Sousse region, the Jessour are widespread in the South (Matmata) see Figure 72.



**Figure 72: Geographical distribution of water harvesting systems in Tunisia**

Source: Quessar (2010)

Large bunds called Tabia in Tunisia are used for livestock production and forestry; (Figure 73). This system consists of large semi-circular, trapezoidal or open v-shape earth bunds with a length of about 10-100m and a height of 1-2m.





**Figure 73: Picture of earth bunds**

#### b) Mulching

Organic mulches are used on orchards and with row crops under reduced tillage operations. They consist of unutilized plant residues or material imported to the field such as straw. The depth of the organic mulch and the fraction of the soil surface covered can vary widely. These two parameters will affect the amount of reduction in evaporation from the soil surface. Farmers distribute the mulch near the cuttings on order to:

- Protect the seedlings against the cold;
- Enhance the soil water storage;
- Reduce the soil evaporation.

In addition to the punctual decisions to alleviate negative impacts of drought, long term interventions have been decided by the government. Indeed, some programs were implemented to achieve this objective:

- Valorization of treated (used) water in production;
- Intensification of fodder crops by subsidizing the seeds mainly during the difficult seasons;
- Valorization of the various agro-industrial by-products food blocks;
- Valorization of straws by their treatment urea;
- Implementation of the national strategy of “afforestation”, water and soil conservation as well as rangeland improvement (Ben Salem et al, 2007).

#### **7.1.1.2 Interventions by Government**

**Government** is involved in improving runoff farming, rehabilitation and improvement of water infrastrucrure, of, water development, development of non-conventional sources of water. These interventions are described in this section.

#### a) Rehabilitation of Runoff Farming

Being conscious of the importance of runoff farming for the water management of the country, the Tunisian Government started in 1990 implementing a project to rehabilitate the Meskat and Jessour systems. Traditional techniques and modern labour saving improvements are combined to make runoff farming feasible for the current economical circumstances. The aim of the project was not only to stabilise the water balance, but also to create work for the many unemployed. Up to 1984, Meskats covered 300000 ha where 100000 olive trees were planted; Jessours covered 400000 ha (Tobbi, 1994). Modern spate irrigation techniques have been applied in central Tunisia since 1980, covering an area of 4250 ha and harvesting about 20 Mm<sup>3</sup> of water annually.

#### b) Water Development

It is estimated that about 29 billion m<sup>3</sup> of the rainfall is lost through evaporation and transpiration and 0.5 billion m<sup>3</sup> is lost to the sea and to salty lakes, consequently, the dams lose this same volume of their storage capacity. In 1990, the government of Tunisia started the implementation of the National Strategy for Surface Runoff Development, which is aimed at building 21 dams, 203 small earth dams, 1000 ponds, 2000 works to recharge the water table and 2000 works to distribute water for irrigation (EUWI, 2007)

#### c) Rehabilitation, Modernization and Development of Small and Medium Scale Hydraulic Infrastructure

This comprises small and large scale water infrastructure, which is described in this section.

##### (i) Mountain lakes and small dams

The building of mountain lakes and small dams marks the divide between the indigenous practices and modern practices: These provide storage for runoff water from mountains. The water is used principally for agriculture development in the region, but other objectives are also targeted such as:

- domestic use;
- improvement of underground water capacity;
- protection against floods.

The average capacity of these structures is about 100 000 m<sup>3</sup> (Chérif et al., 1995).



**Figure 74: Examples of small storage dams**

The mountain lake (El Gouazine Region) and small dam (Cap Bon Region) in Figure 74 provide good examples. Currently, in Tunisia, there are 223 small dams with combined capacity of 0,078 billion m<sup>3</sup>, 825 mountain lakes (small dams with an average of capacity of 100000 m<sup>3</sup>) with a combined capacity of 0,072 Billion of m<sup>3</sup>.

(ii) Large scale hydraulic infrastructure

- Dams

In Tunisia, out of the 29 large dams in use, 4 are used to produce energy; the overall installed capacity is 58.66MW. The demand for water in the industrial sector was estimated at 101 million m<sup>3</sup> in 2000 (representing 4% of the total demand), 32 million m<sup>3</sup> of which are provided via connection to the SONEDE network and 69 million m<sup>3</sup> is from own resources. This demand for water is satisfied by 18 million m<sup>3</sup> coming from surface water and 83 million m<sup>3</sup> coming from underground water.

- Water Transfer

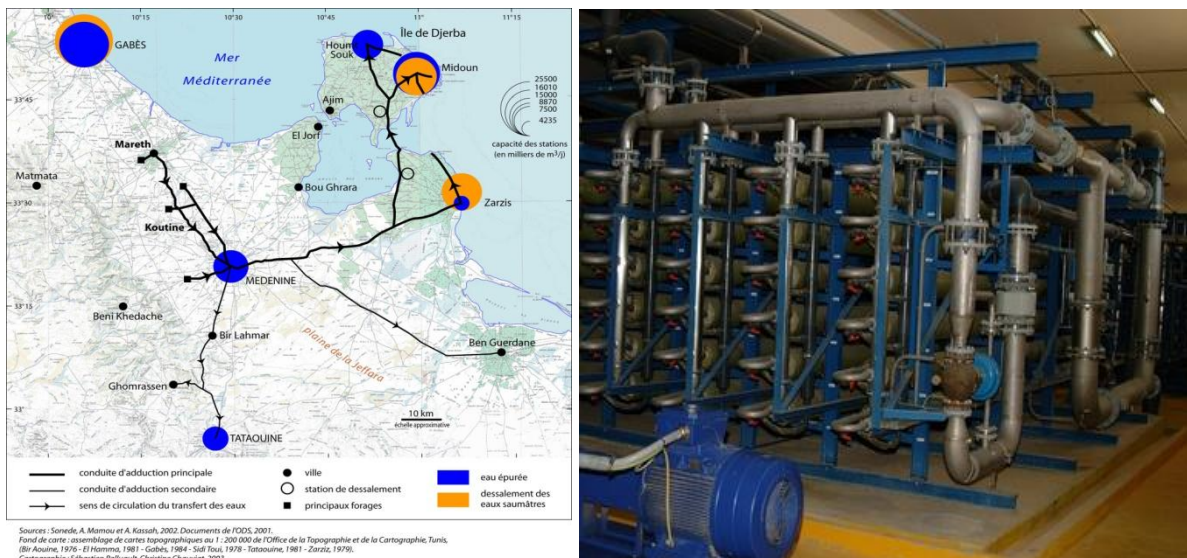
A major challenge in Tunisia is that the points of water availability are not in the same locality as the regions, which have high water demand. As a result the northern country is equipped with a complex water transfer system between connected dams, which is very useful during summer and drought periods. This system is managed by the SECADENORD society. Currently, the interconnection between dams (Canals and aqueducts) is about 500 km.

d) Non-conventional Sources of Water

(i) Desalination

The Tunisia's National Society for Water Exploitation and Distribution has begun a tendering procedure for the construction of 10 desalination plants in the south the country. This is part of an overall effort to build 13 desalination plants. An example of the plant is shown in Figure 75. The plants will process brackish waters and have a total daily capacity of 36,200 m<sup>3</sup>. Tunisia's diverse desalination projects aim to provide water for everything from public to tourist consumption (<http://www.utilities-me.com/article-693-tunisia-starts-tendering-process-for-desal-plants/>).

In Tunisia, four existing desalination plants produce nearly four percent of the country's total water resources. The plants use reverse osmosis (<http://drinking-water.org/html/en/Sources/Desalination-in-Tunisia.html>)



Gabes desalination plant in Tunisia

**Figure 75: Desalination plants in Tunisia**

Indeed currently, SONEDE operates these four desalination plants which are as follows:

- Desalination plant of Kerkennah (3300 m<sup>3</sup>/day);
- Desalination plant of Gabès (34 000 m<sup>3</sup>/day);
- Desalination plant of Jerba (20 000 m<sup>3</sup>/day);
- Desalination plant of Zarzis (15 000 m<sup>3</sup>/day).

The total installed desalination capacity should increase from 103,000 m<sup>3</sup>/day currently, of which 60% is managed by SONEDE, to 200,000 m<sup>3</sup>/day during the next five years and 500,000 m<sup>3</sup>/d in 2025 ([http://www.desalination.biz/news/news\\_story.asp?src=nl&id=5431](http://www.desalination.biz/news/news_story.asp?src=nl&id=5431)).

(ii) Water reuse/recycling

In most Arab countries, agriculture is by far the main water consumer, accounting for about 80% of the total water supply in Tunisia (Choukr-Allah, 2010). Tunisia is a good example of countries that made important steps towards garnering political support for wastewater reuse. It has long experience (since 1965) in using treated wastewater to irrigate the citrus orchards and olive trees of the Soukra irrigation covering an area of 600 hectares (Bahri, 2008). In Tunisia, recycled water accounted for 4.3% of available water resources in the year 1996, and may reach 11% in the year 2030 (Kamizoulis et al, 2004). In 2008, the number of wastewater treatment plants operating in Tunisia were 61, collecting 0.24 billion km<sup>3</sup> of wastewater, of which less than 30% is reused to irrigate vineyards, citrus (Chenini, 2008), trees (olives, peaches, pears, apples, pomegranates), fodder crops (alfalfa, sorghum), industrial crops (cotton, tobacco), cereals, and golf courses in Tunis, Hammamet, Sousse, and Monastir. The wastewater effluent is treated to secondary levels and farmers pay subsidized prices for the treated wastewater they use to irrigate their fields (Bahri, 2008). In Tunisia, demand for reclaimed water by farmers is generally lower than it is for alternative sources of freshwater, although the price charged to farmers for reclaimed wastewater is four times lower than fresh water prices.

In Tunisia, the expected amount of recycled water in the year 2020 is expected to be approximately 18% of the available groundwater resources and could be used to replace groundwater currently used for irrigation in areas where excessive groundwater mining is causing salt water intrusion in coastal aquifers (Kamizoulis et al, 2004). An example of a wastewater treatment plant is shown in Figure 76.



**Figure 76: El kef waste water treatment plant in Tunis**

#### e) Active and Proactive Actions for Drought Adaptation and Mitigation

A programme to invest in soil and water conservation was implemented from 1991 to the year 2002 (Strategy of Soil and Water Conservation (EUWI, 2007)). A budget of almost 500 million dinars was used to cover the cost of all needed interventions from. New farming policies based on the use of technology and adequate water harvesting practices were introduced. This project managed one million hectares, maintained and rehabilitated 440000 ha in watersheds and cereal producing regions. A total of 580 mountain lakes, 2000 small check dams were constructed as well as 2000 diversion dams for water harvesting. After the evaluation and the success of this program, a new national plan set up for implementation during the period 2002-2011. An estimated budget of 780 million dinars was allocated to managing and maintaining 1,5 million hectares of watersheds and to construct 1000 small dams, 3000 structures to recharge aquifers, 1500 diversion structures for water harvesting, 5500 protective structures for water ways and the management of 15000 ha by traditional techniques of soil and water conservation. The objectives of soil and water conservation plan are:

- to reduce the loss arable land estimated to 10.000 ha/year;
- to maintain soil fertility in order to avoid the decrease in soil productivity;
- to retain the 500 million cubic meters of run-off water (which are actually lost in the sea and salty lakes), by carrying out water and soil conservation works;
- to recover arable land by establishing structures (jessours) in the south of Tunisia;
- to improve the life span of dams, which are threatened by sedimentation at the rate of 25.8 million m<sup>3</sup>/year;
- to reduce damages caused in valleys and plains by floods;
- to implement a new farming policy, which aims at utilizing anti erosion works in order to increase production;
- to create job opportunities and to improve revenues of rural population in the marginal areas.

### **7.1.2 Algeria**

#### **7.1.2.1 National plans and programmes for drought adaptation:**

The National Plan for Agricultural and Rural Development (PNDAR) aims to modernize and increase the eco-effectiveness of the agriculture sector through specific programs adapted to the agro-climatic constraints of Algeria:

- Program for adaptation of production systems within the framework of a drought active-management approach (FNRDA)



- Program for marginal lands development within the framework of the agricultural land extension policy. The land is a 90 years concession and the State provide significant support for all the requirements for water mobilization.

The fund for pastoralism, steppe development and for fight against desertification (FLDDPS) program covers 363 rural communes in 23 Wilayas (steppic, agro-pastoral and presaharian). The importance of the rangelands zones degradation, mainly caused by droughts and anthropic actions led to a consequent, coherent and harmonious authorities' intervention as well as an adequate and adapted financial State support in order to promote:

- Life standard and livelihoods development of pastoral and agropastoral population, diversification of the households economic activities;
- Rehabilitation and restoration of degraded rangelands in order to improve feed capacity during droughts periods;
- Intensification of the fodder production through cost-efficient water spreading irrigation;
- Densification of the network and improve watering conditions of the herds;
- Rehabilitation of the agriculture within the Ksours, Oasis, and valleys;
- Promotion of renewable energy in the mobilization of water resources.

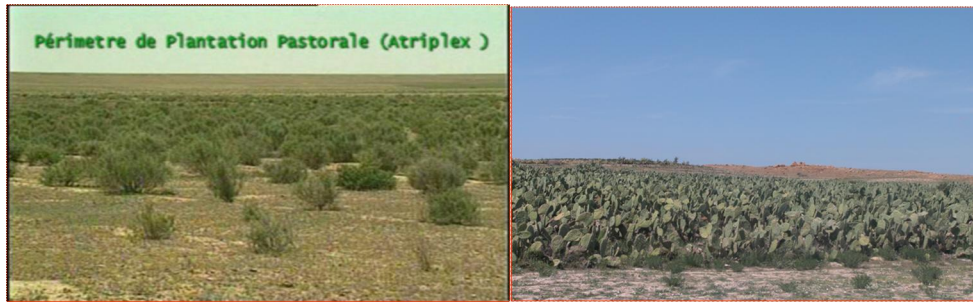
Within the framework of the FLDDPS, several actions are undertaken:

- Rangelands development by rest perimeters (to which herders have recourse during unfavourable years): 2,672,247 ha were achieved within the 2002 to 2005 period (Figure 77);



**Figure 77: Rest perimeter in Algerian steppe**

- Fodder shrubs plantation (*Atriplex*, *Medicago*, *Opuntia*, *Tamaris*...): An area of 110,364 ha has been planted in the 2002-2005 period (Figure 78);



**Figure 78: Atriplex and Opuntia fodder shrubs plantation**

- Intensification of fodder production by water spreading during flood periods (rivers/oueds): 787 water spreading facilities have been build in 2002-2005 period;
- Improvement of livestock watering conditions by ponds, djoubs, Groundwater exploitation: 3726 facilities were achieved between 2002 and 2005 (Figure 79);



**Figure 79: Livestock watering points**

- Rehabilitation of the agriculture within the Ksour, Oasis, and valleys through restoration and the consolidation of the facilities related to water resources and rational use of irrigation water. This initiative promotes the preservation of local products and varieties such as “Al Ghassoul” Mint, “Boussamghoun” Almond trees; “Moughrar” dattes, “Khirane” walnut trees, “Messad” apricot trees (Figure 80);





**Figure 80: Laasal oasis (Wilaya of Biskra) before (2001) and after rehabilitation (2004)**

- Promotion of renewable energy for water pumping and domestic electrification: 92 Solar pumps, 77 Wind pumps and 3330 households equipped (solar electricity) (Figure 81).



**Figure 81: Examples of solar water pumping in Algeria**

### **7.1.2.2 Farmers Coping Strategies**

Herders have developed strategies which include breed practices and use of local know how to assure the viability of their production system. Farmers have developed the following coping strategies for droughts:

- Development of the multi-activity agriculture thanks to the hydraulics investments (drillings and wells);
- Extension of the cereal sole and Fruit-trees culture;
- Market gardening;
- Modification of the structure of the livestock: Introduction of the local bovine;
- Resort to the extra-agricultural incomes: trade, grocer, butchery.

### **7.1.2.3 Other Farming Activities**

On the level of farmers the following drought mitigation measures have been implemented:

- The promotion of dry land farming practices

- The development of drought resistant varieties and varieties with short cycles.

#### 7.1.2.4 Conventional Water Resources

To face the water resources problems and preoccupied with a better management, an integrated approach of protection and rational use of the water resources was adopted. This by:

- a) The increase of water development

Currently, Algeria has 59 dams, with a total storage capacity of 6 billion m<sup>3</sup>, and that mobilize in average years 3 billion m<sup>3</sup>. Thirteen dams with a storage capacity of 1.5 billion m<sup>3</sup> are under construction. By 2025, 75 dams in project will extend the global storage volume to 6 billion m<sup>3</sup>. In addition to large dam construction, the rehabilitation and the development of small and medium scales hydraulics, the intensification of mobilization of groundwater resources, and the artificial refill of groundwater aquifers have been prioritized.

Water transfers from Saharian deep groundwater aquifers represent a big project. It aims at South to North transfers of water from the septentrional desert to the high plateau and high plains, and south to south transfers (Figure 82)



**Figure 82: Water transfers In Algeria**

- b) Rehabilitation of traditional water harvesting techniques such as “foggaras” and development of new ones.

Foggara is the French translation of the Arabic word “qanat” or the Pashto word karez”. Foggara was first practiced in Iran and brought to North Africa during the second expansion of Islam. The Foggara system is a complex network of vertical shafts dug into a sloping plateau overlooking an oasis. These vertical shafts or wells are connected by an underlying channel, which has a gradient flatter than that of the ground. Water is drawn from an aquifer within the plateau by the force of gravity and directed through the channel to the surface for

agricultural or domestic use. There are three significant benefits of the Foggara system (Remini and Achour, 2008). Water loss through both seepage and evaporation are reduced because a majority of the channel is underground and there is no need for pumps as the system is fed entirely by gravity (Figure 83).



**Figure 83: Traditional water harvesting and irrigation system in Algeria (Foggara)**

Other interventions include the following:

- Increase of water savings and increase of water use efficiency through the development of more efficient irrigation techniques such as drip irrigation;
- Better management of water drinking networks;
- Development of decision support and water resources provisional management tools:
  - Development and modernization of monitoring and observation tools
  - Planning tools
  - Management tools
  - Communication tools.

#### **7.1.2.5 Non-Conventional Water Resources**

In Algeria, the non-conventional water resources are coming from the following sources:

- Seawater desalination;
- Demineralization of brackish water;
- Reuse of treated waste water.

##### **7.1.2.5.1 Desalination**

Currently the total water obtained from desalination is about 111.45 million m<sup>3</sup>:

- - 105,85 Hm<sup>3</sup>/year produced by the large stations
- - 5.60 Hm<sup>3</sup>/year produced by the monobloc stations

The installed seawater desalination is contributing to about 70 Litres per capita per day to the drinking water supply of the densely populated coastal strip along the Mediterranean. About 47% of desalinated water in Algeria is produced by multistage flash (MSF) and multiple-effect distillation (MED), 44% by reverse osmosis (RO), 5.5% by vapor compression (VC) and 3% by electro-dialysis (ED). More than 67% of the total desalinated water is produced from seawater, 22% from brackish water, 8% from river water and the rest from other sources. The major user of the desalinated water is municipalities with about 49%, followed by industries with 45%. The rest is by power, tourist places, military and other sectors (Mahmoudi et al, 2009)

Twenty one **monobloc stations**, with a total capacity of 57 500 m<sup>3</sup>/day, were realized within the drought adaptation programme of 2002. This program was realized by two different companies namely LINDE-KCA (Germany), which comprises 08 stations with a total capacity of 22 500 m<sup>3</sup>/day and Hydro Treatment (Algeria), which comprises 13 stations with a total capacity of 35 000 m<sup>3</sup>/day. The capacities of the individual stations are shown in Table 35 and Table 36.

**Table 35: LINDE-KCA / Allemagne.**

No	Station	Region	Optimal capacity m <sup>3</sup> /day
01	Ain Benian 1	Alger	2 500
02	Ain Benian 2	Alger	2 500
03	Bou Ismail	Tipaza	5 000
04	Palm Beach	Alger	2 500
05	Zeralda 1	Alger	2 500
06	Zeralda 2	Alger	2 500
07	Ghazaouet 1	Tlemcen	2 500
08	Ghazaouet 2	Tlemcen	2 500
<b>Total</b>			22 500



**Table 36: Hydro Treatment / Algeria**

No	Station	Region	Optimal capacity m <sup>3</sup> /day
01	Bousfer 1	Oran	3 000
02	Bousfer 2	Oran	2 500
03	Skikda 1	Skikda	2 000
04	Skikda 3	Skikda	5 000
05	Tigzirt	Tizi ouzou	2 500
06	Bateau Cassé 1	Alger	2 500
07	Cap Caxine	Alger	2 500
08	Corso	Boumerdes	5 000
09	Les Dunes*	Oran	5 000
10	Bateau Cassé 2	Alger	2 500
11	Ain Benian 3	Alger	2 500
<b>Total</b>			<b>35 000</b>

The measures planned to rectify drought effects and imbalances of water in Algeria are illustrated by Figure 84.



**Figure 84: Measurements planned to rectify imbalances of water in Algeria**

Source: Mahmoudi et al (2009)

#### 7.1.2.5.2 Treated Wastewater

Algeria is presently looking at improving water availability (600 m<sup>3</sup>/inh.yr) by adopting a new water resources policy and new alternatives that enable to ease the crisis. Treated wastewater represents a promising alternative that is not only constantly available but also increasingly available, with the development of cities, tourism and industry. In the agricultural

sector, reuse of wastewater is a technique that adds to the value of the water resources while it protects the environment.

In Algeria, more than  $350 \times 10^6 \text{m}^3$  of wastewater were disposed of in 1979, and  $660 \times 10^6 \text{m}^3$  in 1985. The total wastewater disposal is expected to reach  $1.5 \times 10^9 \text{m}^3$  by 2010, but, due to sewerage networks conditions carrying the wastewater effluent, the population rate connected to the sewerage network and the availability of wastewater treatment facilities, projections suggest the possibility of reusing not more than  $600 \times 10^6 \text{m}^3$  in that same year (Tamrabet, 2002).

The Algerian laws prohibit absolutely the reuse of the raw wastewater, treated wastewater for the irrigation of raw-eaten vegetable crops, but it is allowed in the production of fodder crops, pasture and trees. The Algerian laws oblige also the cities of more than 105 inhabitants to treat their effluents, prior to any disposal or reuse, through a wastewater treatment station, and in less populated areas through wastewater stabilization ponds or sedimentation basins. Consequently, in the last few years, the Algerian authorities have initiated an ambitious program that enables mainly: (a) the rehabilitation of 28 wastewater treatment stations, (b) the construction of new wastewater treatment stations for the cities of more than 105 inhabitants (32), and (c) for small populated areas, the construction of wastewater stabilization ponds (08) and sedimentation basins (435). For the success of the program, there must be an efficient follow up and periodic evaluation so that the wastewater valorization becomes fruitful, and to safeguard the water resources and the environment from negative impacts of pollution (Tamrabet, 2002).

### **7.1.3 Morocco**

#### **7.1.3.1 Integrated Water Management**

The integrated water management (IWM) is the efficient way to continually manage land and water resources in drought prone areas. The focus of IWM is mobilization, conservation and efficient way of using rain water. IWM combines several approaches to minimize the risk of drought. Morocco has put a lot of effort in the development of water resources.

#### **7.1.3.2 Construction of Large Dams**

Faced to the unequal distribution of water resources in the country both in time and space and to the necessity of its economic and social development, the government from the 1960s onwards implemented a deliberate policy of building a series of large reservoir dams to attempt to even out the availability of water between the cyclic periods of drought. Thus, nowadays, Morocco has 128 big dams in activity, which are able to mobilize 17.2 billion  $\text{m}^3$ ,

which represents in an average year, nearly 90% of the potential surface water resources. (DGH, SEEE) while in 1956, the total storage capacity was only 1.8 billion m<sup>3</sup>. The benefits that Morocco's network of dams has brought to the national economy as a whole may be measured in terms of increased food security and access to both energy and drinking water. They contribute in a significant manner to the mitigation of extreme weather phenomena such as droughts and floods. Dams are used for flood control for more than 400,000 ha of irrigated agricultural land in the rich fertile valleys and plains of Tafilalet, Loukkos, Draa and Gharb. During the severe droughts in the 1980s and 1990s, large dams enabled a continuous supply of water to all the urban centers in the country except for Tanger where special measures were needed to compensate for a 50% shortfall. The objectives for the year 2030 are to increase water mobilization in Morocco by the construction of 30 new large dams (SEEE, 2010).

### 7.1.3.3 Water Demand Management and Increasing Water Use Efficiency

In a context of water scarcity, the management of water demand and its valorization through the implementation, institutional and financial tools are essential. The National strategy for irrigation water conservation (Plan national d'Economie d'Eau d'Irrigation, PNEEI) is one of such tools.

Agriculture uses a large share (up to 85%) of the available water but in 2000-2006, only 55 to 60% (on average) of the demand for irrigation water was met from the main storage reservoirs (MADRPM-1, 2008). Still, there is the perception that agriculture "wastes" water. This perception is justified for several reasons: first, 15 to 20% of the water is lost during transit from the dam to the field. Second, approximately 80% of the hectareage in the large-scale irrigated perimeters is flood-irrigated using traditional methods such as the "Robta" (Figure 85), which involves furrow flooding over a series of small basins (TRM,1999). It is estimated that with the Robta, only about half of the water that enters the field is used by the crop. The other half goes unused mostly through deep percolation below the root zone.



Figure 85 Flood (furrow) irrigation in PIT

In 2007, the government issued an ambitious plan (“Plan National de l’ Economie d’ Eau ‘Irrigation” or PNEEI) to conserve in excess of 510 million cubic meters(Mm<sup>3</sup>) of irrigation water per year (MADRPM-2, 2007). The main premise of PNEEI is that past and current measures to conserve water in agriculture such as the revamping of existing irrigation infrastructure and the introduction of improved irrigation methods (e.g.,sprinkler irrigation) are not sufficient to address water shortages. The goal of PNEEI is to equip about 555,000 ha of irrigated land with drip irrigation from 2008 through 2022. This would bring the total hectarage equipped with drip irrigation to 700,000 ha or 50% of the total irrigated land in Morocco. Most of this hectarage would be achieved by converting from flood- to drip irrigation. According to PNEEI, some of the benefits of drip irrigation would be:

- Water savings of 20 to 50% compared to existing irrigation practices;
- Crop yield gains of 10 to100%;
- Increased farm revenue;
- Reduced labor;
- Protection of the soil and water resources e.g., by reducing leaching of salts, nitrates, and other pollutants into the groundwater.

The total cost of PNEEI was estimated at around \$4.6 billion, of which \$3.8 billion would be financed by the government, mostly in the form of subsidies (Belghiti, 2005). Subsidies were increased from 30% of the cost of some drip irrigation equipment and installation (plus the excavation of wells) in July 1986 to 60% in October 2006 and then 100% recently in some particular cases. Land owners who do not meet certain conditions may only receive the 30% (40% in dry regions) subsidy plus, since1999, a bonus of \$250 for each hectare of land equipped with drip irrigation (Belghiti, 2005; MADRPM-3, 2008). Payments at the 60% rate cannot exceed \$4,500 per hectare (\$/ha) if a water storage reservoir is built and \$2,752/ha if it is not. Additional subsidies are provided for farm equipment, improved seeds and tree seedlings, etc. The procedure to apply for and obtain government subsidies has been simplified and streamlined. Approximately 163,000 ha were equipped with drip irrigation through 2008 (MADRPM-4, 2008), most of which was done on an individual basis and outside the main irrigated perimeters. Consequently, the government plans to convert approximately 218,000 ha of land from mostly flood-irrigation to drip irrigation on a large scale in order to reach its target of 555,000 ha from 2008 through 2022. These so-called “projets de reconversion collectifs” or collective projects will group hundreds if not thousands of farmers in the zones administered by ORMVAs. The government will build the infrastructure to bring pressurize water to the farms and each farmer will equip its land with drip irrigation and receive the 60% subsidy. (Berrada, 2009)



Other strategies include:

- the reduction of water losses between dams and fields;
- the revision of water pricing;
- the sensitization of farmers on water saving.

#### **7.1.3.4 Traditional and New Water Harvesting Techniques**

Water harvesting is defined as the collection of runoff and its use for human consumption or the irrigation of crops, pastures and trees, and for livestock consumption. Its common goal is to secure water supply in dry areas without tapping groundwater or river-water sources. In the past, water harvesting was the back bone of agriculture in arid and semi-arid areas world-wide. Thus, since at least Roman times water harvesting techniques were applied extensively in North- Africa. Archeological research by the UNESCO in Libyan Valley steam revealed that the wealth of the "granary of the Roman empire" was largely based on runoff irrigation (Gilbertson1986). The team excavated structures in an area several hundred kilometers from the coast in the Libyan pre-desert, where the mean annual precipitation is well below fifty millimeters. The farming system here lasted well over 400 years and it sustained a large stationary population, often wealthy, which created enough crops to generate even a surplus. It produced barley, wheat, olive oil, grapes, figs, dates, sheep, cattle and pigs. The precipitation is variable, falling in just one or two rain storms, often separated by droughts several years long. Many other examples of the application of traditional techniques in North Africa can be given. In Morocco's Anti Atlas region, Kutsch (1982) investigated the traditional and partly still practiced water harvesting techniques. He found a wealth of experience and a great variety of locally well adapted techniques.

After a decline, water harvesting gained new interest during past decades. Its future role will be as a linking element between rainfed agriculture, soil and water conservation and irrigated agriculture, still using untapped water resources in arid lands, alleviating slightly the stress on drought-ridden farmers and communities. The goals of water harvesting are:

- Restoring the productivity of land, which suffers from inadequate rainfall;
- Increasing yields of rainfed farming;
- Minimizing the risk in drought prone areas;
- Combating desertification by tree cultivation;
- Supplying drinking water for animals.

✓ Matfias:

The "Matfia" is an old technique of storing water for human and animal consumption in Morocco, which still continues (Tayaa1994). Expensive modern technology, including the use of reinforced concrete has now been introduced in constructing the cisterns, although the local people are less interested in these large and expensive systems (Figure 86). Since 1984, Morocco has started constructing small dams ("Barrages Collinaires") to harvest flood water. The upstream catchment area under these dams ranges from 500 to 10,000 hectares. As of 1988, 35 of these dams had been constructed. They provide consumption and irrigation water for about 160,000 animals and 3,000ha of cultivated plots.



**Figure 86: Traditional matfias in Morocco**

✓ Traditional water detention and diversion practices (Tayaa, 2001).

Water diversions are traditional methods of using flash flood water to irrigate local crops in the drier parts of Morocco. These systems are well adapted to the local conditions and are used to irrigate areas close to or within the water course. In Morocco, more than 165,000 hectares are irrigated using these traditional water diversion practices. Three types of these water diversions are described below:

- Lateral diversion: This technique consists of diverting a part of the flood water from an ephemeral water course or a gully to a conveyance channel, which may at times provide water for several hundreds of hectares downstream. This system has been generally used in streams of relatively steep slope gradients (5 to 10%) and a large stable channel bed. The off-take is generally located at the base of a stream embankment. Several off-takes may be used to irrigate the same area.
- Earth dike diversion: This is an improved version of the lateral diversion. The primary objective is to provide head for an off-take in order to irrigate greater areas. Its use is

restricted to streams with relatively low slope gradients, pronounced banks and medium width. The dikes are constructed of primitive material such as grave lands and excavation from the river bed.

- Small retention dams: This practice is usually encountered in the Saharan zones where floods are less frequent and with limited run off volumes. It consists of small earth or loose rock dikes (up to 1.5 m height) constructed across the river and designed to store flood water for crop cultivation (mainly barley) in the river bed up stream of the dam and to recharge groundwater. It is practiced in wider river shaving lower slope gradients and appropriate bed material for cultivation. They are occasionally washed out and this insures, particularly for the diversion dams, a self cleaning of the sediment deposited upstream of the dikes. The reconstruction and maintenance require a tremendous effort in terms of labor supported totally by farmers, which is a way of keeping solidarity within the community.

✓ Khettaras:

Since the mid-1960s, Morocco has been reviving the age-old technology of underground water channels known as “khattara” (Figure 87). This technology dates back to the 5th century and is also known in Iran, Afghanistan and Algeria. Since the 1960s, the Moroccan state water agency (ORMVA), with active participation by the population, has restored over 300 “khattara” water channels with a total length of 1.190 kilometers. The system enables the irrigation of more than 12.000 hectares of date palm plantations and the supply of clean drinking water to numerous villages. Khettaras are water pipe-lines around 10 to 20 kilometers long laid under the desert sand. Initially they are constructed on the surface, but are then covered with rubble from the rocky desert to protect the irrigation channels from sanding up and prevent the water from evaporating in the hot, dry air. Upkeep and maintenance shafts are placed at 500 meters intervals to facilitate access. The exits are protected with sandbanks. The water comes from the fringes of the atlas mountain range. It is collected there and then piped to the plain trough systems of channels, constructed after making precise calculations of the differences in level. The construction and maintenance of the khettaras demands only low levels of financial investment but significant amounts of manpower. This is contributed by water users and villages. Usage rights are governed by the traditional Moroccan “droit d’eau”. Under this system, users are allocated water in accordance with the work they contribute. Water distribution is under the control of the “Cheikh”- the president of the khettara administration and the “mezregs” the tribal alliances. Restoration of the khettaras is part of the Moroccan program to combat desertification.



**Figure 87: Traditional Khettaras in Marrakech region**

- ✓ Traditional techniques around Morocco for passive irrigation based on atmospheric humidity harvest (Fog and dew harvesting)

Traditional fog and dew harvesting techniques have been practiced in many dry areas since long time (coastal and mountainous areas). Some traditional practices for the water valuation in agriculture are the following:

- Daily tillage:

In order to ameliorate production and atmospheric humidity harvest technique, the farmers plough continuously the ground. The daily tillage by animal traction at early hours is one among traditional practices used by farmers to incorporate the condensed soil surface water and freshening the soil. This method induces a change of soil structure (porosity and hydraulic conductivity) that becomes favorable to the adsorption of water especially coming from atmospheric humidity harvest during the night when the temperature decreases gradually. Thus, the following advantages are identified:

- Plantation of species of resistant fruit trees to the arid climate not requiring any irrigation and will be used as alternative agriculture being able to replace those which consume much water
- Cost of the method of ploughing /ha is very weak, 300dhs (about 30 US \$);
- Preservation of soil and water resources;

- Mulching technique:

On the Atlantic coast of Morocco, south El jadida, farmers practice market-gardening cropping without irrigation. At the seedling stage, farmers distribute the mulch near the cuttings in order to:

- Protect the seedlings against the cold;
- Enhance the soil water storage;
- Reduce the soil evaporation;

- Use of fragment of rocks:

In the area of El Kelâa of Sraghna, varieties of fruit trees present a particular physiological behaviour. They support the aridity of the climate and do not express hydrous stress for a long period of the year. For several decades, farmers have adopted a technique based on the use of rocks placed at the level of the feet of trees (olives, almond tree, argan etc...) as shown in Figure 88. This technique enhances the harvesting of air humidity especially at night and plays also an important part in the reduction of daily evaporation. At a baseline the cost of use of this technique does not exceed 1000 dhs /ha (100 Us \$) for an improvement of the productivity of more than 50%.



**Figure 88: Water collection practice for olives in the mountainous regions of Morocco**

- Use of grass crop as water supply source:

The establishment of the cactus is another technique allowing collecting the relative humidity of the air. In El Kelâa of Sraghna region, some farmers plant crushed cactus rackets in the holes of plantations of Cucurbitaceous crop, as watermelon (known as water consuming crop). This practice allows a progressive water supply to crops by capillarity rising phenomena and at the same time a localized organic fertilization useful for plant growing.

✓ Collecting fog water for drinking water in the Atlas mountains

In some coastal regions and areas adjacent to coasts, fog water harvesting is emerging as an alternative source of water (Figure 89). The first large-scale application of this technique was in Chile in the late 1980s. Since then, countries such as Morocco, Namibia, Croatia, Nepal, Yemen and Peru have experimented with harvesting fog to provide water to

communities on a permanent basis. Fog collection involves setting up mesh screens to trap fog water droplets, which condense on the nets and drip down to containers below. In 2006, a project was initiated to study the viability of fog collection in Ifni, a region located on the Atlantic coast of Morocco across from the Canary Islands (Marzol and Sanchez, 2008).



**Figure 89: A fog-net**

#### **7.1.3.5 Development of Non-Conventional Water Resources**

The options to face chronic water shortages include the development of non-conventional water resources.

##### **7.1.3.5.1 Desalination of sea water**

Morocco is increasingly looking towards seawater desalination as a source to supply its increasing water needs for drinking, industry and mining. ONEP's experience in desalination is in supplying water to Saharan provinces of the kingdom, which lack fresh water and have limited brackish water resources.

Figure 90 represents the evolution of desalination in Morocco from 1976 to 2010 (Hafsi, 2010).



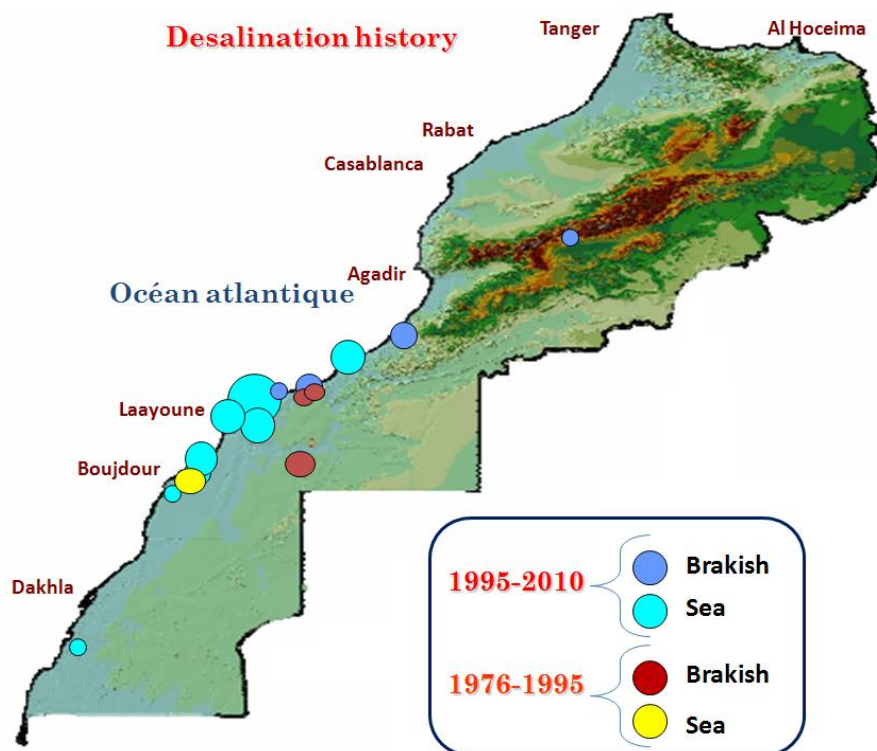


Figure 90: Evolution of Desalination in Morocco from 1976 to 1995 and from 1995 to 2010.

Source: Hafsi (2010)

Table 37 shows the actual Moroccan desalination capacity.

Table 37: Moroccan actual desalination capacity

Place	Raw water	Commissioning Year	Capacity m <sup>3</sup> /d
Laayoune	Sea	1995	7000
Boujdour	Sea	1995	800
Tarfaya	Brackish	2001	800
Tan Tan	Brackish	2003	1700
Laayoune	Sea	2005	6000
Boujdour	Sea	2005	2400
Tagounite	Brackish	2008	400
Daoura	Brackish	2008	240
Abris de pêche	Sea	2008	120
Laayoune	Sea	2010	13000
Akhfenir	Sea	2010	800
Boujdour	Sea	2010	1300
Total			34560

Source: Hafsi (2010)

The future development of desalination in Morocco from 2010 to 2015 includes:

Drinking water projects:

- Agadir (100.000 m<sup>3</sup>/day)
- Nador (43.000 m<sup>3</sup>/day)
- Essaouira (50.000 m<sup>3</sup>/day)
- Sidi Ifni (13.000 m<sup>3</sup>/day)
- Laâyoune (26.000 m<sup>3</sup>/day)
- Boujdour (8.600 m<sup>3</sup>/day)
- Guelmim (Plage Blanche) (6.000 m<sup>3</sup>/day)
- Dakhla (8.600 m<sup>3</sup>/day)
- Al Hoceima (Cal Iris) (8.600 m<sup>3</sup>/day)

#### **7.1.3.6 Agro-ecological characterization, analysis and mapping**

To develop sound drought adaptation strategies, it is necessary to characterize the climate and drought at regional and national levels and to develop tools that can help in management and decision making at political and technical levels in the agricultural sector (El Mourid *et al.*, 1996):

- Determination of climatic change in time and space;
- Characterization of drought at national and regional levels (drought indices, length of growing periods);
- Development of maps of potential yields;
- Development of maps of land suitability and variety adaptation;
- Prediction of productions and crop management.

#### **7.1.3.7 Adaptation to agricultural droughts in Morocco**

The complexity of climatic change and drought phenomena in agriculture imposes the development of an integrated approach of drought mitigation (Karrou, 2002) based on the choice of varieties and species, and agronomic packages adapted to these situations.

- ✓ Development of new crop varieties

The recently released Moroccan varieties are characterized by large adaptation, due to their optimal earliness, their tolerance to drought and their fair resistance to certain parasites.

- In the case of cereals, more than 75 varieties have been released by INRA, 80 % of these varieties after 1983. The adoption of the new varieties by the farmers allowed 35 % and 50 % increase of respectively grain yield of bread wheat and barley. For the last 20 years, the yield improvement of cereals corresponds to an increase of 2 to 4 quintals per hectare at the national level, although this period was characterized by



many dry years. The shift from the old varieties to the newest ones increased also water use efficiency that jumped from 8 to 17 Kg of grains/mm of water used.

- For food legume crops, the most important research achievement is the shift of the period of sowing chick pea from spring to fall by developing adapted varieties (Rizki, Douyet, Farihane). The advantage of this type of crop (called winter chick pea) is that it takes advantage from fall and winter rains. For faba bean and lentil, two varieties per species adapted to drought prone areas were recently released.
- In the case of forages, in addition to the development of nine varieties of Medics and three of *trifolium subterraneum*, Acacia and more importantly *Atriplex* and the alley-cropping system (annual forage grown between strips or bands of *Atriplex*) were appreciated by farmers in the arid and semi-arid areas. (Karrou, 2002)

✓ Introduction of new species

Species consuming too much water are replaced by species with less water needs.

✓ Development of dry land agriculture techniques

In addition to the use of adapted species and varieties, researchers showed in on-station and on-farm trials that the adoption of dry land agriculture techniques in rainfed agriculture areas of Morocco can also substantially contribute to drought mitigation:

- **Minimum tillage, no-till and mulching** technologies: These conservation techniques reduce evaporation, increase the interception of rain and its infiltration and insure the saving of water, energy and time, guaranty a long term productivity increase and increase the sequestration of carbon (reduction of greenhouse gases emission).
- **Early planting** can help the plant to use more water (rains received early in Fall) and to avoid terminal drought stress and high temperatures. If this technique is used, cereals can produce 40 % more than when the late sowing is practiced (Bouchoutroch, 1993).
- **Chemical fallow** (weeds are controlled chemically by herbicides) allow the conservation of an amount of 75 to 100 mm of water in the soil (Bouzza, 1990), which is available to the following crop (usually wheat).
- When limited quantities of irrigation water are available, the application of 60 to 70 mm at critical growth stages as **supplemental irrigation** (tillering, heading and during grain filling in the case of wheat) can increase yields by 70 to more than 100 % (Boutfirass, Karrou et El Mourid, 1994). To take advantage from water saved due to conservation techniques and supplemental irrigation and from the rains received

during the growing season and hence increase yield and water use efficiency, crops have to be well managed.

- **Early weed control** (at 3 to 4 leaf-stage) reduces the competition between the crop and weeds for water and hence this water is better used to produce the crop yield (Tanji and Karrou, 1992).

## **7.2 EQUATORIAL LAKES REGION (BURUNDI, KENYA, TANZANIA, RWANDA)**

### **7.2.1 Tanzania**

The adaptation actions to drought in Tanzania are listed in the Table 38:

**Table 38: Adaptation actions in Tanzania**

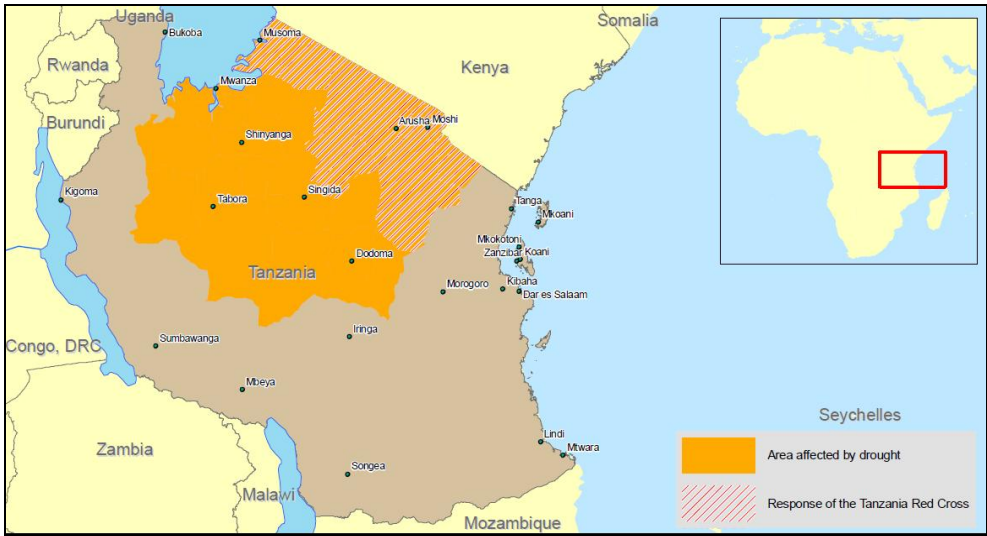
No.	Identified Droughts	Adaptation Actions Implemented	Impacts
1	<p>Agricultural drought (crop failures) during 2005/2006 (FSIT, 2006; TRCS, 2006; IFRCRCS, 2006); Figure 22</p>	<ul style="list-style-type: none"> <li>• Movement of people looking for work and indiscriminate logging as people try to cope by engaging in charcoal production</li> <li>• Maize prices are 85% higher than normal, whilst the cattle prices plunged to levels where a single cow would cost 20 kilos of grain</li> <li>• The Government of Tanzania targeted 613,405 food insecure people in 36 districts with emergency food distributions. About 21,499 metric tonnes of maize were released from the government owned Strategic Grain Reserve (SGR), at a highly subsidized price of TZS 50 per kilo</li> <li>• The FSIT survey in January 2006 set a target of 3.7 million people to be reached with subsidized food sales through local cooperatives until May. Of these, 565,000 people were to be given free food</li> <li>• On 14 February 2005, the government officially requested international assistance and asked for 100,000 metric tonnes of food. The UN's World Food Programme (WFP) was expected to coordinate international food donations</li> <li>• The Government also embarked on a campaign to raise resources domestically. At one of the function that was hosted by the President, local businessmen pledged over TZS 3 billion (approximately USD 3 million) in cash and kind to meet the crisis.</li> <li>• At the same time, the government was forced to introduce power rationing in response to falling water levels in its hydro-electric dams</li> <li>• The Government also suspended import duties on grain imports by commercial companies in an effort to boost supplies. Whilst the recommended price for commercial sale of maize was TZS 300 per kilo, in some areas the price was already TZS 500, reflecting not only scarcity but also the high costs of transportation, added concerns that many of the affected people would not be able to afford to buy expected commercial imports of some 100,000 metric tones</li> <li>• Disaster Management Office, WFP, the United</li> </ul>	<ul style="list-style-type: none"> <li>• Acute and widespread food shortages for Tanzania's rural population (nearly 11% of the mainland population) following prolonged droughts</li> <li>• Affected nearly 85% of Tanzania's 129 districts</li> <li>• More than 565,000 of those needed emergency food supplies (free food) at least until the end of April 2006, as they lacked the resources to purchase heavily subsidized staple food</li> <li>• Poor rainfall had significantly reduced pasture and water availability, resulting in massive emaciation including deaths of livestock, notably cattle in the pastoral and agro-pastoral zones</li> <li>• Evidence of crisis in the rural areas, such as significantly reduced food rations in homes, increasing school drop-out rates, movement of people looking for work and indiscriminate logging as people try to cope by engaging in charcoal production</li> <li>• It was estimated that 75,000 hectares have been decimated by the army worms ("<i>Spodopteraexempata</i>") infestation in the southern grain-producing areas. Not only does the infestation destroyed crops, and thus reduce the overall food supply, but it also affected the amount of grazing stubble available for pasture, since the plants exude a poisonous substance in defense against the worm, thus adding to the destruction of livestock</li> </ul>

No.	Identified Droughts	Adaptation Actions Implemented	Impacts
		<p>Nations Children's Fund (UNICEF), the International Committee of the Red Cross (ICRC) and others, formed a Federation and decided to issue a preliminary emergency appeal to support approximately 75,000 people in three northern districts (Arusha, Kilimanjaro and Manyara) for three months. The appeal, sought to mobilize resources for the local procurement and distribution of some 2,600 metric tonnes grain for the period March to May 2006</p> <ul style="list-style-type: none"> <li>The preliminary appeal was used as a base for a more comprehensive emergency appeal, which should include water and sanitation, health and livelihoods programming (possibly including livestock interventions) at a later stage</li> </ul>	
2	Bagamoyo (Eastern Tanzania) drought in 1991-1992 and 1996	<ul style="list-style-type: none"> <li>Tanzania Red Cross Society and in cooperation with the Federation undertook relief operation for the drought victims</li> </ul>	Food insecurity
3	Lushoto (North-Eastern Tanzania) flood and drought in 1993-1994 and 1996	<ul style="list-style-type: none"> <li>Tanzania Red Cross Society and in cooperation with the Federation undertook relief operations for flood and drought victims</li> </ul>	Food insecurity
4	<p>Semi-arid parts of Tabora Region (Mbola, Mpenge and Isila villages from Uyui District, and Tumbi from Tabora Urban) (Mid-Western Tanzania) in 2009</p> <p>Farmers, research and extension officers perceived increase in drought, temperature and dry spells as being associated to climate change and such changes have occurred in the recent ten years as compared to the previous decades</p>	<ul style="list-style-type: none"> <li>The majority of farmers have developed mechanisms of responding to erratic rainfall through splitting their plots and sowing or transplanting at different times in the season. Although this practice could be one of local adaptation measures, it resulted into further fragmentation of the already small fields and sometimes led to counter productivity as distribution of input resources across split plots may not be the same</li> <li>Farmers in the study area have responded to the impact of climate change and variability through various local adaptations including expansion of areas under cultivation to compensate for reduced yields during droughts, partly by reducing fallows, switch to more drought-resistant crops such as sorghum and cassava</li> <li>Some farmers reported growing alternative crops such as sunflower however; increasing pests and diseases incidences has hindered such effort. Another adaptation measures reported is</li> </ul>	<ul style="list-style-type: none"> <li>Major implications on rain fed agriculture are possible shrinking of the growing season, increasing moisture and heat stress to common food and cash crops, increased insects and pests and eventually low income and food insecurity (Mongi, Majule and Lyimo, 2010)</li> <li>Strong evidence demonstrating the vulnerability of rain fed agriculture to negative impacts of climate change and variability in the study area</li> <li>Recurrent drought, seasonal shift, dry spells and increasing temperatures are reported by farmers as major threats to agricultural production including food crop production. Monthly rainfall for the first and last two months in the season indicated declining trends. This implies delayed propagation for such crops like maize, groundnuts and sunflower, consequently declining yield. Further, it implies delayed transplanting of rice and tobacco, two major cash crops in the study area</li> </ul>

No.	Identified Droughts	Adaptation Actions Implemented	Impacts
		diversification to non-farm activities such as brick and charcoal-making, casual labour and carpentry	
5	The country's major drought in 2006 (Mongi, Majule and Lyimo, 2010)	Not reported	<ul style="list-style-type: none"> <li>• Serious food and power crises in the country</li> <li>• Cost of food shortage to the economy during that year amounted US\$ 200 million in food imports and distribution (Mongi, Majule and Lyimo, 2010)</li> </ul>
6	<p>Meteorological drought in Kilimanjaro and Arusha regions during 1998/1999</p> <p>Severe drought in Kilimanjaro and Arusha regions during 1999/2000 (ACT, 2000)</p>	<ul style="list-style-type: none"> <li>• Food aid to sustain people's lives in these areas. In 1999, for example, a total of 2,850 tons of maize were distributed in Mbulu, Hanang, Babati, and Karatu Districts by the ELCT Mbulu Diocese with assistance from Haydom Lutheran Hospital, the Norwegian Ministry of Foreign Affairs and the people of southern Norway</li> <li>• Increasing prices for food as supplies were squeezed</li> <li>• Decreasing prices for livestock due to distress sales</li> <li>• Migration of men in search of paid labour leaving women, children and elderly to fend for themselves</li> <li>• Migration of pastoralists to agricultural areas resulting in conflict with agriculturalists over water sources and grazing</li> <li>• Declining attendance at local schools</li> <li>• Increased felling of trees to produce charcoal for sale as an alternative source of income</li> <li>• In Mwanza, famers compelled to eat their seed stocks</li> <li>• In Shinyanga, eating porridge only once a day is now a common way of survival for many families</li> </ul>	<ul style="list-style-type: none"> <li>• Severe drought decimated the agriculture and livestock which accounts for 30% of the regional GDP</li> <li>• Rainfall has been declining over the past five years and in the crop season of 1998/99 most areas in the regions received very scanty rainfall. This led to serious crop failures that necessitated food aid to sustain people's lives in these areas.</li> <li>• The performance of the 1999/2000 cropping seasons in Arusha and Kilimanjaro were the poorest in the past ten years. Other regions facing similar conditions include Mwanza, Morogoro, Dodoma, Singida, Shinyanga, Kilimanjaro, Tanga and Tabora</li> <li>• The short rains of October-November 1999 were about 10% of the normal average, which while enough to rejuvenate pasture and water for livestock, was too little for food production</li> <li>• The 2000 long rains season (February-May) started late and was characterised by poor spatial distribution and stopped early which caused permanent wilting at the tasseling and grain filling stages for maize and wheat. Even drought resistant and quick maturing crops such as sorghum, finger millet and sweet potato were unable to survive which resulted in a total food production of only 20% of normal average</li> </ul>
7	Prolonged dry spells during the 2005/2006 season: Seven regions of Tanga, Mbeya, Lindi, Kagera, Morogoro, Iringa and Manyara had surpluses of varying magnitudes but had also several pockets of food shortages. Other food self-sufficient regions that had several pockets of food shortages include Coast, Kilimanjaro, Tabora and Arusha. The other	<ul style="list-style-type: none"> <li>• Where terms of trade between livestock and grain are good, livestock keepers were advised to sell part of their livestock now to buy grain and stock for future use</li> </ul>	<ul style="list-style-type: none"> <li>• The extended periods of dry spells affected availability of pasture and water which, subsequently, adversely affected livestock health and livelihoods of the pastoral and agro-pastoral communities particularly in the central and northern regions of Dodoma, Singida, Mwanza, Shinyanga, Arusha and Manyara</li> </ul>

No.	Identified Droughts	Adaptation Actions Implemented	Impacts
	Five regions of Shinyanga, Dodoma, Singida, Mwanza and Dar es Salaam had food deficits of varying degrees at regional level and in nearly all its districts (PMO, 2006)		
8	Drought in 2009 in the northern Tanzania	Not reported	<ul style="list-style-type: none"> <li>• Pastoralist villages lost up to 80% of their herds</li> </ul>
9	Drought in 2005/6	Not reported	<ul style="list-style-type: none"> <li>• Contributed to low water levels at key HEP installations and led to severe power shortages throughout the country and was reported to have reduced GDP growth by 1 to 2% (ECA, 2009)</li> <li>• An indirect consequence of these climate impacts is increased pressure on other natural resources such as fisheries, wetlands and forests, the latter suffering from encroachment and deforestation leading to increased soil erosion as people turn to charcoal, fuel wood and agricultural expansion as coping strategies</li> </ul>

Drought distribution in Tanzania is presented in Figure 91.



**Figure 91: Drought coverage in Tanzania during 2005/2006**

Source: ESRI, DIVA; IFRCRCS (2006)

**7.2.2 Kenya**

The impact of recurrent drought-related crises in Kenya is rapidly increasing, with more and more people being affected each time a drought occurs. Drought is becoming more frequent, giving less time for recovery in between droughts.

**7.2.3 Rwanda**

There is now greater focus on maintaining the in Rugezi wetland. New measures taken include the eviction of farmers out of the wetland, clearing of eucalyptus tree around the wetland (to prevent sedimentation from adjacent land use activities), creation of a buffer zone of 20m around the wetland, and creation of agro-forestry terraces to protect the wetlands against siltation by erosion in the catchment. These measures have been taken in order to restore the hydrological balance of the swamp currently under an international protection (Hategekimana, 2010).

In response to drought occurred in Eastern and South-Eastern region of **Rwanda** (Bugesera, Kibungo and Umutara) in 1999-2000, the Rwanda Red Cross, in collaboration with the Federation, organized seed and fertilizer distribution (IFRC, 2006).

With drought that affected all wealth categories and the shortage of land for farming, all households in Bugesera have had to devise mechanisms to cope with shortage of food. In order to cope with drought event, households had to sell their material or livestock to be able to buy food. In addition they took a strategy of reducing food consumption per capita in order

to survive food shortage. Another option was the migration and this was not only caused by food shortage for humans, but also for livestock keepers who lost pastures and water for their livestock. The migration had also the objective of searching for work to gain money or food. Another strategy was for some people to develop other economic activities not depending on agriculture like small commerce, bicycle transport, etc.

External response interventions included the following:

- (a) Humanitarian food aid relief.** The WFP and several NGOs (notably Caritas, World Vision, and Red Cross) have provided food supplies mostly targeting the most vulnerable groups i.e. widows and orphans.
  
- (b) Food-for-work programmes implemented by WFP, World Vision, Caritas and other agencies.** Under this arrangement, local people exchange their labour for food but they work on communal projects such as roads, construction of bridges and schools.
  
- (c) Restrictions on sale of food stuffs:** in order to regulate food prices, the Government announced a ban on sale of all agro-produce to private businesses, and directed farmers to sell to local cooperatives, reportedly to avoid speculative business people. In addition, some NGOs have been buying off produce and storing it to be resold to the communities during times of crisis.
  
- (d) Encouraging food storage through communal food banks.** Under this strategy, aiming at anticipating famine, each household is required to deposit some proportion of their food harvest to the public food store at sector level (no silos exist). This food is then recorded and in time of crisis, it can be withdrawn.
  
- (e) Creating off-farm employment opportunities.** The Labour intensive public works programme (HIMO) implemented a tree planting programme to restore tree cover and conserve the environment while providing employment for local people (UNDP, UNEP, GOR, 2007).

#### **7.2.4 Burundi**

In Burundi the adaptation actions are aiming to:

- To sensitize the population with the fight against the drought within the framework of the foreseeable climate changes;
- To elaborate and implement an integral management plan of the river basins in the safeguard of the environment;



- To develop the techniques of conservation and storage of water in particular allowing to face the risks of dryness in the vulnerable areas;
- To catalogue and update the studies related on drought knowledge within the framework of the foreseeable climate changes;
- Human capacity building in the evaluation and the integrated management of the drought.
- Reinforce the management of existing protected areas and include in protected areas the natural ecosystems identified as being threatened and vulnerable;
- Safeguard existing woodlots and reforest the stripped areas;
- Install mechanisms to control erosion in sensitive areas;
- Popularise short cycle and dryness resistant food crops;
- Identify and popularise the breeding of species adapted to local climate conditions; etc (MINATTE, 2007).

The Ministry of agriculture and livelihoods implements the following actions:

- Adoption of national drought adaptation programmes on soil rehabilitation;
- Adoption of national projects on drought adaptation capacity building in the sustainable management of lands;
- Land Community management.

The Ministry of health implements the following actions:

- Contribution in the national capacity building for better implementation of the health resilience to drought;
- Contribution in the implementation of health guidelines and drought adaptation mechanisms;
- Contribution in the preparation of projects related to the sensitization of local communities and population to drought effects and risks.

The Geographic Institute of Burundi implements the following actions:

- Installing automatic gauge stations for drought events forecasting and monitoring ;
- Acquire and install climatological automatic stations to improve early warning systems for extreme drought events;
- Training of climatological observers in equipments use, monitoring and analysis of meteorological drought events;
- Elaborate, validate and disseminate early drought warning messages through medias.

### 7.3 EASTERN NILE REGION (ETHIOPIAN PLATEAU)

Food aid has tended to be managed through emergency mechanisms that hand out food to needy households, rather than being part of development programs that build and/or protect assets (human, natural or physical).

Adaptation involves the action that people take in response to, or in anticipation of, projected or actual changes in climate to reduce adverse impacts or take advantage of the opportunities posed by climate change (Parry *et al.* 2005). In many cases, adaptation activities are local – district, regional or national – issues rather than international (Paavola and Adger 2005). Many authors have identified a portfolio of adaptive and coping strategies pursued by pastoral households and communities to adapt to and cope with risks and uncertainties (Scoones, 1996; Egeimi, 1996; Ali, 1996; Assefa, 1996; Bayer and Waters-Bayer, 1996; Ahmed *et al.*, 2002; Sommer, 1998; Fasilet *al.*, 2001; Dereveux, 2006; Rass, 2006).

These strategies include regular and opportunistic herd movements, tracking rainfall, diversification of species, herd splitting and distribution, livestock accumulation and changing species composition, dispersal of resources and assistance from relatives, forage supplementation, generation of food stores, sale of non-livestock assets, income generation from non-pastoral activities, reduction of food intake and change of composition of diet, etc. These strategies can be categorized into (i) adaptive strategies/responses, (ii) coping mechanisms to food crisis and (iii) drought recovery strategies. The following indicate categories of adaptive strategies:

- Mobility and opportunistic tracking;
- Diversification of species;
- Herd splitting and distribution;
- Livestock accumulation and changing herd/species composition;
- Dispersal of resources and assistance from relatives;
- Forage supplementation.

The following indicate categories of Coping Strategies to Food Crisis:

- Generation of food stores;
- Reduction of food intake and changing composition of diet;
- Sale of non-livestock assets;
- Mobilizing social support networks and claims;
- Income generation from non-pastoral activities.

## 7.4 EASTERN NILE REGION DOWNSTREAM COUNTRIES (EGYPT AND SUDAN)

### 7.4.1 Adaptation actions in Egypt

Many authorities are responsible for improving the deteriorated soils in Egypt, e.g., Executive Authority for land Improvement Projects (EALIP), General Authority for Rehabilitation Projects and Agricultural Development (GARPAD), Egyptian Public Authority for Drainage Projects (EPADP), and Agricultural Research Centre (ARC) each with a certain responsibility. The adaptation actions are listed in Table 39.

**Table 39: Adaptation actions in Egypt**

Intervention to Combat the Desertification	Adaptation Actions Implemented	Impact
Program for Irrigated Agriculture	<ul style="list-style-type: none"> <li>• Increase irrigation water use efficiency and agricultural productivity in Egypt's old lands.</li> <li>• Avoiding spillages into drains at the tail of branched canals</li> </ul>	<ul style="list-style-type: none"> <li>• Irrigation improvement</li> <li>• The integrated irrigation management project.</li> <li>• Land improvement, improvement of drainage for salinity and water-logging control.</li> <li>• Land levelling and reshaping for better water management</li> </ul>
Water and land pollution control	<ul style="list-style-type: none"> <li>• survey and monitor the</li> <li>• locations and impacts of industrial pollutants discharged to the water resources, polluting the</li> <li>• high-value productive land as well as lakes and marine environments..</li> </ul>	
Program for rehabilitation, conservation and sustainable use of range resources	<ul style="list-style-type: none"> <li>• Arrest degradation of the rangelands</li> <li>• and improve its production through the application of some measures (i.e. protection of range, reducing population of grazing animals ... etc.).</li> </ul>	<ul style="list-style-type: none"> <li>• Artificial revegetation of depleted ranges.</li> <li>• Conservation of soil and water resources.</li> <li>• Grazing management</li> </ul>
Program for rain fed agriculture	<ul style="list-style-type: none"> <li>• That will be executed in collaboration, cooperation and integration with the range management and other NAP's programs and intends.</li> </ul>	<ul style="list-style-type: none"> <li>• Land use planning</li> <li>•</li> </ul>
Program for sand dunes stabilization	<ul style="list-style-type: none"> <li>• Control sand movement to the High Dam Lake via establishing successive green belts crossing wind direction and contributed in improving the local climate and environmental conditions of the area.</li> </ul>	<ul style="list-style-type: none"> <li>• Control of sand encroachment on High Dam Lake.</li> <li>• Stabilization of dune sands in Siwa Oasis.</li> <li>• Stabilization of Shifting sand dunes in North Sinai</li> </ul>

### 7.4.2 Sudan

The main adaptation actions implemented for each of the identified droughts are as follows:

- Planting short maturing crop varieties;
- Reduce biomass fuel consumption (improved stoves);
- Introduce different cultural practices (planting in furrow bed, or planting on flat);

- Introduce new technologies (different type of machines, using mulching, infield water harvesting);
- Construct small scale dams.

## **7.5 SOUTHERN AFRICA – SADC AND THE LIMPOPO BASIN**

The Sorghum and Millet Improvement Program of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Matopos, Zimbabwe, provided (with funds from USAID) improved and tested varieties of drought-resistant small grains that matured earlier than the traditional varieties. These were approved for use in all of the SADC countries except Malawi - but even Malawi had a record agricultural harvest in 1993, in part due to improved maize seed that was distributed by an NGO (Callihan et al. 1994). Programmes had also expanded within the SADC to preserve cattle during times of drought, in order to help protect future livelihoods. These types of interventions were possible only because people in the region were not pushed into famine conditions under which they would have chosen short-run survival strategies over long-run subsistence strategies (Field 1995).

Famine preparedness and prompt response on the part of governments in the region to warning signs of famine are an important part of this success story. Even though regional stockpiles controlled by the SADC were insufficient to deal with the magnitude of the problem, the reserves were released onto the market early in the emergency, before food aid from other areas had arrived (Field 1995). Other interventions taken by governments in the region were far from novel but were implemented much earlier than similar strategies typically have been. Food imports and food aid, initiation or expansion of public works, and loans to agriculturists all addressed issues of supply and demand - rather than simply relief - early in the crisis (Field 1995). The government of Zimbabwe also pledged to purchase large quantities of grain before any donor aid had been committed; this proved to be a lifesaving factor (Callihan et al. 1994).

Early warning infrastructure in the region at the time of the crisis consisted of national Vulnerability Assessment Committees (VACs) linked into the SADC Food Security Network. This network was coordinated by the SADC-FANR Regional Vulnerability Assessment Committee (RVAC). RVAC emerged one or two years prior to the onset of the crisis, in response to a perceived lack of effectiveness of the SADC Regional Disaster Management Technical Committee, which had been formed two years earlier (Mano, Isaacson, and Dardel 2003). The national VACs typically include participation of government, NGOs, and the UN agencies, Food and Agriculture Organization (FAO) and World Food Programme WFP). FEWS NET, funded by USAID, collaborated closely with this structure. Two principal

mechanisms were used to generate information on the crisis as it unfolded. During April and May of 2002, FAO and WFP conducted Crop and Food Supply Assessment Missions (CFSAM) in Botswana, Lesotho, Malawi, Mozambique, Swaziland, Zimbabwe, and Zambia. These CFSAMs generated initial estimates of the number of households in need of food assistance. In principle, these estimates were to be updated over the course of the crisis by a series of joint “rolling vulnerability assessments” carried out by the national VACs .

With respect to changing capacities in drought preparedness during the three year period 1992-95, there are three areas of consideration; speed of response, institutional capacity at national and agency levels, and specific operational capacities in both food and non-food sectors. The speed of drought response has been affected by many factors. Although southern Africa has well-developed national and regional systems for meteorologic and agricultural early warning, official governmental reaction to drought conditions has varied greatly from country to country.

Countries in the region made use of both food-for-work and cash-for-work programmes. Almost all of the targeted food-distribution programmes were implemented through non-governmental organizations (NGOs) that had been operating in the affected communities prior to the drought. Resources came not only from the NGOs but also from proceeds from food sold through market channels. Maize subsidies were lifted in Zimbabwe and Zambia during the relief effort, to increase producer incentives at a time when large supplies of foreign maize would otherwise have driven prices down (Callihan et al. 1994). Malawi was the only country that relied on completely free distribution of food as part of its relief effort.

In 1997, the Food Security Technical and Administrative Unit (FSTAU) of the Southern African Development Community (SADC) organized a high-level drought policy seminar in Botswana in response to the threat of a serious regional drought following a strong El Niño phenomenon. The report of this seminar recognized that drought in Southern Africa is a normal and recurring event, and called for long-term action in:

- Investment in soil and water management, such as the improved development and management of fragile catchment areas and river basins, including small-scale irrigation;
- Reviewing the appropriateness of current crop production patterns and possibilities in support of more intensified crop diversification policies;
- Redirecting research towards more appropriate farming systems;
- Improved rangeland and livestock management;
- Reviewing institutional arrangements and physical infrastructure.

Table 40 shows adaptation actions in Limpopo identified from available literature.

**Table 40: List of drought adaptation actions obtained from available literature**

Drought Period	Identified Drought Adaptation Actions
1981-1984	<ul style="list-style-type: none"> <li>• Building capacity to adapt to climate change</li> <li>• Strengthening Local Agricultural Innovation Systems in Less Favourable and High Potential Areas</li> <li>• Programme for Basic Energy and Conservation</li> <li>• Community based adaptation to climate change in Africa Development of climate - resilient crop varieties,</li> <li>• Best conservation agricultural practices, for example, implementation of multi - cropping system.</li> <li>• Land care programme focuses on land restoration</li> <li>• Early System Programme main focus is to provide climate information in a form of advisories to farmers</li> <li>• Plant breeding programme main focus is to develop heat tolerant crops</li> <li>• Change in planting date, row spacing, planting density and cultivar choice.</li> <li>• Planting drought resistant crops such as sorghum and millet, or shifting from crop to livestock</li> <li>• Promoting practices such as conservation tillage, furrow dyking, terracing, contour plantings and planting windbreaks</li> </ul>
1984 -1988	<ul style="list-style-type: none"> <li>• Climate Change and Water Programme</li> <li>• Managing Climate Risk to Agriculture and Water Resources</li> </ul>
1991 - 2005	<ul style="list-style-type: none"> <li>• Rehabilitation of degraded cropland; includes introduction of agroforestry and mixed cropping systems to improve the nutrient status, zero or minimum tillage systems to minimize soil erosion, and physical soil conservation measures.</li> <li>• Rehabilitation of degraded rangeland; includes introduction of sustainable livestock</li> <li>• Management, group and individual title to land, zero grazing, and physical soil conservation measures.</li> <li>• Rehabilitation of degraded forests and woodlands; includes improvement of sustainable</li> <li>• Communal forest management, development of communal woodlots, alternative sources of energy and agroforestry</li> <li>• Improving water management through integrated catchment management, focusing on holistic water use, with a balance between all land uses, including plantation forests, efficient irrigation systems, safe drinking-water, water for cattle, and water harvesting</li> <li>• Combating desertification by addressing the socio-economic causes as well as the physical ones. Measures include: introduction of sustainable production methods</li> <li>• Trees in crop production systems; and physical methods of wind and water erosion control. People's participation in the development of soil and water conservation strategies is essential.</li> <li>• Dam construction;</li> <li>• Water harvesting;</li> <li>• Small irrigation schemes;</li> <li>• Food storage programmes. develop capacity for drought early warning units</li> <li>• import of cereals and relief package for rural people</li> <li>• wider use of early-maturing varieties</li> <li>• adjusting planting dates</li> <li>• Addressing major yield limiting factors.</li> </ul>

### 7.5.1 Botswana

The main adaptation actions implemented for each of the identified droughts are listed in Table 41:

**Table 41: List of drought adaptation actions obtained from available literature**

Adaptation measures - Water	Adaptation measures-Agriculture and food security
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resources-	
<ul style="list-style-type: none"> <li>• Water harvesting</li> <li>• Recycling of water.</li> <li>• Water rationing.</li> <li>• Inter-basin water transfers.</li> <li>• Water conservation</li> <li>• Management of ground water resources.</li> </ul>	<ul style="list-style-type: none"> <li>• Reforestation.</li> <li>• Purchase of water from other countries.</li> <li>• Control of deforestation.</li> <li>• Encouraging tree planting around homesteads.</li> <li>• Improved rangeland management.</li> <li>• National drought early warning system.</li> <li>• Changing crop varieties, e.g. plant sorghum instead of maize.</li> <li>• Expansion of protected areas.</li> <li>• Expansion of Community Based Resource Management.</li> <li>• Strategic destocking.</li> <li>• Diversification of breeds and species used,</li> <li>• Greater use of managed wildlife.</li> <li>• Control of animal numbers and grazing reserves.</li> </ul>

### 7.5.2 Mozambique

The main adaptation actions implemented for each of the identified droughts are as follows:

- Strengthening the early warning system;
- Strengthening capacities of agricultural producers to cope with climate change and variability;
- Reduction of climate change impacts in coastal zones;
- Management of water resources under the framework of climate change for the reduction of droughts and flood impacts along the hydrological basins.

### 7.5.3 South Africa

The main adaptation actions implemented for each of the identified droughts are listed in Table 42:

**Table 42: List of drought adaptation actions available from literature**

Adaptation measures- Water resources	Adaptation measures- Agriculture and food security
<ul style="list-style-type: none"> <li>• Water harvesting</li> <li>• Recycling of water.</li> <li>• Water rationing.</li> <li>• Management of groundwater resources</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of dams for irrigation</li> <li>• Water harvesting</li> <li>• Recycling of water</li> <li>• Water rationing</li> <li>• Management of ground water resources</li> <li>• Reforestation</li> <li>• Growing drought tolerant varieties</li> <li>• Early planting and staggering planting dates</li> <li>• Strategic grain reserves (food storage programmes)</li> <li>• Conservation Farming</li> <li>• Development of drought early warning systems</li> <li>• Animal production and livestock health programmes</li> <li>• Use of soil and water conservation techniques</li> <li>• Crop monitoring</li> <li>• Crop diversification</li> </ul>

### 7.5.4 Zimbabwe

The main adaptation actions implemented for each of the identified droughts are listed in Table 43:

**Table 43: List of drought adaptation actions in Zimbabwe obtained from available literature**

Adaptation measures- Water resources	Adaptation measures- Agriculture and food security
<ul style="list-style-type: none"> <li>• Water harvesting</li> <li>• Recycling of water</li> <li>• Water rationing</li> <li>• Management of groundwater resources</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of dams for irrigation</li> <li>• Growing drought tolerant varieties</li> <li>• Early planting and staggering planting dates</li> <li>• Strategic grain reserves (food storage programmes)</li> <li>• Conservation Farming</li> <li>• Development of drought early warning systems</li> <li>• Animal production and livestock health programmes</li> <li>• Use of soil and water conservation techniques</li> <li>• Precision application on soil nutrient amendments e.g. N micro dosing</li> <li>• Improved cropping pattern</li> <li>• Post-harvest management</li> <li>• Crop monitoring</li> <li>• Crop diversification</li> </ul>

### 7.6 WEST AFRICA - NIGER BASIN

Regarding the 1972-1973 drought, the State and the community were less organized, the shock was not prevented, there were no NGOs and the population was not organized. Rainfall deficits and low water flows did not allow for a refilling and that resulted in:

- Rural exodus ( migration from rural areas to urban areas);
- Nomads carrying on fishing;
- Market crop gardening was introduced (the first market crop gardening areas was established during this period) and the technicity was not well-developed;
- Cereal crops (onion, okra, etc.) were encouraged.

During this same period adaptation measures were taken by the Government:

- Off-season areas;
- The development of ponds, which were no longer receiving water.

During the 1984-1985 drought NGOs started to be present on the ground, cereal banks were established and technical services were accessible. There was no harvesting but the way the population, the Government and the community were organized allowed to better manage the period of drought. Several adaptation strategies were put in place at national and local levels.

The identification of relevant solutions for adaptation to the harmful effects of climate change, has been made according to a bottom-up participatory approach based on local



consultations. Mali has adopted an original approach by choosing local NGOs for organizing consultations. Firstly, these NGOs were trained in the participatory method for identifying priority actions. This had a very positive impact because these NGOs were already working with the population, which facilitated the mobilization of all the stakeholders as well as mutual communication and their active participation.

The no less important spillover benefit for these NGOs and technical services involved in the process was the building of their technical capacity in the field of climate change. The priority adaptation activities (to be defined) should respond to proven vulnerabilities in the various parts of the country and in the various sectors (according to the vulnerability assessment made from the knowledge of the stakeholders, and especially local populations) and be in adequacy with the national development policy drawn up through the Poverty Alleviation Strategic Framework. These activities are going to fit in the framework for potential relevant solutions identified during the local consultations mentioned above at the level of each sector as described in the following sections.

#### **7.6.1 Agriculture sector**

Given the drought situation, one could observe a high level of migration of the population from the North to the South of the country and a high level of migration towards coastal countries and towards Western countries. This mobility fits in the framework of the autonomous adaptation the population has spontaneously developed. In fact during this period, able people emigrate towards more localities and countries with better living and working conditions with the aim to work there and purchase food to feed family members who stayed in the home village. For the people who were no longer able to migrate and who were compelled to stay in the home village, livelihoods were linked to resources such as legumes or edible plants, products from fruit-gathering that have become scarce, fungi and tubers of wild plants, products from hunting and fishing, wild or domestic fruits, and wild gramineae.

The persistence of drought and of rainfall deficit also made the population carry on rain-fed agriculture in lowlands and in the valleys of rivers and ponds liable to flooding, especially for rice farming. However, when exceptional rainfall situations prevail, the coarse grain crops grown in these zones are endangered, which has often led to food shortage situations. For coping with this situation, farmers have adopted new landuse methods. Thus farming on highlands has experienced rapid development. Other measures initiated by the State are related to making free security stocks available to the population or at reasonable price, the liberalization of prices, tax exemptions for cereal imports and request for international assistance.

In case of flooding having entailed food disasters, the same measures above are to be resorted to. In addition to these measures, one should mention the displacement of the population from the flooded areas towards more appropriate sites. Not long ago, other solutions were initiated and continue to be used because of the positive effects they have had on agricultural production, that is:

- Use of suitable crop varieties

For coping with rainfall deficit and poor distribution, many farmers have resorted to varieties with short cycle corresponding to the period of water available and with low water requirements.

- Agrometeorological assistance to the rural world

Rainfall problems led the National Meteorological Directorate to implement a programme for assistance to the rural world. This assistance is relating to the sensitization, the training of farmers in using agrometeorological information and advice, the drawing up of provisional calendars for the implementation of the main farming interventions and the setting up of a database, a rural area system of reference for farmers). The advices meant for the rural world are generally relating to the following:

- The agro-climatic base calendar for the planning of agricultural activities (period of land preparation, agricultural implements and inputs, etc.);
- The ploughing and sowing time based on the tentative calendar for sowing, the daily rainfall records, the water balance and daily weather forecasts;
- The appropriate period for agricultural interventions (onset, weeding, use of fertilizers) based on water balance and daily weather forecasts;
- The time of occurrence of some diseases, especially mildiou, depending on the rainfall, temperature, and humidity (warning).

These solutions greatly contributed to increasing agricultural productions.

### **7.6.2 Natural resources**

- Water resources

Adaptation measures focused on surface water control such as small rural dams, the development of ponds and small water courses at the level of villages and the creation of artificial ponds have been undertaken. In the framework of poverty alleviation, income generating activities for the population have been coupled to land development like market crop gardening, flood recession farming, fishing. Other measures have also been implemented such as the drilling of boreholes, land development operations for groundwater recharge, operations for digging wells. The costs of these land development actions and

equipment are generally beyond the means of the populations, which required a strong involvement of the State and development partners in the implementation of such costs.

- Forest resources

For controlling the effects of the drought of the nineteen seventies (1970s,) Mali designed a National Desertification Control Programme. The improvement of improved stoves (IS) was also included as well as the preparation of several legislative and regulatory texts for natural resources protection. Other important measures were also taken at national level such as a the Manual of Reference for the construction and use of improved stoves (IS) in Bamako in 1983, the adoption of a law by the National Assembly in 1986 making the use of improved stoves mandatory and the setting up, in 1986, of a National Advisory Committee (CNCFA) entrusted with coordinating the activities of the various services and projects for the promotion, dissemination and the sensitization of the population. Major projects were also undertaken namely the Regional Improved Stoves Project of the Inter-State Committee for Drought Control in the Sahel (CILSS), dissemination projects on improved stoves and intervention on firewood supply sectors and the Improved Stoves Project of the National Directorate of Social Affairs. Furthermore, all rural development projects (agricultural, forestry, etc) had a dissemination component on improved stoves. More recently, being aware of the forest resources degradation phenomenon, Malian authorities launched the Household Energy Strategy (SED). Its main objective was to contribute to environmental protection and to desertification control by limiting the withdrawal of woody fuels according to the real regeneration capacity of forest stands. It is worth noting that the results of the Household Energy Strategy (SED) were controversial. Currently, the Mali Agency for Household Energy Development and Rural Electrification (AMADER) is integrating the objectives of the Household Energy Strategy.

Other measures include the following:

- Sensitization of the population;
- Introduction of applied research products in agriculture and livestock breeding;
- Recycling of household and industrial waste waters;
- Protection of waters against pollution of any origin (urban, industrial, agricultural waste);
- Integrated resources water management taking account the various users;
- Strengthening sub-regional cooperation in the field of transboundary resources water management;
- Strengthening the involvement of producers in decision-makings and the devolution of responsibilities upon them in relation to the sustainable management of silvopastoral resources;

- Development of an advocacy/ sensitization by and for the stakeholders of sustainable development.

### **7.6.3 Soils**

For compensating for losses of soil fertility, farmers were trained since the nineteen seventies (1970s.) in making organic manure. However, cultivated land areas related mainly to cotton growing expanded and the use of organic manure has been slowing down. Currently, farmers are again showing interest in the use of organic manure.

### **7.6.4 Energy**

In the energy sector in Mali, an update on the effects of climate change highlighted two subsectors, which are very vulnerable to climate change. These are the hydroelectricity subsector and the sector of woody fuels ( wood and charcoal). Given such climate disturbances, the population and the State have taken or planned adaptation measures which, if applied, will allow for reducing the negative impacts of climate changes and variabilities.

- Adaptation in the hydroelectricity subsector

Before Mali gained independence, the hydroelectricity subsector existed in Mali: the power plant in Felou, near Kayes, the Sotuba plant power in the nineteen sixties (1960s) and the Selingue power plant in the nineteen eighties (1980s). With the decrease in rains resulting in low refilling rates of the catchment lakes, the various power plants, which were supplying towns (Kayes, Bamako and Ségou) were strengthened by generators during the period extending from April to June. This period corresponds to a time of considerable electricity requirements of towns. It is also the time when the various catchment lakes of power plants are empty by half.

- Adaptation in the woody fuels subsector

The lack of woody fuels in some parts of Mali, and especially in major towns has become very preoccupying since the severe drought of the nineteen seventies. In zones of the Niger Inner Delta, the Seno or areas with high concentration of cattle breeding, cow dungs are collected during the dry season for use in the rainy season and in the cold season as a source of energy (cooking, heating, smithery, etc.). The large scale use of cow dung as a source of energy for smoking fish has become very common along water courses and ponds (Niger River, the main lakes and ponds from the 4th to the 7th administrative regions). In the southern parts, given the drought situation, natural resources management projects have been put in place for a short and long term settlement of the fuel problems (village management in 2nd administrative region, PGRN, Household Energy Strategy, etc.).

Other measures include:

- Implementation of energy efficiency;
- Promotion of products substituting woody fuels;
- Promotion of renewable energies;
- Development of hydroelectric sites in order to reduce electricity consumption costs and urge the population to use electric household appliances (electric furnaces and stoves);
- Building capacities for forest resources management.

### **7.6.5 Health**

About twenty years ago, to control or prevent some diseases, the State through their hygiene services, carried out regular inspections in households and the neighbourhood to assess the status of cleanliness and healthiness. Following such inspections, owners of unhealthy households and people living near unhealthy places were ordered to pay fines. At regular intervals, the same hygiene services were disinfecting compounds. In addition to these two operations, the hygiene services used to organize periodical campaigns to administer quinine in the various schools and neighborhoods for malaria prevention.

Other actions were also undertaken as follows:

- During period of high heat:
  - Watering house-yards and public squares;
  - Immunization campaigns for the population;
  - Temporary close down of schools during periods of epidemics.
- During the rainy season:
  - Weeding of public squares and the fronts of compounds;
  - Cleaning and scraping of gutters;
  - Campaigns for immunization against the main endemic pathologies such as malaria, meningitis and measles;
  - Transmission of information through people, by letter, through travellers etc;
  - Restrictions for travels and visits to sick persons in the neighborhood, sometimes even regarding visits to families during periods of epidemics.

On the effects of climate change on the health, the following adaptation actions are being implemented:

- Training, sensitization, information and communication on the harmful effects of climate change on the health and well-being of the population;
- Setting up of a system for the prevention and response to climato-sensitive diseases;
- Assessment of the real impacts of climate change and variabilities on the health and well-being of Malian population;

- Drawing up of plans for warning against extreme weather.

### **7.6.6 Infrastructure**

At the level of road infrastructures, the adaptation solutions used in the past were mainly the traditional means of transportation suitable for each locality and for each season. That is the transport of goods on one's head, on the back of a donkey, on the back of a camel, and by canoe either from one village to another in the same locality or from one locality to another mainly from southern regions to northern ones, or the other way around. These methods of transport were also used in international trade between Mali and its neighbouring countries (especially coastal countries). It is also worth noting the existence of the Bamako/Dakar railways system, which has been playing since then an important role in opening up Mali to the outside world through the Dakar sea-port.

Local solutions for adaptation of settlements and hydraulic infrastructures to the harmful effects of climate change and to extreme climate events (droughts, sandstorms, thunderstorms) were implemented. These are the use of local building materials suitable for the construction of structures, the architectural styles and the judicious choice of the location of dwelling places and of hydraulic infrastructures.

### **7.6.7 Agriculture**

In the sectors of agriculture, livestock breeding, fishing and agroforestry the strategies adopted by producers for coping with climate change are described in this section. These solutions are complemented by measures such as:

- Deepening of ponds, channels, and supplying canals of irrigable zones;
- Return to lower zones;
- Crop diversification;
- Large scale use of organic manure;
- Adoption of water conservation techniques (zaï, micro basins etc);
- Use of short-term crop varieties, for example lowlands rice in Madiama and Gathi Loumo;
- Use of early maturing varieties of sorghum, millet, rice provided by research;
- Use of several types of water retention structures in the various rice farming and pastoral border strips, such as small water retention structures (Figure 92), bunds and embankments, small village irrigated areas (Figure 93), market crop gardening areas.
- Adoption and use of protection and restoration measures (anti-erosion bunds/ embankments, mixed farming, water and soil conservation (zaï, micro basins);

- Regular supplying with inputs;
- Development of a farming calendar for different crops, with the support from research;
- Deepening of the existing natural channels;
- Continuation of development of hydro-agricultural schemes;
- Regular supplying with agricultural equipment and agricultural inputs;
- Safe drinking water supply;
- Decentralized financial systems;
- Setting up of micro-credit systems;
- Setting up of various producer organizations;
- Building the capacities of farmers organizations;
- Involvement of the population for constructing classrooms and health centers.



**Figure 92 : Hydro-agricultural structure in the pastoral border strip of Daiby at about 6 km south of Mopti**



**Figure 93: Mixed Rice-Fish farming in the small irrigated perimeter of the village of Gnimitongo at about ten kilometers North of Mopti.**

#### **7.6.7.1 Livestock-breeding**

The following adaptation actions are practiced by farmers as local practice:

- Gathering and stocking of 'borgou' (*Echinochloa stagnina*) also referred to as 'gamawaral', crop residues, fruit of 'balanzan' and of *Albida nilotica*;
- Organization of farmers communities and livestock breeders communities for a rational use of space during the farming season.

The following adaptation actions are introduced as improved practice:

- Introduction fodder crops (fodder cowpea in Madiama, Mopti and Gathi Loumo);
- Intensification of 'bourgou' farming in Korientzé, soufouroulaye-Diaby, Karbaye, Ibetemi, Youwarou and Ténenkou;
- Organization of livestock breeders for the rational use of the pastoral space;
- Training of livestock breeders in techniques for fortifying rice straw with urea;
- Materialization of the pastoral space in Madiama and of the crossing points in Tiroguel and Saré Mala;
- Regular supplying with Hacienda animal-feed (ABH) health protection for animals;
- Construction of vaccination enclosures and embankment enclosures for livestock export;
- Construction of pastoral wells;
- Artificial insemination in Ténenkou, Mopti, Diafarabé.

The following measures are also implemented:

- Deepening of ponds and construction of pastoral wells in Sensé, Koufa Dagadjan, Sofara;
- Regular supplying with subsidized animal feed;
- Construction of vaccination enclosures;
- Regular supplying with veterinary medicines;
- Intensification 'borgou' farming;
- Capacity building of agro-pastoralists;
- Popularization of artificial insemination tests (improvement of local breeds);
- Materialization of pastoral spaces, delineation of grazing lands (paths, 'bourtols', stop-over shelters)

#### **7.6.7.2 Fishing**

The following adaptation actions are practiced by farmers as local practice:



- Diversification of fishing gears and practices;
- Diversification of activities;
- Use of measuring instruments in fish marketing that was practiced by women in the past;
- Seeking of new techniques adapted to the rejuvenation of stocks and to the exploitation of new biotopes;
- Individualization of fishing practices (adoption of fishing gears operated by one or two persons, collective fishing gears);
- Changes in the way of fish-processing by taking account of both domestic and external demand (smoking and slight burning of fish (85%) for the purpose of drying up (15%));
- Fishermen shifting to other activities (agriculture, poultry raising ,market crop gardening, river transport);
- Migrations from the Niger Inner Delta for seeking more productive fishing areas (Sélingué, Manantali, Republic of Côte d'Ivoire,...).

The following adaptation actions are introduced as improved practice:

- Pond development (fish-breeding);
- Improvement of processing/ preservation techniques (improved furnace: cherkor, insecticides for the preventive treatment of fish through 'Opération Pêche Mopti');
- Setting up of fishing councils and preparation of local fishing conventions;
- Support to the Fishermen Organization (equipment, micro credits to women in Youwarou, Dialloubé and Konna).

The following measures are also implemented:

- Freeing water courses and natural feeding channels from sand;
- Development of fish-breeding;
- Providing fishermen with fishing gears and materials;
- Support to the organization and to capacity building of fishermen ( training);
- Putting micro-credits systems in place;
- Protection of river banks (embankment, reforestation);
- Creation of school and health infrastructures;
- Regular supply of safe drinking water. Safe water is an acute issue when water level is low in the river and water does not flow. One can note the proliferation of waterborne diseases. As illustrative examples are the cholera endemic that prevailed in some localities of the Niger Inner Delta from October 2003 to October 2005 and an epidemic of the same disease occurred from 1982 to 1983.

### 7.6.8 Agroforestry

The following adaptation actions are practiced by farmers as local practice:

- Protection local species;
- Production of seedlings by village nurseries;
- Use of plants on farms, live fencing, windbreaks;
- Setting up of village brigades for protecting the fauna and flora in Madiama and Youwarou;
- Adding value to forest products through the marketing of dead wood (Youwarou, Mopti)

The following adaptation actions are introduced as improved practice:

- Introduction of agroforestry;
- Fixing of the soil on river banks (reforestation along the river in Diafarabé and Kouakourou) and fixation of sand dunes in Gathi Loumo, Djoura and Dogo;
- Protection of natural regeneration in some forests (Dintaka and Akagoun by IUCN in the Circle of Youwarou);
- Tree planting: alignment, shadows, village woods;
- Development of improved and adapted varieties of the main drought resistant cereal crops;
- Adoption of new farming systems;
- Diversification of production;
- Construction of hydro-agricultural infrastructures;
- Use of meteorological information for improving agricultural production;
- Development of fodder crops and management of safe drinking water points;
- Training/ sensitization to hygiene and to sanitation;
- Improvement of food availability and strengthening of the warning system;
- Building innovative capacities.

### 7.6.9 Desertification and climate change

**Desertification** is a major threat in West Africa. The main measures generally suggested for controlling desertification are as follows:

- a) Promotion of Integrated Water Resources Management (IWRM). In most of national communications, this measure aims specifically at water management at the level of catchment areas. We mainly recommend the institutional strengthening of basin agencies where there are any Existing (OMVS, NBA, OMVG, etc.) and the establishment of agencies in the basins where none are present (example of the

Volta River). First and foremost, it is worth noting that national communications do not clearly state how IWRM could contribute to reducing the countries' vulnerability to climate change. Then, one can note that given that the most significant water courses in the region are transboundary ones, such a measure should be envisaged at both national level and interstate level around river basins, and even at regional level.

- b) Strengthening knowledge on water resources: Firstly, this measure concerns quantitative information (estimation of the resource availability and its variations in time and space) but also qualitative data relating to surface waters and groundwater. In connection with this measure, many communications are pleading for the extension and/or the establishment of networks for the observation and mobilization of increased efforts to support research. It is clear that each State can bring a significant contribution to the implementation of this measure (support research, strengthening of the data collection network). However, owing to the above mentioned reasons (strong regional inter-dependence in water issues), the effective and sustainable implementation of this measure requires a coordination at the level of basins or at regional level. In some basins (especially the ones not having a basin organization), some riparian States sometimes set up their own network for data collection and processing (for example GIS) without consultations with others. That leads to the production of fragmented information that would be, therefore, of limited usefulness.
- c) Controlling erosion and the deterioration of water quality through the reforestation of watersheds. As mentioned above, water courses in the region are subject to erosion, to sand silting and even to water pollution (example of the middle section of the Niger River). Where there is none, small and large catchments are endangered of being filled up by sedimental deposits (for example some sources deem that small water catchments of Burkina Faso have lost a considerable part of their capacity because of sedimentation).
- d) Better legislation or application of legislations in force: Many national communications also suggested the implementation in force of the texts on the environment and natural resources management, especially the practical implementation of national water policies. The necessity of the application of international conventions on the environment (humid zones, biodiversity and desertification) is often underlined as one of the appropriate responses to variability and to climate change. Connected to this, one should recall that all the countries in the region, except for Liberia and Cape Verde have accessed the Ramsar Convention on Wetlands and that Sierra Leone is the only one not still being a party to the Biodiversity Convention.

At national level more specific measures for adaptation to variability and to climate change in the water resources sector are communicated. Among these measures, it is worth noting the following:

- Inter-basin water transfers;
- Conjunctive use of surface waters and groundwater;
- Artificial refilling of aquifers;
- Closed channels in the water supply lines;
- Popularization of technologies and more water saving behaviors;
- Recycling of waste waters (household and industrial);
- Desalification of sea-water;
- Harvesting of rain-waters, etc.

Some measures proposed for agriculture are also relevant for the water resources sector and these are:

- The erection of structures allowing for the collection of runoff water and rain water in order to avoid losses as well as erosion and flood phenomena, while facilitating the refilling of aquifers;
- A better mastery of irrigation techniques for making them more effective and more water saving;
- Strengthening the early warning system in case of extreme events (droughts, floodings) and agro-hydro-meteorological monitoring.

Finally, some communication underlines the dual role of some adaptation options that could also have a carbon sequestration role (reforestation operations) and could contribute at the same time to the mitigation of greenhouse gas emissions. The following are amongst the mitigation measures at regional level:

- Water control infrastructures: In West Africa, significant investments were made in water control and hydro-agricultural infrastructures. For example, Burkina Faso - a country located on the pre-Cambrian soil therefore, with very limited underground aquifers resources, has invested massively in small water catchments. This country has constructed over 1,500 of them during these recent three decades. Other countries in the region (Benin, Niger, Mali, Senegal) have now embarked on similar actions. Concerning big dams, as mentioned above, the region has now only 110 dams whereas countries such as the United States of America and China which have comparable land areas, have respectively 6,000 and over 20,000 dams. India, 1/3 of the land-area of West Africa has over 5,000 big dams. However, one should note that each of the countries in the region has at least one big dam project in its drawers. On the River Niger alone, there are 9 big dam projects at a more or less advanced stage

of planning. In total, even when taking into account the efforts for promoting irrigation (5 % of cultivated lands at the level of Africa against a global average of 17%), West Africa has a weak water control and remains highly dependent upon climate hazards.

- Artificial rains: That is techniques consisting in making rains fall through cloud seeding. It is being experimented in Burkina Faso since the year 1999, in collaboration with Morocco. Unfortunately, it is a heavy and expensive technique with often uncertain results. Even, if one can make a longer list of attempted responses conducted here and there, the fact is that generally the most noteworthy solutions West Africa has brought to chronic drought and to the increase in climate variability, which has been prevailing in the region for three decades now, concern research, that is to say data collection and, to a less extent, data analysis. This is obviously very important but research efforts remain insufficient. In any case, the significant reduction of the vulnerability of the region to variability and climate change requires that research actions should be supplemented by concrete adaptation measures on the ground.

The following measures are also implemented:

- Deepening of natural channels in Djangoudjé, Banika in the Circle of Youwarou;
- Production of seedlings, reforestation;
- Organization of the marketing of dead wood;
- Multiplication village woodstock for timber production;
- Promotion of renewable energies ;
- Building the capacities of tree-planters.

The requirements for implementation of the desired actions include: social cohesion, awareness-raising in the population on the consequences of climate change, their commitment, their courage to overcome the current difficulties. Among weaknesses, one can note the implementation of manual tasks and the lack of technicians most of the time.

The decrease in floods entailed a behavioral change in farmers, leading them to adjust to the new conditions created by the degradation of climate conditions and the construction of upstream dams. This is what was explained by Tagola (2002), for whom "...cultivated land areas vary with the level of the flood: during our field surveys we observed that sorghum farms were 4 kms width more than in 2 000 as compared with the year 1999. The decrease in rainfall reduces not only cultivated land-areas but also the production of rain-fed crops. It entailed a pauperization of farmers and compelled them to seek other sources of income. It

is in this context that off-season crops were adopted. The proceeds of their sales are used for purchasing the necessary additional quantity of cereal for family consumption, but they give rise to the issue of space sharing. Therefore, the population knew how to cope with the impact of the decrease in floods on agriculture. The results of our survey highlights other adaptations. Since the occurrence of drought, the flooded land-areas of `` bourgou`` has been increasingly shrinking. Animals were coming home only for drinking through corridors delineated for that purpose.”

Among these forms of adaptation, it is worth mentioning that the one which is most practiced is migration, or growing less crops, or even sowing early varieties. In fact, the Niger Inner Delta area is subject to a high migration of its inhabitants. This migration takes place within the Mopti region or at national level, and even internationally. On crops, farmers think that by sowing less they can bring a response to the uncertainties of flooding. That allows for minimizing risks of losses of energy and means in case floods are not sufficient. Furthermore, that is the reason why early crop varieties (9 local varieties) are widespread and more used, because these seeds have the advantage of not being renewable contrary to improved seeds which are sown in border strips under controlled submersion and in small village irrigated perimeters. These varieties are exclusively sown in uncontrolled submersion zone. Among other forms of adaptation, the following can be mentioned:

- The deepening of ponds, channels and feeding canals of irrigable zones canals. This form of adaptation is a response to water deficit that characterize some zones, especially the ones located in the lateral parts of the Delta. It is a strategy consisting in creating conditions allowing for carrying on a double cropping per year: one cropping in wet season and another one in dry season.
- Shifting back to lower zones: In some places, the cultivable part of the Delta can be subdivided into two parts. A first part, is the farming zone during years of good floods. A second part is the one to shift back to when floods are not good. In fact, the level of the flood can be a disturbing factor for the crop development when it is too high; this is what accounts for the alternative movement between the two parts. Shifting back to lower zones is easy as uncontrolled submersion rice does not always need to be sown. The seeds which fell on the ground during the previous harvest are sufficient for regenerating the farm. This form of adaptation is widespread in the lateral zones of the Niger Inner Delta.
- Large scale use of organic manure mainly used in border strips under controlled submersion by those who cannot use fertilizer because of its relatively high cost. Manure is also used as a supplement to fertilizers.

- Adoption of local techniques for Water and Soil Conservation, Environmental Protection and Restoration (WSC/SDR), zaï, micro-basins etc. These techniques are mainly carried out in the dewatered Delta because low rainfall and poor farming practices have degraded soils
- Use of short cycle varieties, like in border strips under controlled submersion and in small village irrigated areas (PPIV).

## **8 LIST OF EXISTING INSTITUTIONS INVOLVED IN DROUGHT ADAPTATION**

### **8.1 NORTH AFRICA – ALGERIA, MOROCCO AND TUNISIA (MAGHREB REGION)**

#### **8.1.1 Tunisia**

The institutions involved in adaptation to drought in Tunisia are listed in Table 44.



**Table 44: List of institutions involved in implementing drought adaptation actions obtained from available literature - Tunisia**

<b>Ministry of Agriculture, Environment and water Resources</b>		
<b>Institution</b>	<b>Responsibility</b>	<b>Contact details/Website</b>
BPEH (Bureau de la Planification et des Equilibres hydrauliques)	The BPEH is continuously connected with all organizations and institutions involved in the management of water resources in the country. Therefore, a large database of water resources is continuously collected and updated.	cabinet du ministre, 30, Rue Alain Savary- 1002 – Tunis boagr@email.ati.tn www.semide.tn/BPEH.htm
DGBGTH (Direction Générale des Barrages et Grands Travaux Hydrauliques/General Direction of Dams and Large Hydraulic Work)	<ul style="list-style-type: none"> <li>- Elaboration of the hydraulic studies.</li> <li>- Elaboration of mastering surface water resources planning.</li> <li>- Elaboration of water mobilizations studies.</li> <li>- Making up the dams and lakes building studies.</li> <li>- Elaboration of important water planning studies for surface water resources mobilization (big dams, water transfer...).</li> <li>- Control and maintenance of dams.</li> <li>- Realization of the planning and large hydraulic works related to the rural and agricultural zones protection against floods.</li> <li>- Ensuring a platform to encompass all the areas of flood prevention and disaster management. - Supervising the drought management system.</li> </ul>	Ministère de l'Agriculture 30 Rue Alain Savary 1002 Tunis, le Belvédère webmaster@semide.tn www.semide.tn/BGTH.htm
DGRE (Direction des Ressources en Eau/General Direction of Water Resource).	<ul style="list-style-type: none"> <li>- Setting up and managing of measurement and observation networks related to all country water resources components (water data and information system and flood early warning, etc.).</li> <li>- Elaboration of basic and applied studies on the water resources evaluation and setting their general balance.</li> <li>- Drawing the principal and specific methods for the water resources management, according to the supply and the demand.</li> <li>- Promotion of the research and experimentation activities related to the conventional and non conventional water uses.</li> <li>- Finalizing and perfecting the different ground (basics) of water mobilizations planning and their exploitation.</li> </ul>	43, rue la Mannoubia -1008 – Tunis webmaster@semide.tn www.semide.tn/DGRE.htm
DGACTA (Direction Générale de l'Aménagement et de Conservation des Terres Agricoles/Genera Direction of Planning, Management and Conservation of Agricultural Lands).	<ul style="list-style-type: none"> <li>- Elaboration of plans and orientations related to natural resources (soil, plant and water).</li> <li>- Proposition, elaboration and promotion of measures ensuring the optimization of natural resource utilization.</li> <li>- Soil resources evaluation (vocation and agricultural aptitude). The GIS and remote sensing technique are used.</li> <li>- Realization of research on soil sciences, using advanced techniques and equipped soil and water analysis laboratories.</li> <li>- Control of soil evolution under the different exploitation modes, and their protection against salinity, degradation, and desertification.</li> </ul>	30 Rue Alain Savary, 1002 Tunis, Tunisie. webmaster@semide.tn www.semide.tn/Acta.htm
CRDA (Commissariat Régional au Développement Agricole/Regional Commissary of	- Application of the legislation and regulation related to soil protection, forest and water management, supervising plant protection, and caring for	30, Rue Alain Savary 1002 Tunis onagri@email.ati.tn www.semide.tn/CRDA.htm

Ministry of Agriculture, Environment and water Resources		
Institution	Responsibility	Contact details/Website
Agricultural Development or Regional District Department of MAERH)	<p>animal health.</p> <ul style="list-style-type: none"> <li>- Ensurance of forest resources development and protection, soil land water conservation and agricultural land and basin planning.</li> <li>- Regional hydraulic system and forest domain management.</li> </ul> <p>Conservation of natural resources.</p> <ul style="list-style-type: none"> <li>- Realization of hydraulic planning and hydro agricultural infrastructure valorization.</li> <li>- Hydro agricultural infrastructure management and maintenance. Achieving the water supply network management.</li> </ul>	
CRDA (Commissariat Régional au Développement Agricole/Regional Commissary of Agricultural Development or Regional District Department of MAERH)		30, Rue Alain Savary 1002 Tunis onagri@email.ati.tn www.semide.tn/CRDA.htm
BIRH (Bureau de l'Inventaire et des Recherches Hydrauliques/Hydraulic Inventory and Research Bureau).	<ul style="list-style-type: none"> <li>- Establishment and updating of the national surface and groundwater resources inventories and development of prospecting for new water resources identification.</li> <li>- Mounting and management of measurement and observation networks related to all the country water resources components (surface and ground water).</li> <li>- Realization of pumping operations in order to determine the technical aquifers characteristics.</li> <li>- Computation and optimization of water information and data base management.</li> <li>- Dissemination of water data and information recorded and analysed, by publishing bulletins and technical yearbooks (annuaires).</li> </ul>	43, rue La Mannoubia 1008 TUNIS – TUNISIE webmaster@semide.tn www.semide.tn/BIRH.htm
SONEDE Société Nationale d'Exploitation et de Distribution des Eaux/Water Exploitation and Distribution National Company.	SONEDE is responsible for the management of fresh water quantity and quality. maintenance, transportation (transfer and pipeline), and all activities related to the field of drinking water as a treatment for water quality standard (physical, chemical, biological and bacteriological) and its equitable distribution.	Siège social, Avenue Slimen Ben Slimen, El Manar 2, Tunis 2092 webmaster@semide.tn www.tunisie-web.org
SECADENORD (Société d'Exploitation du Canal et des Adductions des Eaux du Nord/Company of Exploitation, Canalization and Adduction of the Canal and the Northern Water)	provides management and maintenance of the north-west water transfer system (pipes and channels) of the far Northwest for users located in the Northeast, Central and South of the country	30, Rue Alain Savary 1002 Tunis onagri@email.ati.tn www.secadenord.com.tn
IRESA (Institution de la Recherche et de l'Enseignement Supérieur Agricoles/Agricultural	IRESA has to sit up, to keep awake and to supervise the agricultural research programs, and to promote the agricultural higher education in order to enhance the agriculture sector.	Ministère de l'Agriculture - 30, Rue Alain Savary - 1002 Tunis Belvédère -TUNISIE- webmaster@semide.tn

Ministry of Agriculture, Environment and water Resources		
Institution	Responsibility	Contact details/Website
Research and Higher Education Institution).		www.iresa.agrinet.tn
NGO (GIC associations)	GIC associations are a group of users in the rural areas that have to manage their demand on water (domestic and agricultural use). They are created by MAERH and advised by DGGREE	12 Rue Tantaoui El JAwhari ElOmrane 1005 Tunis www.atpne.org amabroug@gnet.tn
ANPE (Agence Nationale de Protection de l'Environnement/National Environment Protection Agency).	ANPE control pollution discharged (liquid and solid) in natural systems and also their treatment plants, attends law enforcement, and promotes public awareness of the environmental protection and preservation. Each new project related to agriculture, tourism, industrial and urban areas is subject to this organization to identify its environmental impacts	contact@anpe.nat.tn Centre Urbain Nord 15 rue 7051 cité Essalem 2080 Ariana www.anpe.nat.tn
CITET (Centre International des Technologies de l'Environnement/International Centre of Environment Technologies).	The CITET activities are hinged on 3 axes: - National and international trainings, notably on the urban cleansing, solid and liquid rejections management, industrial pollution control, urban management systems, environmental impact studies, campaign against desertification. - Conducting a research related to industrial effluents treatments, and purifying water stations, air quality, etc. - Technologies transferring, as desalinization of saline and sea waters and industrial water physical and chemical treatments. CITET has advanced equipped laboratories, and realizes current water analysis for ANPE, ONAS, DGRE and DGBGTH.	Boulevard du Leader Yassar Arafat Tunis 1080 boc@citet.nat.tn www.citet.nat.tn
DGEQV (Direction Générale de l'Environnement et de la Qualité de la Vie/General Direction of Environment and Life Quality).	The General Direction of Environment and Life Quality (DGEQV, Direction Générale de l'Environnement et de la Qualité de la Vie) has to: - formulate the general political aspects related to the environment; - coordinate and attend the state operations and measures for the environment protection; (iii) campaign against pollution and its negative effects; and (iv) improve the quality of life. It is involved in environment aspects related to water resources.	43, rue La Mannoubia 1008 TUNIS – TUNISIE boc@mineat.gov.tn www.semide.tn/DGEQV.htm
ONAS (Office National de l'Assainissement/National Service of Used Water Cleansing).	Created in 1974, the National Service of Used Water Cleansing (ONAS, Office National de l'Assainissement) is involved in water management by the following activities: (i) Avoiding water pollution in the urban, industrial and touristic zones. (ii) Management, exploitation, maintenance and construction of the network of town cleansing. (iii) Realization of studies projects related to the individual rural water cleansing. (iv) Management of water purifying stations (used water reclamation), and supplying the reclaimed water for the specified irrigation uses. (v) Collecting data on the rejected water and gathering information about	32, rue Hédi Noura - 1001 Tunis -Tunisie. webmaster@semide.tn www.onas.nat.tn

Ministry of Agriculture, Environment and water Resources		
Institution	Responsibility	Contact details/Website
	the industrial effluents. Information related to the mapping of the industrial units are organized in "Cadrin" database.	
DGSV (Direction Générale des Services Vétérinaires/General Direction of Veterinary Services).	This branch is associated in the process of fight against drought by its central departments and regional services in the CRDA	www.onagri.nat.tn/
DGPCQA (Direction Générale de la Protection et du Contrôle de la Qualité des Produits Agricoles/General Direction of Agricultural Products Quality Control and Protection).	It controls the quality of many products and certify their compliance with standards: (seeds, plants, chemical treatment products, agricultural products imported and exported, etc.).	30, rue Alain Savary 1002-Tunis le Belvédère mag@ministeres.tn
DGEDA (Direction Générale des Etudes et du Développement Agricole/General Direction of Agricultural Studies and Development).	(i) Realization of studies and analysis for the agricultural development. (ii) Elaboration and attending the development plan execution with the collaboration of the different MAERH departments. (iii) Identifying the agricultural development plan components and evaluation of related programmes and projects. (iv) Elaboration of the MAERH budget, realization of economics-related research topics, establishing statistical data analysis on the agricultural activities for future utilization in the economic planning programmes. (v) Attending the evolution of the agricultural circumstances, notably during the drought events. (vi) Elaboration of economic analysis related to the agricultural development policy.	30, rue Alain Savary 1002-Tunis le Belvédère mag@ministeres.tn
DGPA (Direction Générale de la Production agricole/General Direction of Agricultural Production).	DGPA is not involved in water management but it is associated in the drought mitigation system and contributes through its central and regional services ("Arrondissements") in the CRDAs in the different steps of drought management. The General Direction of Financing, Investments and Professional Institutions (DGFIOP, Direction Générale du Financement et des Investissements et Organismes Professionnels) prepares the MAERH budget with the collaboration of DGEDA, and draws up all operations related to the financial support for the agricultural activities as well as for the drought management.	1002 - Tunis - le belvedere Tunisie www.tunisie.gov.tn mag@ministeres.tn www.onagri.nat.tn 30, rue Alain Savary odno@mdci.gov.tn
DGF (Direction Générale des Forêts/Forest General Direction).	Forest General Direction (DGF, Direction Générale des Forêts), is not involved in water management but contributes in the forest lands management and acts against forest fire, especially during drought events.	Rue Hmida Zine El Abidine Khezama Ouest Sousse

Ministry of Agriculture, Environment and water Resources		
Institution	Responsibility	Contact details/Website
	DGF manages several rangelands that are open for farmers during drought. DGF has numerous forest lands data and maps containing numerous water resources information.	
OC (Office des Céréales/Cereal Agency).	The Cereal Agency (OC, Office des Cereals) is in charge of the promotion and the management of the cereal production.	30, Rue Alain Savary 1002 Tunis onagri@email.ati.tn
OEP (Office de l'Elevage et des Pâturages/Animal Husbandry and Pasture Agency).	The Animal Husbandry and Pasture Agency (OEP, Office de l'Elevage et de du Pâturage) is entrusted with the management of all tasks related to animal husbandry and pasture.	Av. Habib Bourguiba 7030, Mateur, BIZERTE
AVFA (Agence de la Vulgarisation et de la Formation Agricoles/Agricultural Extension and Training Agency).	The Agricultural Extension and Training Agency (AVFA, Agence de Vulgarisation et de la Formation Agricoles) is responsible for the attending the farmers to promote agricultural practices and to transfer the new agricultural technologies.	30, rue Alain Savary, 1002 Tunis, Tunisie bo.avfa@iresa.agrinet.tn
<b>Others</b>		
Authority	Responsibility	Contact details/Website
MPH (Ministry of Public Health).	DHMPE	Ministère de la Santé Publique, Bab Saâdoun, 1006 - Tunis. webmaster@semide.tn www.semide.tn/DHMPE.htm
Prime Ministry	Media	contact@mediatunisie.com
NGO	UTAP	Rue 8451 Avenue Alain Savary Tunis Tunisie 1003 utap.tunis@email.ati.tn
Ministry of Finance	Ministry	30, rue Alain Savary, 1002 Tunis mag@ministeres.tn.
Ministry of Economic Development	Ministry	Place Ali Zouaoui 1000 Tunis mde@ministeres.tn
Ministry of Interior	Ministry	Avenue Habib Bourguiba, 1000 Tunis, Tunisie
Ministry of Commerce	Ministry	Avenue Kheireddine Pacha tunis
Ministry of Agriculture and Water Resources- National Observatory of Agriculture	Public Institution	Tel: 18 73 - 71 78 68 33 Fax: 71 76 61 07 mag@ministeres.tn http://www.onagri.nat.tn/
National Institute of Meteorology (INM)	Public Institution	Tel : 71 773 400 Fax: 71 772 609 admin@meteo.tn

Ministry of Agriculture, Environment and water Resources		
Institution	Responsibility	Contact details/Website
		<a href="http://www.meteo.tn/default.htm">http://www.meteo.tn/default.htm</a>
Ministry of Agriculture and Water Resources- National Observatory of Agriculture	Public Institution	Tel: 18 73 - 71 78 68 33 Fax: 71 76 61 07 mag@ministeres.tn <a href="http://www.onagri.nat.tn/">http://www.onagri.nat.tn/</a>
National Institute of Meteorology (INM)	Public Institution	Tel : 71 773 400 Fax: 71 772 609 admin@meteo.tn <a href="http://www.meteo.tn/default.html">http://www.meteo.tn/default.html</a>
National Center of remote sensing (CNCT)	Public Institution	BP. 200, 1080 Tunis Cedex Tél : +216 71 761 333 Fax : + 216 71 760 890 e-m@il :cnt@defense.tn <a href="http://www.cnt.nat.tn/Fr/index.php?m=904">http://www.cnt.nat.tn/Fr/index.php?m=904</a>
Ministry of Economic Development	Ministry	Place Ali Zouaoui 1000 Tunis mde@ministeres.tn

### 8.1.2 Algeria

The institutions involved in adaptation to drought in Algeria are listed in Table 45.

**Table 45: List of institutions involved in implementing drought adaptation actions obtained from available literature - Algeria**

Authority	Responsibility	Contact details/Website
Ministry of Planning, Environment and Tourism (MATET)	Environment e fight against desertification Planning and Tourism Coordination of environmental conventions	Rue des quatre canons Alger www.mate.gov.dz
Algerian Space Agency (ASAL)	The Agency is the instrument design and implementation of national policy for the promotion and development of space activities on the technological, scientific and application for and contribute to the economic, social and cultural development and ensure the safety and well-being of the national community.	14 Rue Omar AISSAOUI EL HAMMADIA - BOUZAREAH ALGER ALGERIE info@asal.dz www.asal-dz.org
National Agency of Water Resources	The exploration for and evaluation of water resources and soil of the country The collection, processing and updating information on water resources and soil The monitoring of the resource quantity and quality The preservation, protection and preservation of the resource against all forms of degradation	40 Avenue Mohammedi clairbois Bir Mourad Rais Alger dhyl@anrh.dz www.anrh.dz
National Meteorological Office (ONM)	Weather stations form a professional network to ensure national weather watch. Observation functions are complemented by functions of concentration, control, analysis and dissemination of learning.	BP 153 avenue Khemisti Dar el Beida Alger www.meteo.dz Tel : 021 50 73 93 Fax:021 50 88 49 contact@meteo.dz
Institut National des Sols, de l'Irrigation et du Drainage (INSID)		bp148 oued smar el harrach insid@insid.dz www.insid.dz
Direction du Développement Agricole des Zones Arides et Semi Arides (DDAZASZ)		

### 8.1.3 Morocco

The institutions involved in adaptation to drought in Morocco are listed in Table 46.

**Table 46: List of institutions involved in implementing drought adaptation actions obtained from available literature - Morocco**

Institution	Responsibility	Contact details/Website
<b>Ministry of Agriculture and Maritime Fisheries</b>		
Directorate of Plant Production (DPV)	Agricultural and Rural Development Horizontal control, promotion, production and food processing, agricultural, industrial and other	Direction de la Production Végétale MADRAP, Rabat
Water and Ag-Engineering Administration (AGR)	Hydro-agricultural development. Administration: Agriculture and Agrarian Reform	avenue Hassan II, Dar Dbagh +212 537 69 11 01
National Institute Agronomic Research (INRA)	"INRA" mission is to undertake research for agricultural development.	INRA Avenue Ennasr Rabat, Maroc BP 415 RP Rabat, Maroc Tél: 0537 77 26 54 webmaster@inra.org.ma www.inra.gov.ma
Agronomic and Veterinary Institute Hassan II (IAV HII)	Higher Education, Research and Development	

Institution	Responsibility	Contact details/Website
<b>Ministry of Agriculture and Maritime Fisheries</b>		
Regional Office of Agricultural Development		
Marrakech (ORMVAM)	The regional agricultural development (ORMVA), expected agricultural policy framework of the state, confined in the role of water vendors. Drowning in debt and a heavy payroll, they continue to gobble up huge budgets	Avenue Hassan II B.P. 2411 Marrakech Tél : 0524 43 10 09
Tadla (ORMVAT)	The same than previous line	B.P 244 Fqih Ben Salah Tel.:+ 212 5 23 43 50 23/35/48 Fax.:+212 5 23 43 50 18/22 E-mail : ortadla@menara.com contact@ormvatadla.com web: http://www.ormvatadla.com
Gharb (ORMVAG)	The same than previous line	BP 79 Kénitra 14000 Tél. 05 37 37 45 02. Fax 05 37 37 43 86 web: http://www.ormvag.ma
Doukkala (ORMVAD)	The same than previous line	Avenue Mohamed VI, BP 58, El Jadida Tél. 0523-34-36-19, 0523-35-00-94, 0523-34-22-75/74/70/71/76, 0523-34-23-75, 0523-34-34-30, 0523-35-33-44 Fax 0523-34-22-72
Haouz (ORMVAH)	The same than previous line	Av Hassan II, Gueliz BP 2411, Marrakech Tél. 0524-44-95-97, 0524-44-96-50, 0524-43-14-09, 0524-43-19-23, Fax 0524-44-97-93
Souss Massa (ORMVAS)	The same than previous line	Rue des Administrations, BP 21, Agadir Tél. 0528-84-08-16/84, 0528-84-01-12/71, 0528-84-67-86/87, 0528-84-08-27, Fax 0528-84-65-21
Loukkos (ORMVAL)	The same than previous line	BP 48, Ksar El Kébir Tél. 0539-91-86-76, 0539-91-90-28, 0539-91-81-97, 0539-91-89-29, Fax 0539-91-82-03
Moulouya (ORMVAM)	The same than previous line	BP 463, Berkane Tél. 0536-61-25-32, 0536-61-26-28, 0536-61-27-28, 0536-61-28-28, 0536-61-34-68, Fax 0536-61-29-28
Ouarzazate (ORMVAO)	The same than previous line	BP 29, Ouarzazate Tél. 0524-88-26-87, 0524-88-26-14/02/70, 0524-88-25-61, Fax 0524-88-34-42
National Drought Observatory (NDO)		IAV Hassan II. B.p. 6202 Institurs. Rabat Maroc www.iav.ac.ma
National School of Forest Engineers (ENFI)	Engineering education in State of Water and Forests.	BP : 511, Tabriquet – Salé www.enfi.ac.ma eauxetforets@iam.net.ma
<b>Secretary of State to the Ministry of Energy, Mines, Water and Environment</b> Rue Hassan Benchekroun. Agdal Rabat. Chellah Tel. +212537778727 <a href="http://www.water.gov.ma">www.water.gov.ma</a> see@water.gov.ma		
Superior Council for Water and Climate (SCWC)	The national strategy of knowledge of climate and its impact on water resources, * The national plan for water * Plans for integrated management of water	



Institution	Responsibility	Contact details/Website
<b>Ministry of Agriculture and Maritime Fisheries</b>		
	resources with particular emphasis on the distribution of water between different users, transfers of water and provisions for the use and protection of water resources.	
National Council for Environment (NCE)	Coordination and consultation, provides a forum for discussion and exchange on topics related to environment and sustainable development, and includes all departments, non-governmental organizations (NGOs), professional associations, scientific institutes and the private sector.	National Council for Environment (NCE)
General Direction of Hydraulics	Public Department	General Direction of Hydraulics Tél : 212 037 778715 Fax : +212 7 778696 e-mail : dgh@mtpnet.gov.ma/http://www.mtpnet.gov.ma/dgh
Oum Er Rbia Basin	is to ensure the planning and management, integrated and collaborative water resources with a view to ensure sustainable development of the basin of the Oum Er Rbia through: harmonious management, planned, rational and sustainable water; decentralized management based on cooperation and partnership; solidarity among water users; A master of the resource and the recognition of its economic value.	Agence du Bassin Hydraulique de l'Oum Er Rbia BP: 511 Beni Mellal Téléphone: +212 23 48 23 55/28.55/37.13 Fax: +212 23 48 94 15 agence@abhoe.ma
Tensift basin	Coherent and coordinated planning across the river basin; Integrated, decentralized and coordinated water resource and public water; Protection and conservation quantity and quality of water resources; Optimum and rational utilization of water.	Av. Jnane El Harti Bp : 2388 - Marrakech - Maroc Tél. : +212 (0) 24 44 89 64 Fax : +212 (0) 24 43 56 20 E-mail : info@eau-tensift.net
Bouregreg basin	Hydraulic Basin Agency Bouregreg and Chaouia is a public institution, endowed with legal personality and financial autonomy. Having a central role in the management and protection of public water, it initiates and implements the policy of water in its area of action.	ADRESSE Agence du Bassin Hydraulique du Bouregreg et de la Chaouia Route de Casablanca B.P. 262 Benslimane TEL : (212)523290821 ou (212)523290283 ou (212)661685523 FAX : (212)523290999 Email : abhbc@abhbc.ma
Sebou basin	The Agency is governed by a Board chaired by the government authority responsible for water resources are represented and in which all actors in the field of water at the river basin.	Adresse: BP 2101 Fes Tel: +212535642998/97 Fax: +212535640444 direction@abhsebou.ma
Iokkous basin	assessment, planning, resource management, exploitation of hydraulic works, etc. ...	Adresse : Avenue Al Massira, B.P. 616 Tétouan-Maroc Tél : +212 5 39.99.45.67 / +212 5 39.99.45.72 Fax : +212 5 36 68 38 48 Email : abloukkos@iam.net.ma
Moulouya basin	Assessment of water resources and their use of state Development of water resources of the basin Project preparation PDAIR Basin Moulouya	Adresse : BP 703, Bd Hassan Loukili Oujda-Maroc Tél : +212 5 36 68 45 13 / +212 5 36 68 68 99 Fax : +212 5 36 68 38 48 Email : abhm@menara.ma Web : http://www.eaumoulouya.ma/
Massa Agadir basin	overexploitation of groundwater increased, the increasing urbanization of the area regional emergence of new needs for water, and good governance in the management of water resources.	Adresse : Avenue MY Abdellah BP 432 80000 Agadir-Maroc Tél : +212 5 28 84 25 51 / +212 5 28 84 39 59 Fax : +212 5 28 84 20 82

Institution	Responsibility	Contact details/Website
<b>Ministry of Agriculture and Maritime Fisheries</b>		
		Email : abhsm@menara.ma Web : http://www.abhsm.ma/
DPCC : Partnership and Communication Department. Climate Change service	Coordination of policies, plans and programs of regional planning, environment and water and Partnership Coordination of Environmental Action UNFCCC Focal Point	4 place Abou Baker Esseddik. Avenue Fal Ould Amir – Agdal - RABAT  dpcc@minenv.gov.ma www.ccmoroc.ma
National Office for Drinking Water (ONEP)	Planning del'approvisionnement drinking water (EPA) across national - Production of drinking water - Distribution of drinking water for the local - Management of liquid waste disposal on behalf of CL - Monitoring water quality	Station de Traitement Avenue Mohamed Belhassan El ouazzani BP.Rabat-Chellah 10002 Rabat Maroc onepbo@onep.ma +212 5 37 75 96 00
Directorate General of Hydraulics, (DGH)	The evaluation and monitoring of water resources; Planning their development; Management; The control and protection of their quality; The construction and maintenance works for mobilization and transfer of water.	dgh@mtpnet.gov.ma +212 7 778696 212 037 778715
Direction de la Recherche et de la Planification de l'Eau (DRPE)	Development and implementation of government policy planning, mobilization, management and conservation of water resources.	Rue Hassan Ben Chekroun Rabat Agdal –Maroc- see@water.gov.ma www.water.gov.ma
Direction de la Météorologie (DMN)	Drought long term forecast and artificial rain program	contact@ marocmeteo.ma www.marocmeteo.ma
<b>High Commissariat of Water, Forests and Fight Against Desertification</b>		
HCEFLCD: High Commissariat of water, forests and fight against desertification	Coordination of the implementation of the LCD Preparation programs in watershed management and soil conservation Preparation of development plans of parks and wildlife reserves Defining strategies to protect forests, integrated development programs and ecotourism	B.P : 605 Rabat-Chellah Tél:(212) 5 37.76.00.38/41 Fax: (212) 5 37.76.84.96 contact@eauxetforets.gov.ma http://www.eauxetforets.gov.ma/fr/index.aspx

## 8.2 EQUATORIAL LAKES REGION (BURUNDI, KENYA, TANZANIA, RWANDA)

### 8.2.1 Tanzania

The institutions involved in adaptation to drought in Tanzania are listed in Table 47.

**Table 47: List of institutions involved in implementing drought adaptation actions obtained from available literature - Tanzania**

Institutions & Contact Details	Roles in Adapting Droughts
<p>Prime Minister's Office (PMO), Disaster Management Department (DMD) Address: P.O. Box 3021 Dar es Salaam, Tanzania Telephone: +255 2221172266; +255 22 2111249/50/51/52 Fax: +255 2221172266</p> <p>Website: http://www.pmo.go.tz</p>	<ul style="list-style-type: none"> <li>Establishment and strengthening Regional and District disaster management committees is a national Strategy so as to cover and increase community awareness and understanding of, preparedness for, and participation in hazards and emergency management; reducing the risk from hazards; and</li> <li>Enhancing capability to resource mobilization, allocation and accountability.</li> <li>For the case of preparedness and response during disasters, government has established National Relief Fund specifically to deal with response</li> <li>The disaster relief Act no 9 of 1990, which oversee and coordinate overall relief operations at national level</li> <li>When a national disaster occurs, funds will be released from national treasury for intervention</li> <li>The Disaster Management Department in PMO has a</li> </ul>

Institutions & Contact Details	Roles in Adapting Droughts
	budget for public awareness <ul style="list-style-type: none"> <li>• For the case of Local Government Authorities has its own power and mandate to fund its activities</li> <li>• Communities and individuals have a role of using their own capacities to safeguard their lives and property against disasters</li> </ul>
Ministry of Agriculture, Food Security and Cooperatives P.O Box 9192 Dar es Salaam General Lines Telephones: +255 22 2862480 +255 22 2862481 Website: <a href="http://www.agriculture.go.tz/">http://www.agriculture.go.tz/</a>	<ul style="list-style-type: none"> <li>• Advise peasants on agronomic practices to sustain and improve productivity in moisture stress situation when drought is anticipated</li> <li>• Ensure proper management of available moisture in drought prone areas</li> </ul>
Ministry of Lands, Housing and Human Settlements Development P.O. Box 9132, Dar es Salaam, Tanzania Tel: +255 22 2121241-9, 2120209, 2113165, 2118506 Fax: +255 22 2113224 Website: <a href="http://www.ardhi.go.tz/">http://www.ardhi.go.tz/</a>	<ul style="list-style-type: none"> <li>• The National Land use frame work plan of 2008, help the land use sector adapt to climate change and build resilience to the increased likelihood of more adverse events</li> <li>• Risk assessments to identify priority concerns, and may include hazard risk mapping</li> </ul>
UNICEF lead One UN Joint Programme on strengthening National Disaster preparedness and response capacity UNICEF P.O. Box 4076 Dar es Salaam, Tanzania Tel.: +255 22 2196600 Fax: +255 22 2151603 / +255 22 2151593  Website: <a href="http://www.unicef.org/infobycountry/tanzania.html">http://www.unicef.org/infobycountry/tanzania.html</a>	<ul style="list-style-type: none"> <li>• Supporting the Government of Tanzania (GoT) in sudden and long-term emergencies by providing life-saving assistance and assured protection for children in emergencies</li> <li>• Responding to both in man-made and natural disasters using resources through its health, water and sanitation, protection, education and HIV/AIDS programmes</li> </ul>
Tanzania Red Cross Society and in cooperation with the Federation P.O. Box 1133 Dar es Salaam, Tanzania Tel: +255 22 2150336 / 2150330 / 2150131 / 2152526 Fax: +255 22 2150147 Telex: TACROS 41878 Website: <a href="http://www.trcs.or.tz">http://www.trcs.or.tz</a>	<ul style="list-style-type: none"> <li>• Undertook relief operation to victims during the Bagamoyo drought in 1991-1992 and 1996</li> <li>• Undertook relief operation to victims during the Lushoto flood and drought in 1993-1994 and 1996 (IFRCRCS, 2003)</li> </ul>

## 8.2.2 Kenya

The institutes involved in drought adaptation in Kenya are listed in Table 48.

**Table 48: List of institutions involved in implementing drought adaptation actions obtained from available literature - Kenya**

Institution	Role	Contacts
Ministry of Special Programmes	<ul style="list-style-type: none"> <li>• Coordinate the formulation and implementation of Policies and Institutional Framework for Drought Management.</li> <li>• Coordinate the mobilization of resources for Drought Management.</li> <li>• Coordinate all stakeholders in Drought Risk Reduction and Management.</li> <li>• Monitoring and Evaluation of the Drought Management Programme.</li> </ul>	Comcraft House, 5th Floor, Haile Selasie Avenue P. O. Box 40213 - 00100 Nairobi Tel: +254-20-2250645 Website: <a href="http://www.sprogrammes.go.ke">www.sprogrammes.go.ke</a>
Ministry of State for Development of Northern Kenya and other Arid Lands	<ul style="list-style-type: none"> <li>• Coordinate the formulation and implementation of Policies and Institutional Framework for Drought Management in Kenyan Arid Lands.</li> <li>• Coordinate the mobilization of resources for Drought Management in Kenya Arid Lands.</li> <li>• Coordinate, monitor and evaluate all stakeholders in Drought Risk Reduction and Management in Arid Lands.</li> </ul>	KICC Building, 13 <sup>th</sup> Floor Harambee Avenue, P.O.Box 53547 - 00200 Nairobi Kenya E-mail: <a href="mailto:alrmphq@africaonline.co.ke">alrmphq@africaonline.co.ke</a> <a href="http://www.aridlands.go.ke">http://www.aridlands.go.ke</a>
Ministry of Water and Irrigation	<ul style="list-style-type: none"> <li>• Water resources management policy.</li> <li>• Water storage implementation programs.</li> <li>• National irrigation planning and implementation programs.</li> </ul>	Maji House, Off Ngong Road, P. O. Box 49720 Nairobi, Kenya Tel. +254 020 2716103 <a href="http://www.water.go.ke">http://www.water.go.ke</a>
Ministry of Regional Development Authorities	<ul style="list-style-type: none"> <li>• Coordination of regional (basin) development policy.</li> <li>• Coordinate, monitor and evaluate basin management authorities.</li> </ul>	N.S.S.F Building 21st Floor, Eastern Wing, P.O. Box 10280 - 00100 GPO, Nairobi Tel. 2724646 Website: <a href="http://www.regional-dev.go.ke">www.regional-dev.go.ke</a>
Ministry of Medical Services	<ul style="list-style-type: none"> <li>• To provide prompt health services in drought areas.</li> <li>• Create an enabling environment, regulate, set standards and policy for health service delivery in drought risk areas.</li> </ul>	Afya House, Cathedral Road P.O. Box 30016, Nairobi Tel. 2717077. Fax: 2713234 Website: <a href="http://www.medical.go.ke">www.medical.go.ke</a>
Ministry of Livestock Development	<ul style="list-style-type: none"> <li>• Guiding Livestock Policy and Services (National Food Policy). Assist in Crop Production and Marketing. Provide agriculture extension services in farm practice, pests and diseases control.</li> </ul>	Kilimo House, Cathedral Road P.O. Box 30028, Nairobi Tel. 2718870. Telex: 22766 Website: <a href="http://www.livestock.go.ke">www.livestock.go.ke</a>
Ministry of Agriculture	<ul style="list-style-type: none"> <li>• Guiding Agricultural Policy and Services (National Food Policy).</li> <li>• Assist in Crop Production and Marketing.</li> <li>• Provide agriculture extension services in farm practice, pests and diseases control.</li> </ul>	Kilimo House, Cathedral Road P.O. Box 30028, Nairobi <a href="http://www.kilimo.go.ke">www.kilimo.go.ke</a>
ISDR	<ul style="list-style-type: none"> <li>• Drought risk reduction strategy policy through</li> <li>• Forum within the United Nations system for devising strategies and policies for the reduction of drought as a natural hazard;</li> <li>• Identifying gaps in drought risk reduction policies and programmes and recommend remedial action;</li> <li>• Provision of policy guidance to the isdr secretariat; and</li> <li>• Convening ad hoc meetings of experts on issues related to disaster reduction.</li> </ul>	<a href="http://www.unisdr.org/africa">www.unisdr.org/africa</a>
ICPAC	<ul style="list-style-type: none"> <li>• Process data and develop baseline risk scenarios and other applications;</li> </ul>	<a href="http://www.icpac.net/">http://www.icpac.net/</a>

Institution	Role	Contacts
	<ul style="list-style-type: none"> <li>• Monitor, predict and provide early warning information of the space-time evolutions of weather and climate extremes over the sub-region;</li> <li>• Hazards and climate risk mapping of the extreme climate events thresholds;</li> <li>• Networking with WMO, the National Meteorological and Hydrological institutions as well as regional and international centers for data and information exchange;</li> <li>• Applications of climate tools for specific climate sensitive sector risk reduction, environment management , and sustainable development, including integration of indigenous knowledge;</li> <li>• Monitor, assess, detect and attribute climate change and associated impacts, vulnerability, adaptation and mitigation options;</li> <li>• Develop relevant tools required to address the regional climate challenges through research and applications in all climate sensitive socio-economic sectors including addressing linkages with other natural and man-made disasters; and</li> <li>• Networking and exchange of information regarding disasters in the sub-region</li> </ul>	
World Vision	<ul style="list-style-type: none"> <li>• Training and equipping community health workers and establishing drug supply chains to facilitate their work</li> <li>• Rehabilitating and constructing shallow wells and boreholes to meet the water needs of pastoralists and their livestock.</li> <li>• Promote rain water harvesting.</li> </ul>	<a href="http://www.worldvision.org">http://www.worldvision.org</a>
ASARECA	<ul style="list-style-type: none"> <li>• Promoting research and growing of drought resilient crops (Millet and sorghum)</li> <li>• Promoting appropriate farming methods.</li> </ul>	<a href="http://www.asareca.org/">http://www.asareca.org/</a>
Action Aid	<ul style="list-style-type: none"> <li>• Non-Governmental</li> </ul>	<a href="http://www.actionaid.org">www.actionaid.org</a>
Practical Action	<ul style="list-style-type: none"> <li>• Training and equipping community animal health workers and establishing drug supply chains to facilitate their work</li> <li>• Rehabilitating and constructing shallow wells and boreholes to meet the needs of over 25,000 pastoralists and their livestock</li> <li>• Strengthening the capacity of water user associations to manage the water resources on a sustainable basis</li> <li>• Catalyzing the formation of peace and grazing committees and supporting their work in cross-border peace initiatives and proper management of rangeland resources</li> </ul>	<a href="http://practicalaction.org">practicalaction.org</a>
Kenya Red Cross	<ul style="list-style-type: none"> <li>• Carry out humanitarian work in times of peace or conflict. Natural disasters such as drought, famine, floods.</li> <li>• Promote pilot intervention on resilience.</li> </ul>	<a href="http://www.redcross.org">http://www.redcross.org</a>
Care International	<ul style="list-style-type: none"> <li>• Non-Governmental</li> </ul>	<a href="http://www.careinternational.org">www.careinternational.org</a> or <a href="http://www.careclimatechange.org">www.careclimatechange.org</a>
Plan International	<ul style="list-style-type: none"> <li>• Non-Governmental</li> </ul>	<a href="http://plan-international.org">plan-international.org</a>

### 8.2.3 Rwanda

The institutions involved in adaptation to drought in Rwanda are listed in Table 49.

**Table 49: List of institutions involved in implementing drought adaptation actions obtained from available literature - Rwanda**

Institution	Role	Contacts
MINALOC: Ministry of Local Government (Good governance, Community Development and Social Affairs.	<ul style="list-style-type: none"> <li>Implementation of Environmental Policy through decentralized administration.</li> <li>Sensitization on efficient land use and management at all local government level. Each District has an employee in charge of environment and another in charge of Land and.</li> <li>In addition community work known as "Umuganda held every month has a key role in environmental rehabilitation especially tree planting.</li> <li>Community Mobilization for implementation of actions to be taken in case of emergency.</li> <li>Coordination of activities related to the management of the risks and disasters</li> </ul>	<a href="http://www.minaloc.gov.rw">www.minaloc.gov.rw</a> Email: <a href="mailto:secretariat@minaloc.gov.rw">secretariat@minaloc.gov.rw</a>
Ministry of Infrastructure	<ul style="list-style-type: none"> <li>Forecast of meteorological information awareness)</li> <li>Publication of timely weather information for more strategies of adaptations</li> </ul>	P.o.Box 24 Kigali T: +250 252 585503 F: +250 252 585755 <a href="http://www.mininfra.gov.rw">www.mininfra.gov.rw</a> E: <a href="mailto:info@mininfra.gov.rw">info@mininfra.gov.rw</a> <a href="http://www.meteorwanda.gov.rw">www.meteorwanda.gov.rw</a>
MIDIMAR: Ministry of Disaster Management	<ul style="list-style-type: none"> <li>MIDIMAR is the leading institution in terms of policy formulation, coordination, monitoring and evaluation of Disaster risk reduction and Disaster Management activities. It is also deeply involved in a process of supervising humanitarian assistance in emergency situations and mobilization of various stakeholders in order to promote disaster risk reduction awareness culture.</li> </ul>	P.o.Box 4386 Kigali-Rwanda <a href="http://www.midimar.gov.rw">www.midimar.gov.rw</a> <a href="mailto:Info@midimar.gov.rw">Info@midimar.gov.rw</a>
MINIRENA: Ministry of Natural Resources	<ul style="list-style-type: none"> <li>Elaboration of national policy of natural resources management</li> <li>Implementation through the National Land Centre and National Forestry Authority, this Ministry gives the policy of land and forestry wise use and management.</li> <li>Elaboration, follow up and evaluation of national policy of water resources management</li> </ul>	Tel:+ 250 252 582628 Po.Box:3502 Kigali-Rwanda <a href="http://www.minirena.gov.rw">www.minirena.gov.rw</a> <a href="mailto:info@minirena.gov.rw">info@minirena.gov.rw</a>
REMA: Rwanda Environmental Management Authority	<ul style="list-style-type: none"> <li>Implementation of National Environmental Policy</li> <li>Regulation of environmental management for sustainable development</li> </ul>	<a href="http://www.rema.gov.rw">www.rema.gov.rw</a> <a href="mailto:info@rema.gov.rw">info@rema.gov.rw</a> T: +250 252 580101 F: +250 252 580017
Ministry of Health	<ul style="list-style-type: none"> <li>Diseases control during disasters including drought events (especially malaria, waterborne diseases, etc.)</li> </ul>	P.O.Box 84 Kigali, Rwanda Telephone: +250 252 577458 Fax: +250 252 576853 <a href="http://www.moh.gov.rw">www.moh.gov.rw</a>
MINAGRI	<ul style="list-style-type: none"> <li>Elaboration and follow up of Agriculture policy: Improvement of soil fertility with Girinka (one cow per family programme to help in land rehabilitation); hillside irrigation, agroforestry techniques, erosion control, crop selection, land use consolidation, etc.</li> <li>To ensure food security of Rwandan population</li> </ul>	P.o.Box 621 Kigali Rwanda <a href="http://www.minagri.gov.rw">www.minagri.gov.rw</a>
NGO'S: (WFP, Red Cross, CARITAS,	<ul style="list-style-type: none"> <li>Emergency intervention: Food and seeds distribution in case of Disasters, first aid, etc.</li> </ul>	

Institution	Role	Contacts
etc.)	<ul style="list-style-type: none"> <li>• Advocacy</li> </ul>	
Private sector and donors	<ul style="list-style-type: none"> <li>• Participation in implementation of adaptation measures to drought (tree planting, funding of project, etc).</li> </ul>	

The following projects had been identified by the Rwanda National Adaptation Programmes of Action to Climate Change (NAPA-RWANDA) as emergent measures to be taken regarding adaptation to climate change (including drought):

- Lands conservation and protection against erosion and floods at districts level of vulnerable regions to climate change;
- Mastering hydrometeorological information and early warning systems to control extreme phenomena due to climate change: - Installation and rehabilitation of hydrological and meteorological stations;
- Development of irrigated areas by gravity water systems from perennial streams and rivers in zones often vulnerable to prolonged droughts;
- Support Districts of vulnerable regions to climate change in planning and implementing measures and techniques related to land conservation, water harvesting and intensive agriculture and promoting existing and new resistant varieties of crops adapted to different bioclimatic soil;
- Increase adaptive capacity of grouped settlement “Imidugudu” located in vulnerable regions to climate change by the improvement of potable water, sanitation and alternative energy services, and the promotion of non agricultural jobs;
- Increase food and medicine modes of distribution to respond to extreme climate change and sensitize to stocking and conservation of agriculture products;
- Preparation and implementation of woody combustible substitution national strategy to combat the deforestation and erosion as well.

**8.2.4 Burundi**

The institutions involved in adaptation to drought in Burundi are listed in Table 50.

**Table 50: List of institutions involved in implementing drought adaptation actions obtained from available literature - Burundi**

Institution	Role	Contacts
<b>Ministry of agriculture and livelihoods</b>	<ul style="list-style-type: none"> <li>➤ To control food insecurity at national level and particularly in drought region; <ul style="list-style-type: none"> <li>➤ To elaborate National adaptation actions on drought and technical guidelines and disseminate it to all stakeholders;</li> <li>➤ To develop and test Drought tolerant crop varieties in vulnerable regions;</li> <li>➤ To adapt agricultural practices, such as planting and harvesting times, fertilizers use, pest control, and so on to drought and soil rehabilitation.</li> </ul> </li> <li>➤ To raise public awareness through sensitization on drought adaptation actions</li> </ul>	<p><i>Odette Kayitesi,</i> Email: <a href="mailto:okayitesi125@yahoo.com">okayitesi125@yahoo.com</a></p>
Ministry of Health	<ul style="list-style-type: none"> <li>➤ To enhance health resilience to drought; <ul style="list-style-type: none"> <li>➤ Elaborate training modules on topics such as the impact of severe drought on human health;</li> <li>➤ Develop diseases control system, early warning system, preparedness and emergency response to drought;</li> <li>➤ Define and implement health guidelines and drought adaptation mechanisms ;</li> <li>➤ Organise training workshops for medical staff and decision makers on drought adaptation measures;</li> </ul> </li> <li>➤ Sensitization of local communities and population on drought effects and risks</li> </ul>	<p>Dr Etienne Bunzigiri, E-mail: <a href="mailto:etiennebu@yahoo.fr">etiennebu@yahoo.fr</a></p>
<b>Geographic Institute of Burundi</b>	<ul style="list-style-type: none"> <li>➤ Improve daily and seasonal forecasting of drought to assist with timely preparation within relevant sectors;</li> <li>➤ Improve early warning systems for extreme drought events;</li> <li>➤ Raising Capacity building and awareness on drought adaptation at both institutional and local level;</li> <li>➤ To raise the general public (women and children) drought adaptation knowledge</li> </ul>	<p>Renilde Ndayishimiye, E-mail: <a href="mailto:renildend@yahoo.fr">renildend@yahoo.fr</a></p>

### 8.3 EASTERN NILE REGION (ETHIOPIAN PLATEAU)

Involved institutes and their roles are listed in Table 51.



**Table 51: List of institutions involved in implementing drought adaptation actions obtained from available literature - Eastern Nile region (Ethiopia)**

Institution	Role	Contacts
The Ethiopian Climate Change National Adaptation Plan (NAPA)	The primary goal of the NAPA process is to broadly communicate to the international community priority activities that address Ethiopia's urgent needs for adapting to the adverse impacts of climate change. The NAPA process has identified and prioritised 11 project areas that address the immediate climate change adaptation needs in the country, focusing on: human and institutional capacity building; improving natural resource management; enhancing irrigation agriculture and water harvesting; strengthening early warning systems and awareness raising., of which the following are directly relevant to the water and agricultural sectors:	NATIONAL METEOROLOGICAL AGENCY (NMA) P.O.BOX 1090 ADDIS ABABA, ETHIOPIA Tel: (251) 11 661 5779 Fax: (251) 11 662 5292 E-mail: nmsa@ethionet.et
<p>Project 1: Promoting drought/crop insurance program in Ethiopia- Responsible institution is: Ministry of Agriculture and Rural Development Other stakeholder institutions include the National Meteorological Agency, Disaster Prevention and Preparedness Agency, National/international, insurance company</p> <p>Project 2: STRENGTHENING/ENHANCING DROUGHT AND FLOOD EARLY WARNING SYSTEMS IN ETHIOPIA Responsible institution is: National Meteorological Agency</p> <p>Project 3: DEVELOPMENT OF SMALL SCALE IRRIGATION AND WATER HARVESTING SCHEMES IN ARID, SEMI-ARID, AND DRY SUB-HUMID AREAS OF ETHIOPIA Responsible institution: Ministry of Agriculture and Rural development Ministry of Water resources, Bureau of Agriculture and Rural development, Water Users Associations, farmers and private investors are the main stakeholders</p> <p>Project 4: IMPROVING/ENHANCING THE RANGELAND RESOURCES MANAGEMENT PRACTICES IN THE PASTORAL AREAS OF ETHIOPIA Responsible institution: Ministry of Agriculture and Rural Development (MoRAD)</p> <p>Project 5: COMMUNITY BASED SUSTAINABLE</p>	<p>Will lead the coordination of the project.</p> <p>Will lead the project coordination.</p> <p>Will lead the coordination of the project.</p>	<p>Ministry of Agriculture and Rural Development Addis Ababa , Ethiopia T+251-11-151-8040 F+251-11-152-8298 Webhttp://moard.org.et/</p> <p>National Meteorological Agency P.O. Box 1090 , Tel.: 251-11-6615793/79, Fax: 251-11-6625292, Addis Ababa , Ethiopia Contact Person (S) : RANET-Ethiopia Coordinator, Girmaw Gezahegn (BSc(maths), PGD (meteorology), Msc ( meteorology and air quality modelling)) e-mail: <a href="mailto:girmaw.bogale@gmail.com">girmaw.bogale@gmail.com</a></p> <p>Ministry of Agriculture and Rural Development Addis Ababa , Ethiopia T:+251-11-151-8040 F:+251-11-152-8298 Web: <a href="http://moard.org.et/">http://moard.org.et/</a> Address: Haile G/Silassie Road P.O.Box 5744 Addis Ababa , Ethiopia Tel: +251-11-661-1111 Fax:+251-11-661-0710 Email <a href="mailto:info@mowr.gov.et">info@mowr.gov.et</a> <a href="http://www.mowr.gov.et/">http://www.mowr.gov.et/</a></p>

Institution	Role	Contacts
<p>UTILIZATION AND MANAGEMENT OF WET LANDS IN SELECTED PARTS OF ETHIOPIA Ministry of Water Resources The main stakeholders include Regional Environmental Protection Agencies; Bureaus of Agriculture and Rural development; Community Based Organizations; Local NGOs, farmers, pastoralists and local administrations.</p> <p>Project 6: CAPACITY BUILDING NEEDS FOR CLIMATE CHANGE ADAPTATION IN ETHIOPIA Responsible institute: National Meteorological Agency will lead the coordination of the project Disaster Prevention and Preparedness Agency, Ministry of Capacity Building and Higher Learning Institutions. departments, academic and research institutions, and NGOs</p> <p>Project 7:Realizing food security through multi-purpose large scale water development project in Genale–Dawa Basin responsible institute: Ministry of Water Resources</p> <p>project 8:COMMUNITY BASED CARBON SEQUESTRATION IN THE RIFT VALLEY SYSTEM OF ETHIOPIA Responsible institution: Environmental Protection Authority</p> <p>Project 9:ESTABLISHMENT OF NATIONAL CLIMATE RESEARCH CENTER Responsible institution: National Meteorological Agency</p> <p>Project 10: STRENGTHENING MALARIA CONTAINMENT PROGRAMS IN SELECTED AREAS OF ETHIOPIA Responsible institution: Ministry of Health</p> <p>Project 11: PROMOTION OF ON FARM AND HOMESTEAD FORESTRY AND AGRO-FORESTRY IN ARID, SEMI-ARID AND DRY SUB</p>	<p>Will lead the coordination of the project.</p> <p>Will lead the project coordination</p> <p>Will lead the project coordination</p> <p>Will lead the project coordination</p> <p>Will lead the coordination of the project.</p> <p>Will lead the coordination of the project</p>	<p>Ministry of Water Resources</p> <p>National Meteorological Agency P. O. Box 12760 Tel. 251-1-464569 Fax 251-1-464882 E-mail: esid@telecom.net.et Addis Ababa, Ethiopia</p> <p>Ministry of Water Resources</p> <p>Environmental Protection Authority</p> <p>National Meteorological Agency</p> <p>Ministry of Health P.O.Box 1234 Addis Ababa , Ethiopia Tel: +251-11-551-7011 F:+251-11-551-9366 Web: <a href="http://moh.gov.et/">http://moh.gov.et/</a></p> <p>Ministry of Agriculture and Rural Development</p>

Institution	Role	Contacts
<p>HUMID PARTS OF ETHIOPIA Responsible institution: Ministry of Agriculture and Rural Development (MoRAD)</p>		
<p>OIC Ethiopia is a community-based informal skills training and employment organization, headquartered in Addis Ababa. OIC Ethiopia is nationally recognized by the Ministry of Justice and operates under the umbrella of the Ministry of Labor and Social Affairs of Ethiopia.</p>	<p>OIC Ethiopia operates two centers, one in Addis Ababa for unemployed urban youth and the second one in the town of Jimma, the Gambella Region of Ethiopia for Sudanese Refugees in collaboration with the UNHCR and the Ethiopian Administration for Refugee and Returnee Affairs office.</p>	<p>Ethiopia Country Representative: Dr. Fantaw Makonnen Opportunities Industrialization Centers Ethiopia (OIC Ethiopia) Year Established: 1973 Board Chair: Mr. Tilahun Giday Address: Pathfinder International, P.O. Box 12655, Addis Ababa, Ethiopia Tel: (251) 11-661-3549 Fax: (251) 11-661-4209 Email: <a href="mailto:tgiday@pathfinder.org">tgiday@pathfinder.org</a> Program Director: Mr. Yalew Melesse Address: P.O. Box 2486, Addis Ababa, Ethiopia Tel: (251) 11-275-0151 Fax: (251) 11-550-7847 Email: <a href="mailto:icethiopia@ethionet.et">icethiopia@ethionet.et</a></p>
<p>NGOs (CONCERN, SIDA), local administration, cooperatives, schools, village communities (e.g. Got) women's groups micro-financing groups, self-help groups, National Meteorology Agency. Extension agents (safety net programs, watershed management)</p>	<p>Extension agencies reach almost all households in the areas where they operate. In the areas not covered by them, NGOs are active. Even though many households indicate that they are in contact with cooperatives, religious communities, and women's groups, households do not view these institutions as providing help for climate change adaptation.</p> <p>Extension agencies focus their assistance on agricultural and communal strategies. Their role is smaller for strategies related to livestock, migration, small scale income diversification activities, and trade. This gap is partly filled by NGOs, cooperatives and (informal) village community institutions. The better-off households seem to receive more assistance from (informal) village community institutions than the marginalized households. This is an indication that the better-off households, who also adopt communal strategies more often, are more effective in bringing their interests forward. Even though institutional stakeholders indicate that no distinction is made between household types, marginalized groups may not be able to access community institutions if membership fees are required.</p> <p>Assistance received by households, both for individual farming and for communal strategies, is especially in terms of training. This is positive as it improves household skills. Input is provided for individual farm strategies like adopting improved seeds and fertilizer application and for communal strategies that require investments like reforestation, irrigation schemes, terrace construction, and soil erosion measures (like rock bunds). Improves household skills. Input is provided for individual farm strategies like adopting improved seeds and fertilizer application and for communal strategies that require investments like reforestation, irrigation schemes, terrace ETHIOPIAN construction, and soil erosion measures (like rock bunds).</p>	

Other institutions include the following:

- Common Interest Groups (CIGs) such as WUAs and farming associations;
- Individuals, especially women;
- Small holder farmers organized into a CIG based on their production systems;
- Different social actors including landlords (during the imperial regime), farmers, local government administrators, development agents, and Abo mai ('father of water');
- Local government bureaucracies;
- International organizations such as UNDP, UNECA and FAO;
- The Commission for Sustainable Agriculture and Environmental Rehabilitation;
- The Bureau of Natural Resources and Agriculture through the woreda department of agriculture;
- Local government administration and non-governmental organizations such as the Relief Society of Tigray (REST) and the Dedebit Credit and Savings Institution (DECSI);
- Formal and informal social organizations such as Mahber (religious associations) and equb (saving groups).

## 8.4 EASTERN NILE REGION DOWNSTREAM COUNTRIES (EGYPT AND SUDAN)

### 8.4.1 List on institutions in Egypt

The institutions involved in adaptation to drought in Egypt are listed in Table 52.

**Table 52: List of institutions involved in implementing drought adaptation actions obtained from available literature - Eastern Nile region (Egypt)**

Institution	Role	Contacts
climate change unit in Ministry state of Environmental Affairs, 1992	Representing the focal point of the UNFCCC and Kyoto Protocol, aiming at coordinating and integrating all national and international activities relevant to climate change.	<a href="http://www.eeaa.gov.eg">www.eeaa.gov.eg</a> <a href="http://www.eeaa.gov.eg/ecc/ClimateMain.htm">www.eeaa.gov.eg/ecc/ClimateMain.htm</a> NA
National Committee of Climate Change, Minister of State for Environmental Affairs, 1997	To oversee climate change policies at the national level.	NA
national authority for the clean development mechanism, Minister of State for Environmental Affairs, 2005	This committee is also headed by the Minister of State for Environmental Affairs, and composed of high level government representatives from different relevant sectors, including the business and scientific community as well as NGOs	NA
New and Renewable Energy Agency, Ministry of Electricity, 1986	Ppromoting renewable energy projects and schemes in Egypt.	NA
A Supreme Energy Council was established, Prime Minister, 2007.	This Council is composed of relevant ministers and supervising and coordinating energy policies on the national level.	NA
A ministerial committee for climate change, Ministry of Agriculture and	To supervise mainstreaming of climate change policies into the national plans.	NA

Institution	Role	Contacts
Reclamation Land (MARL)		
A ministerial committee for climate change headed by Ministry of Water Resources and Irrigation (MWRI)	Overseeing the mainstreaming of climate change policies into national plans.	NA
A Regional Center for Renewable Energy and Energy Efficiency, Ministry of Electricity, 2009	Promoting renewable energies and energy efficiency in the MENA countries	NA
Proposed Involved Institutions National center for climate change	Focusing on the different aspects of climate change is planned. This center would allow networking with existing research institutes in sectors relevant to climate change, as well as represent a think tank for decision makers to determine and prioritize climate change needs and the policy instruments for meeting these needs.	

The following ministries are involved in drawing and implementing an adaptation strategy:

- Ministry state of Environmental Affairs;
- Ministry of Agriculture and Reclamation Land (MARL);
- Ministry of Water Resources and Irrigation (MWRI);
- Ministry of Electricity.

Research Centers are supported in developing research activities and designing the monitoring systems such as:

- Desert Research Center (DRC);
- National Authority of Remote Sensing and Space Science (NARSSS);
- Executive Environmental Agency Affairs EEAA (Ministry state of Environmental Affairs);
- Agriculture Research Center (ARC);
- Academy of Scientific Research and Technology (ASRT).

There is a proposal to involve/establish the following institutions in the future:

- Local authorities and concerned NGO's;
- Establishing and promoting an institutional capacity for "Adaptation". This is to be carried out through initiating **a national center for climate change**, which would be responsible for integrating activities and outputs of various assessments of coastal zones (as well as other vulnerable sectors);
- Establishment of an Adaptation Policy Monitoring and Assessment Unit (APMAU).

## 8.4.2 Sudan

The institutions involved in drought adaptation in Sudan are listed in Table 53.

**Table 53: List of institutions involved in implementing drought adaptation actions obtained from available literature - Eastern Nile region (Sudan)**

Institution	Role	Contacts
Desertification Research Institute, (DRI), National Centre for Research	Implementation of farm water management, Studies in biodiversity, Water harvesting and supplementary irrigation Biodiesel and biomass fuel consumption (reduce carbon emission).	P.O. Box 6096_Khartoum, Sudan Tel: + 249 183 47615 Fax: + 249 183463416
Dry Lands Section, Forestry Research Centre (FRC), Agricultural Research	Use of modern irrigation systems (micro-irrigation). Intercropping and agro-forestry	Corporation Agricultural Research Corporation Soba-Khartoum, Sudan Tel: +249-122047407 or +249-917232979 <a href="http://www.arcsudan.sd/">http://www.arcsudan.sd/</a>
Rainfed Crops Research Centre for Arid and Semi-Arid Areas (rccasa)	Development and improvement of population (s) for drought escape/tolerance crops for the different targeted climatic zones (with especial focus on Arid and semi-arid Zones). Introduction of new crops through breeding programmes	Faculty of Agricultural Science, University of Gezira, P.O. Box 20, Wad Medani Sudan
Practical action organization- Sudan	Training women in food processing and preservation Distribute improved stoves Goat and donkey loans Strengthening the capacity of local groups	PO Box 4172, Khartoum West Website: <a href="http://practicalaction.org/sudan">http://practicalaction.org/sudan</a> E-mail: <a href="mailto:sudan@practicalaction.org.sd">sudan@practicalaction.org.sd</a>
Dams implementation unit, Ministry of Electricity and Dams (DIU)	Construction of water harvesting dams for agriculture and for domestic uses	P.O. Box 12843 Khartoum Tel: +249 83235719 or + 249 83230028 Fax. +24983235719 / +249183240001 Website: <a href="http://www.diu.gov.sd/">http://www.diu.gov.sd/</a> E-Mail: <a href="mailto:info@merowedam.com">info@merowedam.com</a>

Different institutes mentioned above work for both mitigation and adaptation practices in same geographical area mentioned in the mitigation part of this report. These institutions take the following actions in relation to climate change adaptation:

- Water harvesting and supplementary irrigation;
- On farm water management;
- Rainfall and wadi discharge forecast;
- Studies in biodiversity;
- Range land enclosures;
- Crop breeding for drought tolerance;
- Biodiesel and biomass fuel consumption (reduce carbon emission);
- Rural economies and livelihood adjustment mechanisms;
- Use of modern irrigation systems (micro-irrigation);
- Intercropping and agro-forestry.

## 8.5 SOUTHERN AFRICA – SADC AND THE LIMPOPO BASIN

### 8.5.1 SADC Level

The institutions involved in adaptation to drought at SADC level are listed in Table 54.

**Table 54: List of institutions involved in implementing drought adaptation actions obtained from available literature - SADC**

Drought Period	Identified Adaptation Actions	Name of Institution	Spatial Coverage
1981-1984	<ul style="list-style-type: none"> <li>Groundwater and Drought Management</li> <li>Regional Early Warning System</li> <li>Regional Climate Outlook Forum</li> <li>Disaster Management Programme</li> <li>Regional Remote Sensing Unit</li> <li>Regional Climate Change Programme</li> </ul>	U.S. Agency for International Development	SADC
1987-1988	<ul style="list-style-type: none"> <li>Regional Climate Outlook Forum</li> <li>Disaster Management Programme</li> </ul>	U.S. Agency for International Development, Food and Agriculture Organisation, World Food Programme	SADC
1991-1995	<ul style="list-style-type: none"> <li>Disaster Management Programme</li> <li>Disaster Management Programme</li> </ul>	U.S. Agency for International Development, Red Cross, World Health Organisation, World Food Programme	SADC
2002-2005	<ul style="list-style-type: none"> <li>Regional Climate Outlook Forum</li> <li>Disaster Management Programme</li> </ul>	Famine Early Warning System Network, Red Cross	SADC

### 8.5.2 Botswana

The institutions involved in adaptation to drought in Botswana are listed in Table 55.

**Table 55: List of institutions involved in implementing drought adaptation actions obtained from available literature - Botswana**

Institution	Responsibility	Contact details/Website
Office of the President (OP)	Management of disaster at National level	Mr. Nkosiyabo MOYO National Disaster Management Office E-mail address : nmoyo@gov.bw Telephone : +267 3950936 Fax : +267 3904017
National Committee on Disaster Management (NCDM)	coordinates the activities related to disaster risk management	
National Disaster Management Technical Committee (NDMTC)	Coordinates the activities related to disaster risk management	
District Disaster Management Committee (DDMC)	District commissioner in responsible for drought management at district level	
Village Development Committee (VDC)	implement activities related to disaster risk management in their respective jurisdiction	

The specific objectives of the disaster risk management plan are:

- to establish a set of working definitions for the integral components of disaster risk management in Botswana;
- to define measures to reduce vulnerability to disasters and build capacity and resilience at national, district and community levels;

- to outline structures for organising and coordinating disaster risk management functions;
- to outline functional responsibilities and the requirements for implementing the various elements of disaster risk management. These include mitigation, preparedness, response, recovery, rehabilitation, reconstruction and disaster safe development.

### 8.5.3 Mozambique

The institutions involved in adaptation to drought in Mozambique are listed in Table 56.

**Table 56: List of institutions involved in implementing drought adaptation actions obtained from available literature - Mozambique**

Name of Institution	Role	Web address
<b>National Institute for Disaster Management (INGC)</b> – (CCGC – Coordinator committee of disasters management, CTGC – Technical committee for disasters management)	Coordinating body. Within INCG and through the Department for Development of Arid and semi-arid areas, they research on best adaptation mechanisms for droughts.	Marta Manjate (coordinator) Address: Maputo Mozambique Telephone: +25801490222 Fax: +25801490222 Mobile: +258825929546 Email: <a href="mailto:martamanjate@yahoo.com">martamanjate@yahoo.com</a> <a href="http://www.ingc.gov.mz">http://www.ingc.gov.mz</a>
National Meteorological Institute (INAM)	Support institution on weather information and forecast. The information generated is useful for planning adaptation interventions when extreme events (e.g. droughts) are forecasted.	Mr. Berino Francisco Silinto Address: Rua de Mucumbura Nr. 164 P.O.Box 256 Maputo Mozambique Phone: + 25821493193 Fax: +25821491150 Mobile: +258842263890 Email: <a href="mailto:berino_s@inam.gov.mz">berino_s@inam.gov.mz</a> <a href="http://www.inam.gov.mz">http://www.inam.gov.mz</a>
Ministry for Coordination of Environmental Affairs (MICOA) – (DNGA – National Directorate of Environmental Management)	Development of appropriate policies and laws that will ensure the sustainability of resource use. Coordinating and fulfilling the intersectorial view of correct use of natural resources (e.g. NAPA).	Mr. Custodio Mário - DNGA .Av Acordos de Lusaka No. 2115 Maputo - C.P. 2020 Mozambique Telephone: + 258 21466495 Fax: + 258 21465849 Mobile: +258828632120 Email: <a href="mailto:custodiomaphossa@yahoo.com.br">custodiomaphossa@yahoo.com.br</a>
Ministry of Agriculture (MINAG)	Farmers awareness on possible occurrence of droughts and promotions of relief and mitigation actions.  Acquisition and distribution of seeds (tolerant/resistant to drought), movement of animals from highly drought risk zones to better locations.	Mr. Eusébio M. Tumuitikile Praça dos Heróis Mocimbanos Maputo- C.P. 1406 Mozambique Telephone: +250-21-49-1785; +258-21-46-0011 Fax: +258-21-49-9673; +258-21-46-0055 Mobile: +2588206003 Email: <a href="mailto:muitikile@gmail.com">muitikile@gmail.com</a> <a href="http://www.minag.gov.mz">http://www.minag.gov.mz</a>
Ministry of Public Works and Housing (MOPH) – (DNA – National Directorate of Water)	Development and implementation of the water resources management plans and enforcement tools for water scarce scenarios.	Av. Karl Marx 606, Maputo-C.P. 268 Mozambique Telephone: +258-21-430028 Fax: +258-21-421369 <a href="http://www.mop.gov.mz">www.mop.gov.mz</a>
Technical Secretariat for Food Security and Nutrition (SETSAN)	Working group comprising professionals from various ministerial sectors, including nongovernmental organisations. Supports the establishment of food and nutritional security in the country	Mrs: Francisca Cabral Av. das FPLM nº 2698 - Recinto do IIAM (Pavilhão novo), Maputo, Moçambique Telephone: (+258 - 21) 461874 – Fax: (+258 - 21) 462403 / 461850 Mobile: +258823943820 Email: <a href="mailto:fcabral@setsan.org.mz">fcabral@setsan.org.mz</a> <a href="http://www.setsan.org.mz">http://www.setsan.org.mz</a>



## 8.5.4 South Africa

The institutions involved in adaptation to drought in South Africa are listed in Table 57.

**Table 57: List of institutions involved in implementing drought adaptation actions obtained from available literature – South Africa**

Institution	Responsibility	Contact details/Website
National Disaster Management Centre	Integrated and co-ordinated disaster risk management policy that focuses on preventing reducing the risk of disasters, mitigating the severity of disasters, preparedness, rapid effective response to disasters, and post-disaster recovery the establishment of national, provincial and municipal disaster management centres disaster risk management volunteers	The National Disaster Management Centre 87 Hamilton Street, Arcadia, Pretoria, South Africa . 0001 Phone +27 12 334 0600 • Fax +27 12 334 0810.
World Vision	World Vision identifies places at risk of disaster, prepares resources and staff in high-risk zones, and builds capacity and resilience among communities to help them protect themselves before an emergency and rebuild afterwards.	MAPHOSA Stanley: World Vision South Africa Mobile+27738254188. Email:stanley_maphosa@wvi.org Skype: ramaphosa2311 P. Bag x 12 Florida 1710  5 Main Avenue, Florida: Gauteng-Johannesburg South Africa. Phone:+27116711300 Fax: +27114724885 www.worldvision.co.za
World Bank	The World Bank is a vital source of financial and technical assistance to developing countries around the world. Our mission is to fight poverty with passion and professionalism for lasting results and to help people help themselves and their environment by providing resources, sharing knowledge, building capacity and forging partnerships in the public and private sectors	<a href="http://www.worldbank.org">www.worldbank.org</a>
Food and Agriculture Organisation (FAO)	Achieving food security for all is at the heart of FAO's efforts - to make sure people have regular access to enough high-quality food to lead active, healthy lives. FAO's mandate is to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy	<a href="http://www.fao.org">www.fao.org</a>
World Food Programme (WFP)	WFP is the food aid arm of the United Nations system. Food aid is one of the many instruments that can help to promote food security, which is defined as access of all people at all times to the food needed for an active and healthy life. The policies governing the use of World Food Programme food aid must be oriented towards the objective of eradicating hunger and poverty. The ultimate objective of food aid should be the elimination of the need for food aid	<a href="http://www.wfp.org">www.wfp.org</a>
Department of Agriculture	<ul style="list-style-type: none"> <li>• Agricultural risk management</li> <li>• Farmer settlement</li> <li>• Agricultural finance and cooperative development</li> <li>• Food security and rural development</li> <li>• Domestic marketing</li> <li>• International trade</li> <li>• Business and entrepreneurial development</li> <li>• Water use and irrigation development</li> <li>• Land use and soil management</li> <li>• Scientific research and development</li> <li>• Animal and aqua production</li> </ul>	Ms N. Vutula Chief Director: Communication and Information Room K FF 10 012 319 7348 CDCI@daff.gov.za  Dr M. Visser Chief Director: Agricultural Production

Institution	Responsibility	Contact details/Website
	<ul style="list-style-type: none"> <li>Plant production</li> <li>Education and training</li> <li>Agricultural information services</li> <li>International relations</li> <li>Land redistribution; land use planning; resource conservation; control of pests and noxious weeds; infrastructure; policy development; empowering small emerging farmers; agricultural statistics</li> <li>Trade and industry; tourism; economic planning, research and policy</li> <li>District health systems; social welfare programmes; poverty alleviation</li> </ul>	<p>Room 234 012 319 6506 CDAP@daff.gov.za <a href="http://www.nda.agric.za/">http://www.nda.agric.za/</a></p> <p>Dr P P PHEME, Private Bag X9487, Pietersburg 0700. Tel. (015) 295 7048/295 7090. Fax: 015-2913740. E-mail: PHEMEPP@agricho.vorprov.gov.za</p>

### 8.5.5 Zimbabwe

The institutions involved in adaptation to drought in Zimbabwe are listed in Table 58.

**Table 58: List of institutions involved in implementing drought adaptation actions obtained from available literature - Zimbabwe**

Institution	Responsibility	Contact details/Website
FAO(Food and Agricultural Organization)	Promoting activities and projects that foster food security for communities. Promotion of soil and water conservation.	Block 1, Tendeseka Office Park, Corner Samora Machel and Renfrew Drive, Eastlea, Harare, Zimbabwe Phone: +263 4 252021 - 3
Ministry of Agriculture, Mechanization and Irrigation Development	Agricultural extension, land use planning, soil and water conservation. Irrigation rehabilitation and development. Soil and water conservation.	No. 1 Borrowdale Road, Ngungunyana Building. Harare, Zimbabwe. Tel:702015
WORLD VISION	To provide emergency relief to victims of disasters.	59 Joseph Road, off Nursery Road Marlborough East. Box 2420, Harare, Zimbabwe. Phone: +2634729467
EMA(Environmental Management Agency)	Provide for the sustainable management of natural resources and protection of the environment; the prevention of pollution and environmental degradation.	Makombe Complex, Block 1, Harare St/H.Chitepo, Box CY385, Causeway, Harare, Zimbabwe.
ZINWA-Mzingwane	Water planning quasi-government agency advising Catchment Councils and Sub-catchment Councils. Management of the water permit system and the operationalization of water pricing systems, planning, coordination, management of water resources and the delivery of water	Corner 10th Av & Batsch Street, Bulawayo, Zimbabwe.
Ministry of Local Government, Urban and Rural Development	Coordination of stakeholders at involved in drought mitigation.	Makombe Building, Bag 7706, Causeway, Harare, Zimbabwe. Tel: +263 4 727906.
Meteorological Services Department.	Monitoring and interpretation of regional climate systems.	Corner Bishop Gaul & Hudson, Box BE150 Belvedere, Harare, Zimbabwe.
ZimVac	Assessing vulnerability status of communities and recommending to the government the need for intervention.	1574 Alpes Road, Hatcliffe, Harare Telephone 263-4-860320/9
Zimbabwe Regional Disaster Alleviation Trust (ZRDAT)	To educate and alert the population of Zimbabwe to be prepared and take preventive measures against natural disasters and the damage they cause, in order to avoid or minimise human suffering and environment devastation.	Satcoy House, 125 Robert Mugabe Road, Harare, Zimbabwe. Telephone: +2634792728
World Food Programme	Providing relief to drought victims.	Takura Hs67-69 Corner Kwame Nkrumah Avenue and first Street, Box 4775
Civil Protection Unit.	Provide emergency relief to drought affected communities.	P.Bag 7706 Causeway, Zimbabwe

Institution	Responsibility	Contact details/Website
		Phone: +263 4 727906 Fax: +263 4 703715 Email: eprzim@africaonline.co.zw
Swedish Cooperative Centre	Promoting conservation agriculture and providing relief.	70 Livingstone Avenue, 1 Verona Gardens Harare Zimbabwe Phone +263-4-795865/707494/737 492
ICRISAT(International Crops Research Institute for the Semi-Arid Tropics)	Crop research and plant breeding. Development of soil and water conservation technologies.	Matopos Research Station, PO Box 776, Bulawayo, Zimbabwe
DDF(District Development Fund)	Provision of relief aid and development of water resources.	Mukwati Building Harare. Tel: +263 4 793655
Forestry Commission	Ensuring preservation of plant tree species.	1 Orange Groove Drive, Highlands, Harare, Zimbabwe

## 8.6 WEST AFRICA - NIGER BASIN

The institutions involved in adaptation to drought in the Niger basin listed in Table 59.

**Table 59: List of institutions involved in implementing drought adaptation actions obtained from available literature – Niger Basin**

Name of Institution	Web address
CENTRE RÉGIONAL AGRHYMET	BP 11011 Niamey, NIGER. Tél (227) 20 31 53 16 / 20 31 54 36 Fax : (227)20 31 54 35 Email : admin@agrhyment.ne Site Web : <a href="http://www.agrhyment.ne">www.agrhyment.ne</a>
Institute for Rural Economy	Adresse:: BP 258 - Rue Mohamed V - Bamako - Mali. Email: info@ier. ml Tel: (223) 20 22 26 06 /20 23 19 05 Fax: (223)223775 URL: <a href="http://www.ier.ml/ier">http://www.ier.ml/ier</a>
ORM (Office Riz Mopti)	Tel: +223 21 42 00 55 +223 21 42 01 20 +223 21 42 00 18
Direction Générale Opération Pêche Mopti	Tel:+223 21 43 03 24
DRHE ( Regional Directorate for Hydraulics)	Direction Nationale de l'Hydraulique BP: 66 Bamako - MALI Tel: + 223 20 21 48 77 Fax:+ 223 20 21 86 35 dnhe@malinet.ml www.dnh-mali.org Regional Directorate for Hydraulics- Mopti Tel: +223 21 42 01 17
DRA (Regional Directorate for Agriculture)	Direction Nationale de l'Agriculture : Tel: (223) 20 22 34 20/20 22 40 36/20 22 48 12/20 23 33 61/20 21 83 62/ 20 22 28 77 B.P 1098 Bamako
Direction National Directorate for Meteorology	Direction Nationale de la Météorologie Route de l'aéroport de Bamako-Sénou - B.P. 237 Bamako - MALI Tel: +223 20 20 62 04 Fax: +223 20 20 21 01 Email: dnm@africone.net.ml Site Web: <a href="http://www.meteo-mali.com">www.meteo-mali.com</a>
CARE International	CARE International au Mali BP : 1766

Name of Institution	Web address
	Tel. (223) 20 24 22 62/ 20 24 91 37 Bamako Mali Fax : ( 223) 20 24 75 32
SAP (Early Warning System )	Department : DNS/ SAP Address: sapmali@afribone.net.ml Telephone: +223 20 21 27 28
WFP ( World Food Programme)	PAM Badalabougou Est, Porte 1331, Bamako Mali Tél. :+223 20 22 20 45. Fax : +223 20 22 68 85. Site internet :http://www.wfp.org
OMA (Agricultural Market Observatory)	OMA, BAMAKO, Mali BP. 132 - BAMAKO - MALI. Tel: (223) 20 21 40 73/ 20 21 17 11. Email : oma@datatech.net.ml
OPAM	OPAM - Mali. BP 132. BAMAKO. Tél. : (+223) 20 22 40 73
FEWS-net	FEWS NET Mali. Bamako. Tel: 223 20 29 94 60. Mali@fews.net. www.fews.net/Mali
Caritas-Mali	Caritas Mali Badalabougou est - Rue 17 porte 130 BP 1726 Bamako Mali (Bamako) Tél.: 223 20 23 30 88  Caritas-Mopti BP 45 Mopti Tél : (223 ) Fax : Email : caritasmopti@yahoo.fr pastsocmpoti@afribone.net.ml

## **9 INVENTORY OF INSTITUTIONAL FRAMEWORKS FOR DROUGHT ADAPTATION**

### **9.1 NORTH AFRICA – ALGERIA, MOROCCO AND TUNISIA (MAGHREB REGION)**

In general, north-African countries at the beginning of independence, set up and strengthened the institutions working on environmental issues. The establishment of these institutions initially responded to the need for environmental protection and natural resources and the development of the rural sector and forestry. Thus, their goals initially focused on measures for water conservation, soil and vegetation through the development of protected areas and wildlife reserves, the protection mechanisms of arid against different types of degradation, etc. On climate issues in general, efforts have focused on the creation of national meteorological services for the collection of climate data. National centers for remote sensing and mapping were later introduced as useful modeling for decision making. In terms of climate change, very few institutions work specifically on this issue and institutional frameworks need more development. The main structures that are directly or indirectly involved in adaptation in North Africa are scattered among several departments including Water and Environment, Agriculture, Forestry, Energy, Mines, Industry and Transport.

In North-Africa, Environment ministries, through their strategic position and cross coordination of various environmental issues are currently positioning themselves as leaders on adaptation issues. This is particularly the case of Morocco where the High Council for Water and Climate is the main consultative body on water and drought management. In Algeria, the National Agency for Climate Change was created in 2005 whereas Tunisia implemented in 2001 a focal point on Climat Change within its ministry of Environment.

#### **9.1.1 Tunisia**

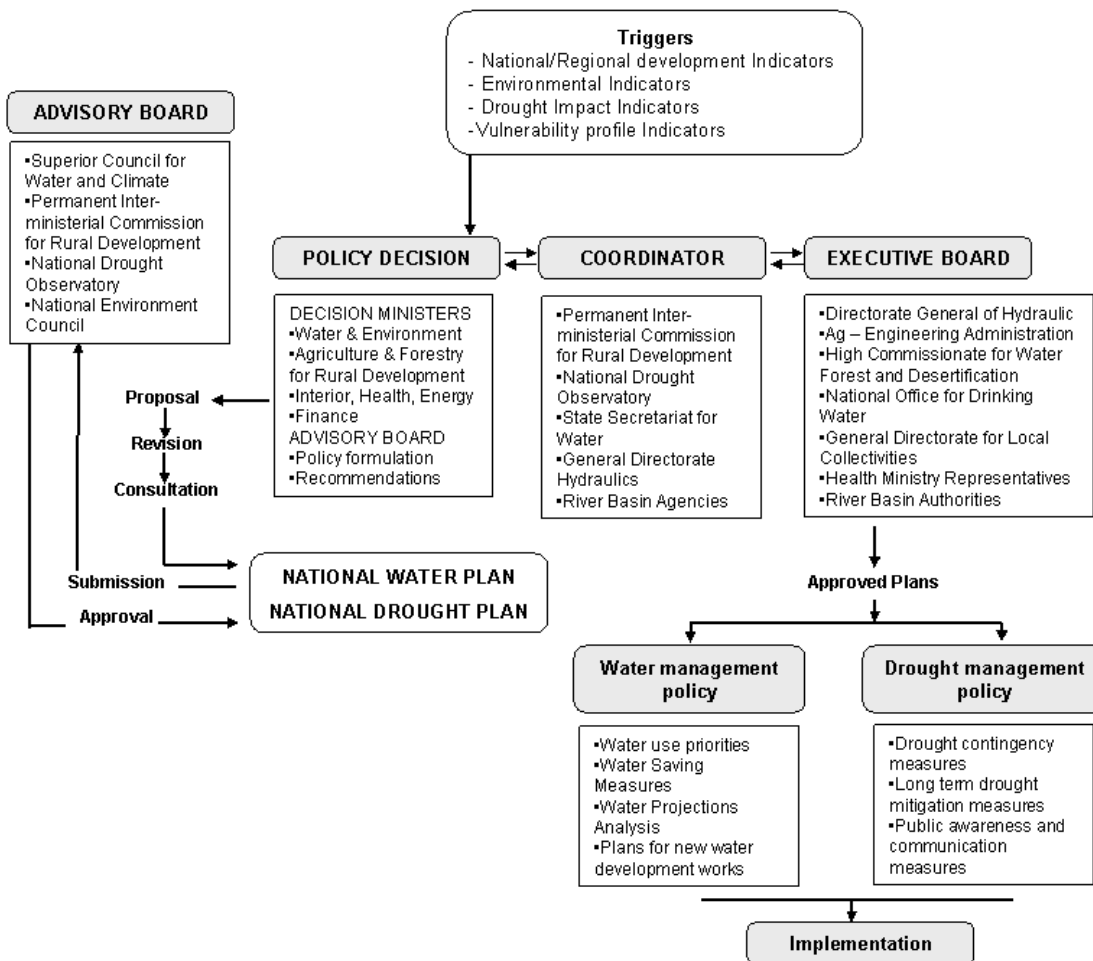
On the basis of very deep internet search, there was no information regarding how institutions involved in drought mitigation work together during drought episodes.

#### **9.1.2 Algeria**

On the basis of very deep internet search, there was no information regarding how institutions involved in drought mitigation work together during drought episodes.

#### **9.1.3 Morocco**

Figure 94 shows how institutions involved in drought management work together in order to implement drought adaptation strategies.



**Figure 94: Overall model of hydrological and agricultural drought adaptation in Morocco**

(Ouassou et al, 2007)

Among drought adaptation strategies is the creation of several institutions and ministerial departments involved in water and drought management, amongst them are the following:

- The High Council for Water and Climate:

It is the main consultative body on water and drought management and it includes all administrations involved in the water sector, representatives of the parliament, of users and nominated experts that have competencies on the water issues. The SCWC convenes to address issues of national importance and formulate recommendations on the options of planning, mobilization and management of water resources. The Directorate General of Hydraulics within Ministry of Territorial Administration, Water and Environment (MTAWE) is responsible for the technical Secretariat of the SCWC.

- The National Council for Environment (NCE)

The National Council for Environment (Conseil National de l'Environnement, CNE) was created in 1981 but has been reactivated only in 1995 in order to advise the government on

all environmental issues. On water issues, the NCE contributes to define guidelines that limit conflicts between institutions and promote environmental awareness and education.

- The Permanent Interministerial Council for Rural Development

The Permanent Interministerial Council for Rural Development (Conseil Interministériel Permanent du Développement Rural, CIPDR) was created in 1999 following the severe drought episodes in Morocco. This Council is headed by the Prime Minister and the Ministry of Agriculture and Rural Development is responsible for its technical Secretariat. The main activities of the Council relate to the declaration of drought onset, the preparation of the National Drought Plan, the supervision of the planned drought actions and the elaboration of rural development strategies for Morocco.

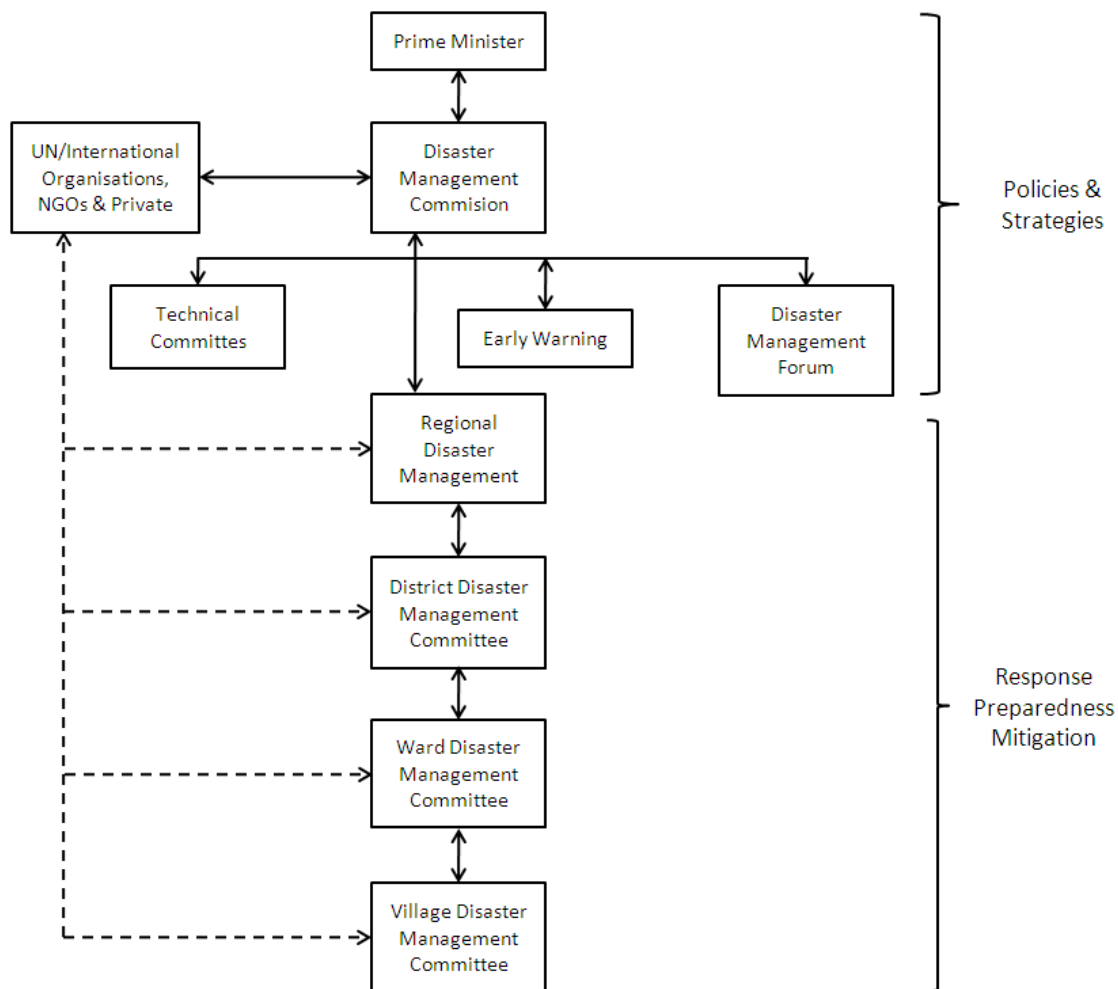
- The National Drought Observatory

The National Drought Observatory was created in 2001 as an entity attached to the General Secretary of Ministry of Agriculture and Rural Development and based at the Institut Agronomique et Vétérinaire Hassan II (IAV), as a result of a ministerial decision to locate it physically in an academic institution allowing multidisciplinary collaboration, and giving it certain neutrality with regard to policy pressures. It has an organizational structure involving regional centers in research institutions in Settat, Meknès and Salé, and a framework of working groups that can include and be led by a number of partner institutions. The main mission of the Observatory is to provide decision makers with decision support tools for drought management and to advise on strategic drought planning, preparedness, mitigation and response.

## **9.2 EQUATORIAL LAKES REGION (BURUNDI, KENYA, TANZANIA, RWANDA)**

### **9.2.1 Tanzania**

The DMD was established under the Disaster Relief Coordination Act. No. 9 of 1990 together with the Tanzania Disaster Relief Committee (TANDREC), the DMD oversees and coordinates activities of the government on matters related to prevention, preparedness and response to all disasters management in the country. The system is owned by Government of Tanzania, Prime Ministeres Office (see Figure 95). The funding mechanisms are through the government and other stakeholders.



**Figure 95: Conceptual description of the system functioning for adaptation and mitigation**

Stakeholders can be grouped as follows:

- TMA (Tanzania Meteorological Agency) with roles of weather and drought forecasting
- MoAFS (Ministry of Agriculture & Food Security) with roles of contingency planning, food situation assessment, stockpiling of food and seeds, and early warning.
- UN and International development agencies with roles of participating in the National Disaster Management forum for the purpose of information and sharing experience; participate in Technical committees dealing with specific disasters; provide financial and technical support for disaster management in the country.
- MoW (Ministry of Water) with roles of response actions in the areas of emergency water supply.
- Media with roles of documentation, reporting, sensitization and incident coverage on disaster management activities as a whole and in assisting public awareness programs; mainstreaming disaster issues in their plans and budget; participate in disaster management forum in order to ensure media's effective contribution.



- NGOs/CBOs with roles of reducing vulnerability to the community and individual; participate in training, public education, damage assessment, rehabilitation and construction activities in disaster stricken areas.
- Tanzania Red Cross Society with roles of playing specific voluntary humanitarian in disasters and emergencies as an auxiliary to public authorities; provide valuable source of skilled manpower and funding; engage in sensitizing and mobilization of the community as a first line in disaster prevention, mitigation, preparedness and response.
- FEWS with roles of providing famine early warning system.

### 9.2.2 Kenya

From national ministerial policy development, the government agency delegates to the implementing department, who in turn hands down the project execution to the district level who then deals with the community. In the non-governmental agency, the response is a step lower as they assign implementing units to community level as shown in Figure 96.



Figure 96: Drought adaptation framework

### **9.2.3 Rwanda**

The main institution in charge of adaptation to drought is the Ministry of Disaster Management and Refugees affairs that must intervene in case of any disaster. Another institution is the Ministry of Health that has to intervene in case of diseases outbreak especially for malaria control. Others institutions intervene in terms of emergency with medical service, food and fresh water distribution, seeds distribution, employment in order to help to earn money for food purchase, etc.

### **9.2.4 Burundi**

Those institutions should interact with communities by Public involvement and participation in the implementation of drought actions presented within the adaptation plan. The public may be involved through:

- Locally organized community meetings;
- Local news and other media relations;
- Written document reviews and other ways deemed appropriate by planning personnel.

When the plan is completed and implementation commenced, the public may benefit from regular updates and opportunities to learn about the progress made with regard to the implementation of adaptation actions outlined within the plan. By keeping the public involved throughout the entire process, it will ideally foster a sense of ownership and community, hereby resulting with public support of future needed actions.

Those institutions should also interact with communities by educating and informing them about the “ongoing activities” and progress made with the implementation of the plans proposed recommendations and adaptation strategies.

## **9.3 EASTERN NILE REGION (ETHIOPIAN PLATEAU)**

The NAPA (National Adaptation Program of Action) preparation process in Ethiopia has followed the annotated guidelines prepared by the LDC (Least Developed Countries) Expert Group (LEG). According to the guidelines the steps for preparing NAPA’s include building NAPA team, synthesizing available information, conducting stakeholder consultation, synergy assessment, identification of adaptation options, development and evaluation of criteria, prioritizing adaptation projects and development of project profiles (UNFCCC/LEG, 2002).

The National Adaptation Program of Action for Ethiopia was initiated and coordinated by the National Meteorological Agency. A project Steering Committee with representatives from the following stockholder institutions has been established. The role of the steering committee is to provide overall guidance and oversight for the project.

- Ministry of Water Resources;
- Ministry of Agriculture and Rural Development;
- Ministry of Finance and Economic Development;
- Disaster Prevention and Preparedness Agency;
- Ethiopian Science and Technology Agency;
- National Meteorological Agency;
- Addis Ababa University;
- Institute of Biodiversity Conservation and Research;
- Ethiopian Rural Energy Promotion and Development Center;
- CRDA representing NGOs.

A Project Management Team consisting of a project coordinator, assistant project coordinator, secretary, accountant, technical coordinator, and data processor was established within NMA to implement the day to day activities of the project. A National UNV was also employed to assist the project management team. Use was made of national experts as consultants to prepare various technical reports that were used as input to the preparation of NAPA. Multidisciplinary NAPA Team for Ethiopia is composed of experts from the following 14 institutions:

- Ministry of Finance and Economic Development (MOFED);
- Ministry of Water Resources (MoWR);
- Ministry of Agriculture (MoA);
- Ministry of Health (MoH);
- Ethiopian Science & Technology Commission (ESTC);
- Disaster Prevention and Preparedness Commission (DPPC);
- Environment Protection Agency - National Focal Institution for GEF & Focal Institution for CCD;
- Ethiopian Agricultural Research Organization (EARO);
- Forestry Research Center - Ethiopian Agricultural Research Organization (FRC-EARO);
- Institute of Biodiversity Research & Conservation (IBCR) - Focal Institution for CBD;
- Ethiopian Health & Nutrition Research Institute (EHNRI);

- National Meteorological Services Agency (NMSA) - Executing Agency for NAPA & Focal Institution for UNFCCC;
- The Addis Ababa University (AAU);
- Christian Relief & Development Association (CRDA), one of the NGOs network in Ethiopia.

OIC Ethiopia Board of Directors consists of community leaders, private sector representatives (including the Chamber of Commerce of Addis Ababa) and representatives from line Ministries such as the Ministry of Labor and Social Affairs, Ministry of Education, and the Addis Ababa City Administration.

## **9.4 EASTERN NILE REGION DOWNSTREAM COUNTRIES (EGYPT AND SUDAN)**

### **9.4.1 Institutional frameworks in Egypt**

In 1992, Egypt established a climate change unit in the Egyptian Environmental Affairs Agency, representing the focal point of the UNFCCC and Kyoto Protocol, aiming at coordinating and integrating all national and international activities relevant to climate change. This unit has recently been upgraded to be a central department for climate change. Meanwhile Egypt established a ***National Committee of Climate Change in 1997***, and restructured it in 2007 by a prime ministerial decree, for it to oversee climate change policies at the national level. This committee is headed by the *Minister of State for Environmental Affairs* and is composed of high level government representatives from all relevant ministries and authorities in addition to high level scientific experts from research and scientific institutions as well as civil society.

Additional to the above, Egypt has established in 2005 a designated ***national authority for the clean development mechanism***. This committee is also headed by the Minister of State for Environmental Affairs, and composed of high level government representatives from different relevant sectors, including the business and scientific community as well as NGOs. So far, the committee has reviewed and accepted CDM projects.

A New and Renewable Energy Agency was created in 1986 in the Ministry of Electricity with the aim of promoting renewable energy projects and schemes in Egypt. A ***Supreme Energy Council*** was established in 2007 with the mandate of supervising and coordinating energy policies on the national level. This Council is composed of relevant ministers and headed by the Prime Minister.

**A ministerial committee for climate change** has been established within the Ministry of Agriculture. *Headed by the Minister of Agriculture*, its mandate is to supervise mainstreaming of climate change policies into the national plans. Similarly, *the Ministry of Water Resources and Irrigation has established another ministerial committee* for climate change headed by the Minister, overseeing the mainstreaming of climate change policies into national plans.

**Regional Center for Renewable Energy and Energy Efficiency** was established in 2009. Hosted by Egypt, it is located within the Ministry of Electricity, and it aims at promoting renewable energies and energy efficiency in the MENA countries.

Egypt is facing increasing challenges with regards to climate change. In this respect, adaptation issues together with the need to develop capacities to be able to properly address them are of particular significance. Potential institutional arrangements, additional to existing ones, which would be conducive to this end, include the establishment of an independent national scientific and technological committee to offer advisory support to top level decision makers. Additionally, the establishment of a *National climate Change Research Center* focusing on the different aspects of climate change is planned. This center would allow networking with existing research institutes in sectors relevant to climate change, as well as represent a think tank for decision makers to determine and prioritize climate change needs and the policy instruments for meeting these needs.

#### **9.4.2 Sudan**

In most cases the different institutes in Sudan dealing with Agricultural and Socio-economic drought. They develop programs in the area related to drought adaptation. This program is funded by governmental agencies, UN agencies and NGOS and other sponsors. The institutional framework involves the following:

- The different institutes interact in so many ways to deal with the impact of the drought;
- Development and improvement of population (s) for drought escape/tolerance crops for the different targeted climatic zones (with especial focus on Arid and semi-arid Zones);
- Introduction of new crops through breeding programs and establishment of sound scientific rotations;
- Development of water harvesting and agricultural techniques;
- Training women in food processing and preservation;
- Distribute improved stoves;
- Goat and donkey loans;
- Strengthening the capacity of local groups;

## 9.5 SOUTHERN AFRICA – SADC AND THE LIMPOPO BASIN

### 9.5.1 Botswana

The institutional framework is presented in Figure 97:

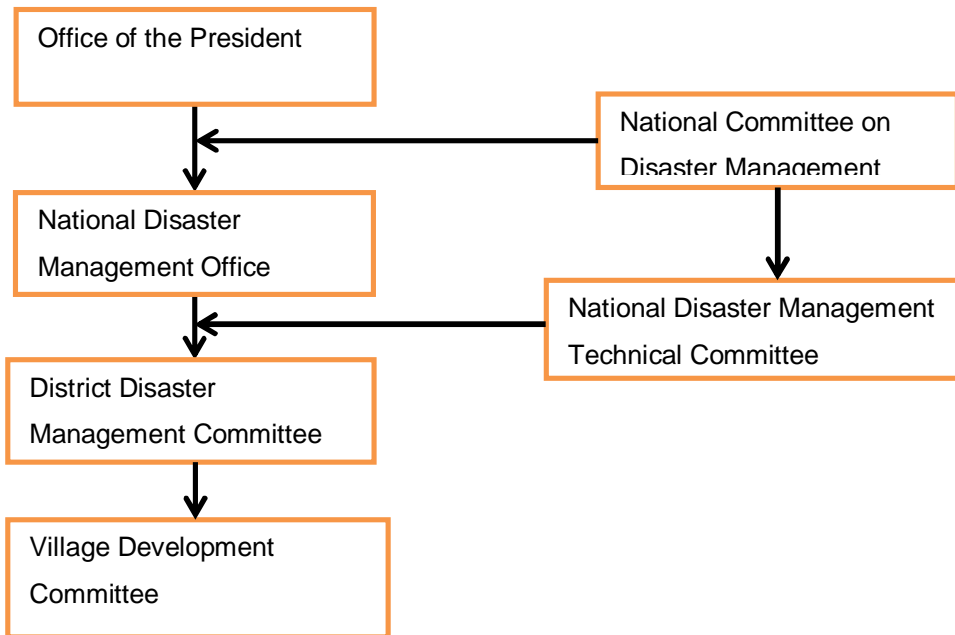


Figure 97: Disaster Management in Botswana

### 9.5.2 Mozambique

The institutional framework is presented in Figure 98.

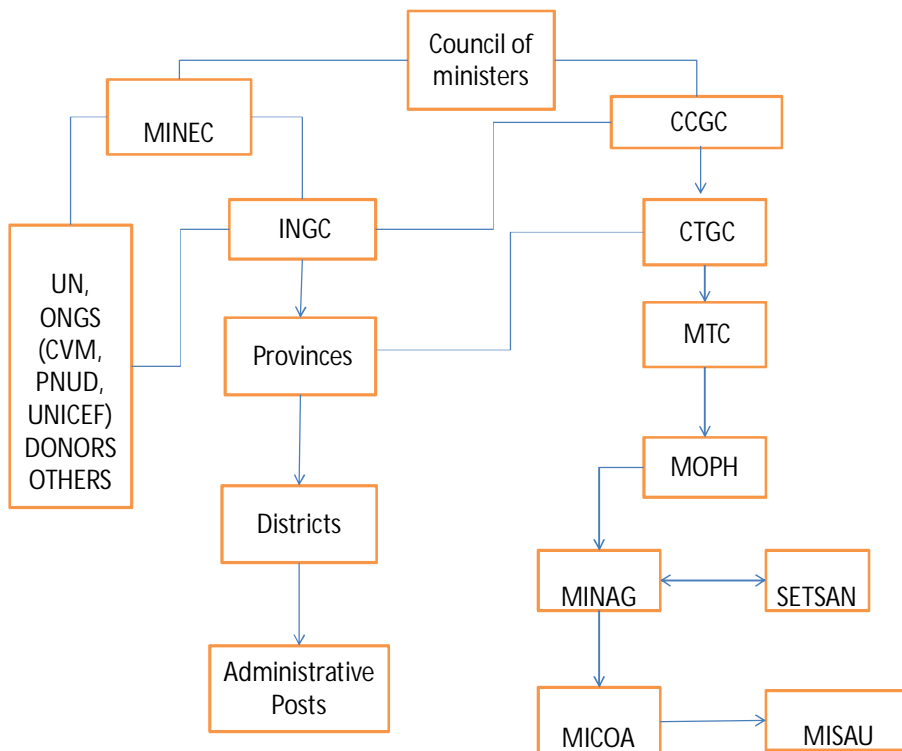
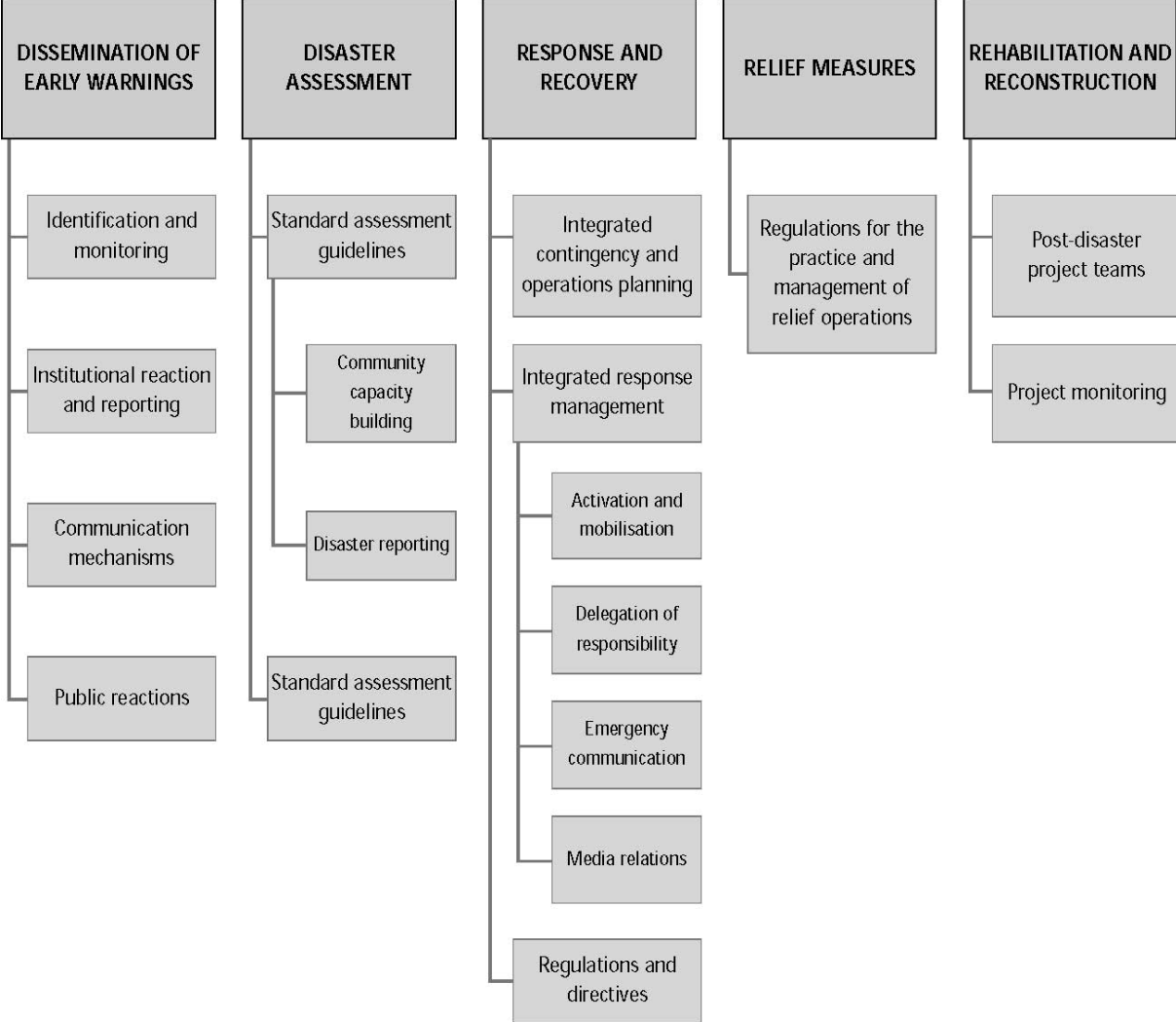


Figure 98: Mozambique Disaster Management Framework

For abbreviations see the list at the beginning of the report.

**9.5.3 South Africa**

The institutional framework at national level is presented Figure 99.



**Figure 99: National Disaster Management Framework in South Africa**

The institutional framework at provincial level is presented Figure 100.

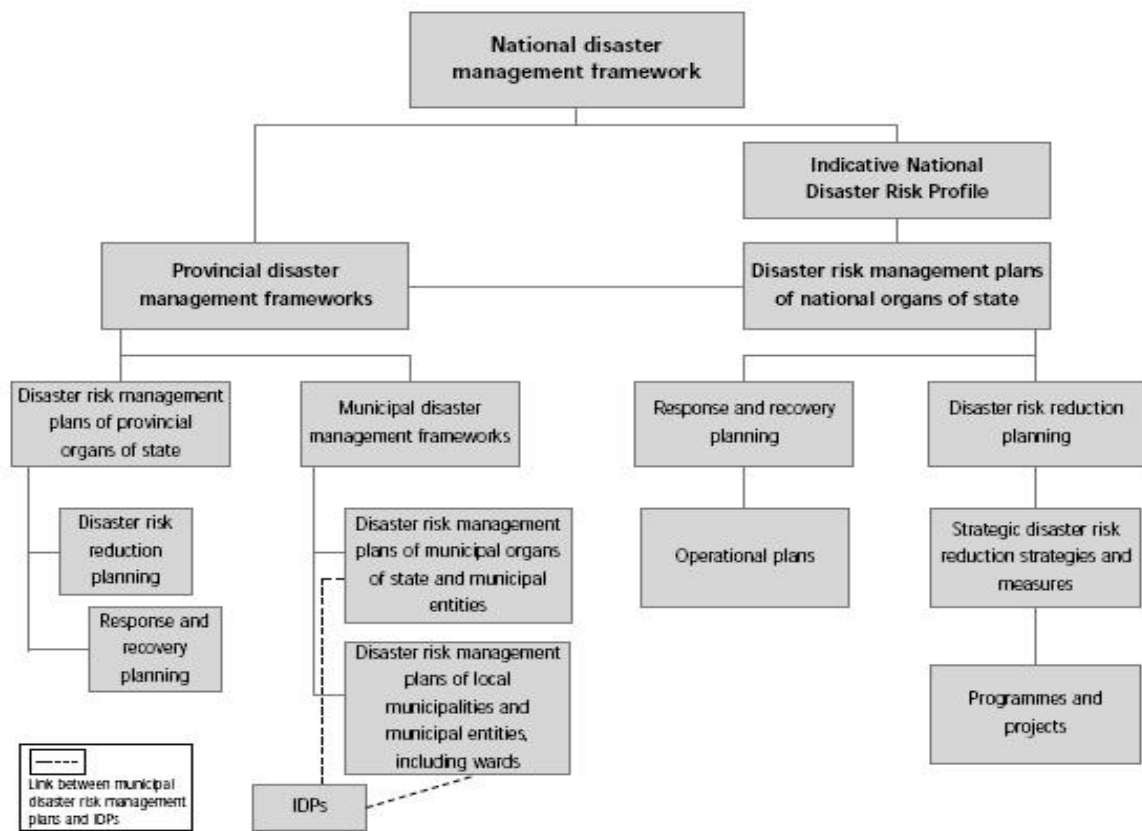


Figure 100: National, Provincial Disaster Management in South Africa

### 9.5.4 Zimbabwe

The institutional framework at national level is presented Figure 101.

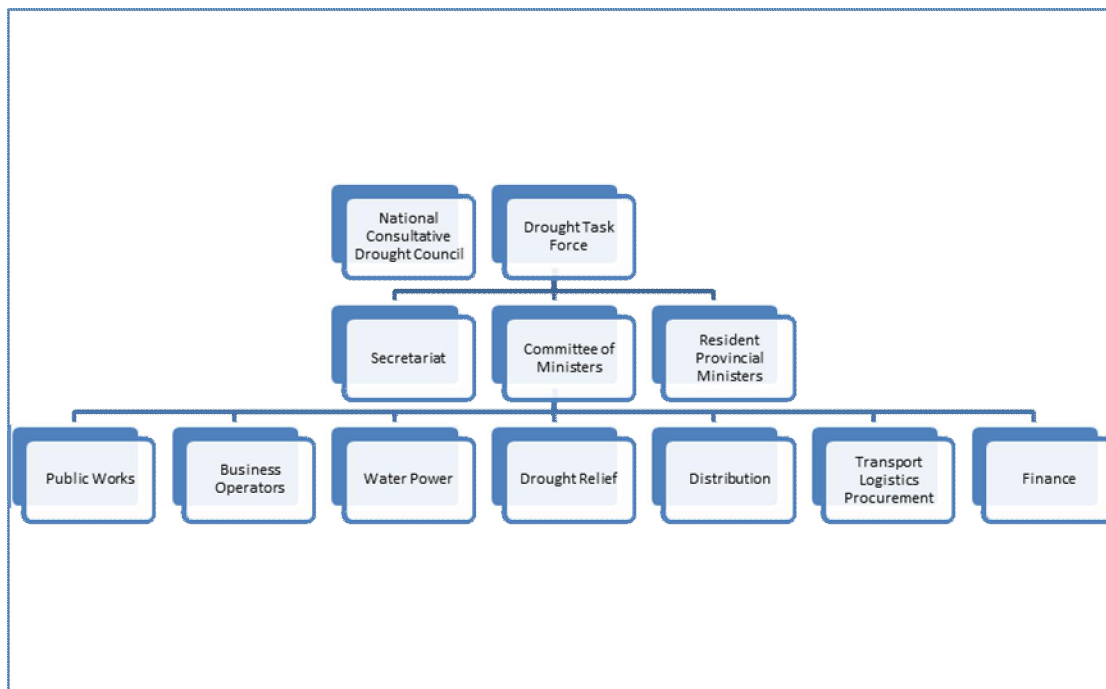
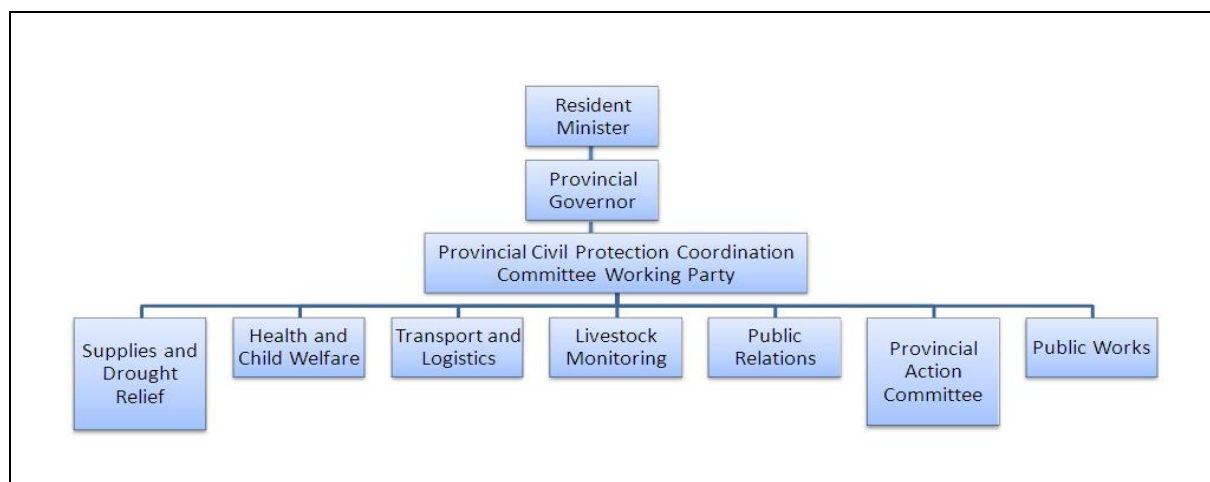


Figure 101: Zimbabwe National Action Group

Source Thompson (1993:86)



The institutional framework at provincial level is presented Figure 102.



**Figure 102: Zimbabwe Provincial Drought Administration**

Source Thompson (1993:86)

## 9.6 WEST AFRICA - NIGER BASIN

The 1972-1973 drought in the Niger Inner had a great impact on the life of the population, owing to the non-existence of committees for managing this kind of risk. Not many local technical services were there and the population was poorly organized. The State was less organized. Consequently food stocks coming from the World Food Programme (WFP) were handled by it as its only activity but not effectively because those donations were not properly distributed among the Circles and the population.

The 1984-1985 droughts had less impact in the Niger Inner Delta than that of 1972-1973. For coping with these droughts, the Mali Government put in place a number of mechanisms specific to each type of drought and that evolved in time. The current configuration of this mechanism is made up of the following:

- An inter-ministerial commission on Droughts Management led by the Prime Minister;
- A technical committee made up of Ministries, the United Nations Agencies, Embassies and International Organizations;
- National cells, including a Forecasting component and an Evaluation Component, depending on the category of disaster;
- Monitoring cells, attached to key-Ministries involved, with Monitoring Committees at the regional level, at the Circle (Territorial Division) level and at the Commune level, according to the nature of the disaster;

- Sectorial Structures and/or Ministries in charge of the day-to-day management in the field of risks and disasters management, with lead institutions or bodies, depending on the nature of the disaster (Epidemics, Epizootics, locust invasion, flooding, drought, etc.).

Institutions interact with affected communities in the following manner:

- Study of the identification of most vulnerable communities. That will allow for defining the level of vulnerability of of the population involved;
- Meeting with the councils of villages in their localities;
- Animation and sensitization campaigns for making the population understand the stakes of climate change and their implications for the rural world;
- Defining jointly with the population the best adaptation strategies or actions;
- Workshop with the communities ,local services ,and the training staff;
- Media (proximity Radio);
- Support to the implementation and to the seeking of funding (fund-raising).

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