IMPROVED DROUGHT EARLY WARNING AND FORECASTING TO STRENGTHEN PREPAREDNESS AND ADAPTATION TO DROUGHTS IN AFRICA

(DEWFORA)

A 7th Framework Programme Collaborative Research Project

Work Package 2

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

DELIVERABLE 2.1 - INVENTORY OF DROUGHT MONITORING AND FORECASTING SYSTEMS IN AFRICA

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DOCUMENT INFORMATION

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Reference	Inventory of drought monitoring and forecasting systems in Africa	

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SUMMARY

This document provides an inventory of drought monitoring and forecasting systems which cover Africa. The inventory considers systems, networks/ institutions and project and captures the information on a list, factsheets and detailed descriptions. The list can be considered as census. It can be divided into groups by coverage as follows:

(i) Global which also cover Africa,

(ii) Europe covers the whole of the African continent,

(iii) Europe which covers Northern Africa

(iv) Regional namely Northern Africa, Eastern Africa, Southern Africa and Western Africa as focus areas and

(v) National which covers individual countries in Africa.

The factsheets provide a summary of key information on each system/network/institution or project obtained from further based interrogation. The detailed descriptions provide information on the status of each system/network/institution or project.

The information reflected in this document is obtained from existing literature, the internet and people contacted during this research.

This inventory can be summarised in terms of coverage as follows:

Item	Coverage						Total
	Global	Europe plus African continent	Europe plus Northern Africa	Africa Continental	Regional	National	
List systems/ networks/ institutions and projects	18	2	4	3	8	103	138
Factsheets	9	2	4	3	8	29	55
Detailed descriptions	11	2	4	3	5	29	54

The spread of the systems/networks/ institutions or projects in the regional and national groups can be further broken down as follows:

Item	Coverage							
	Regional				National			
	Northern Africa	Eastern Africa	Southern Africa	Western Africa	Northern Africa	Eastern Africa	Southern Africa	Western Africa
List systems/ networks/ institutions and projects	2	3	2	1	22	37	37	7
Factsheets	2	3	2	1	13	8	3	5
Detailed descriptions	1	2	1	1	12	10	2	5

A list of modelling and local knowledge systems applied to provide drought early warning in Africa is also provided in this document. The list comprises 7 global modelling systems, 13 national systems and 2 local knowledge systems.

The reliance on the internet, published materials and contacts for information limited the number of system/network/ institutions or projects and early warning modelling systems that could be identified 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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1 INTRODUCTION

The importance of droughts has raised significant awareness all over the world, hence a need to incorporate drought mitigation measures in policy, planning and institutional strengthening in order to reduce vulnerability of drought prone regions. This document presents *an inventory and capability assessment of drought monitoring and forecasting systems in Africa*. This is done in the 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.

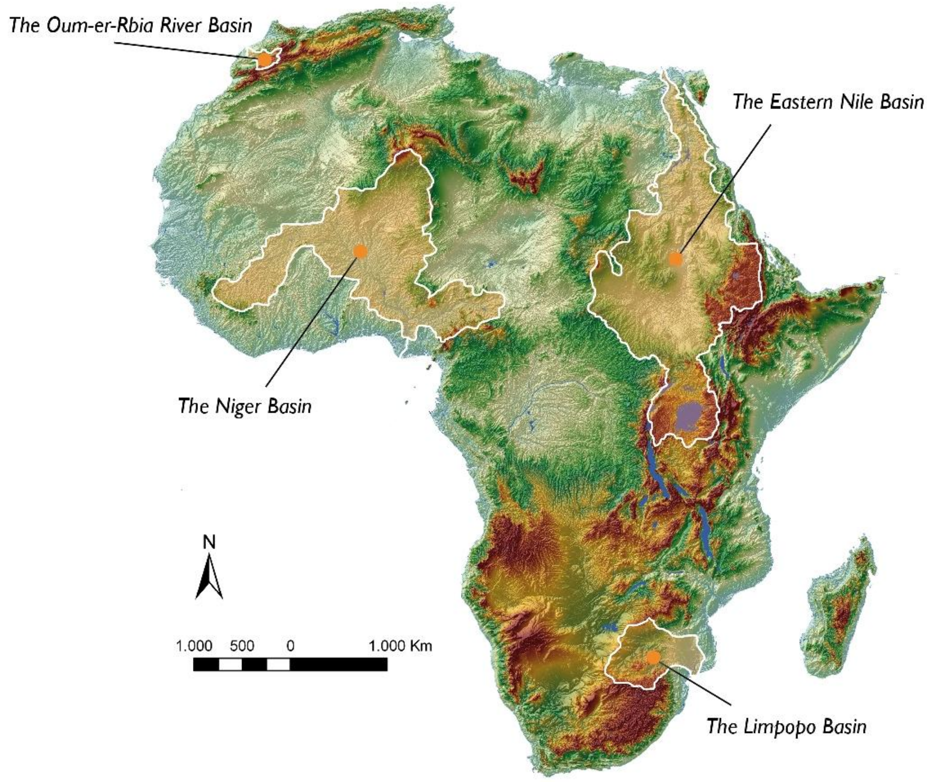


Figure 1: Location of case study basins

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.

The Nile Basin countries and other counties which cover the Eastern and Northern parts of Africa are shown in Figure 2.

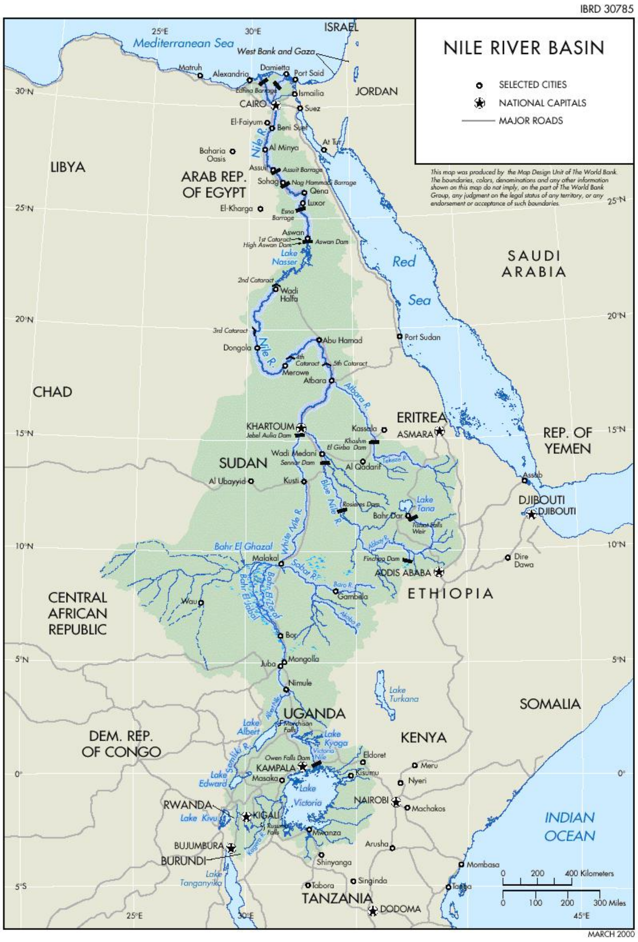


Figure 2: The Nile Basin and other countries in Northern and Eastern Africa

The countries in Southern Africa considered in this assessment are shown Figure 3.

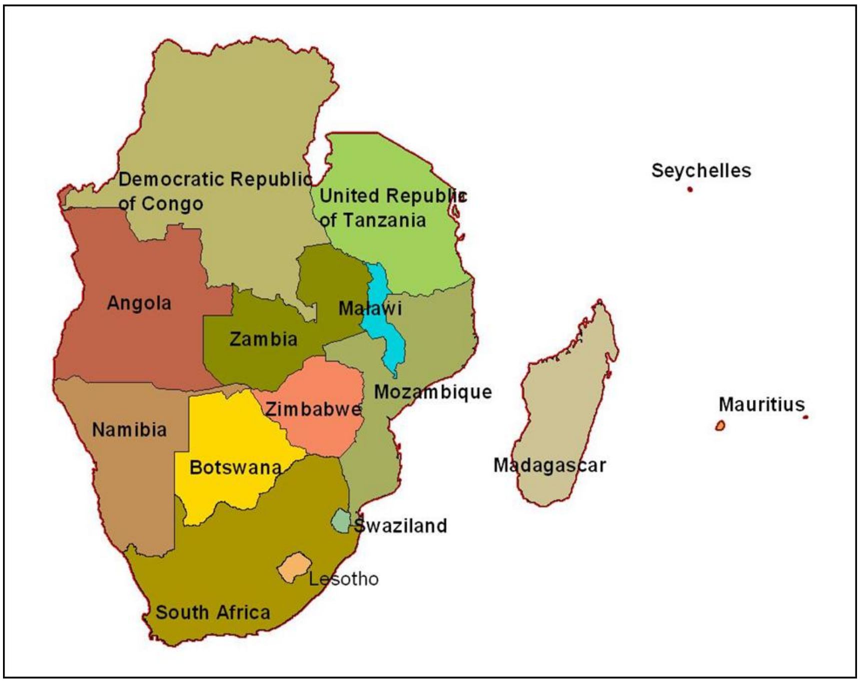


Figure 3: Countries in Southern Africa

The Niger Basin countries and other countries which cover the Western parts of Africa, are shown in Figure 4.

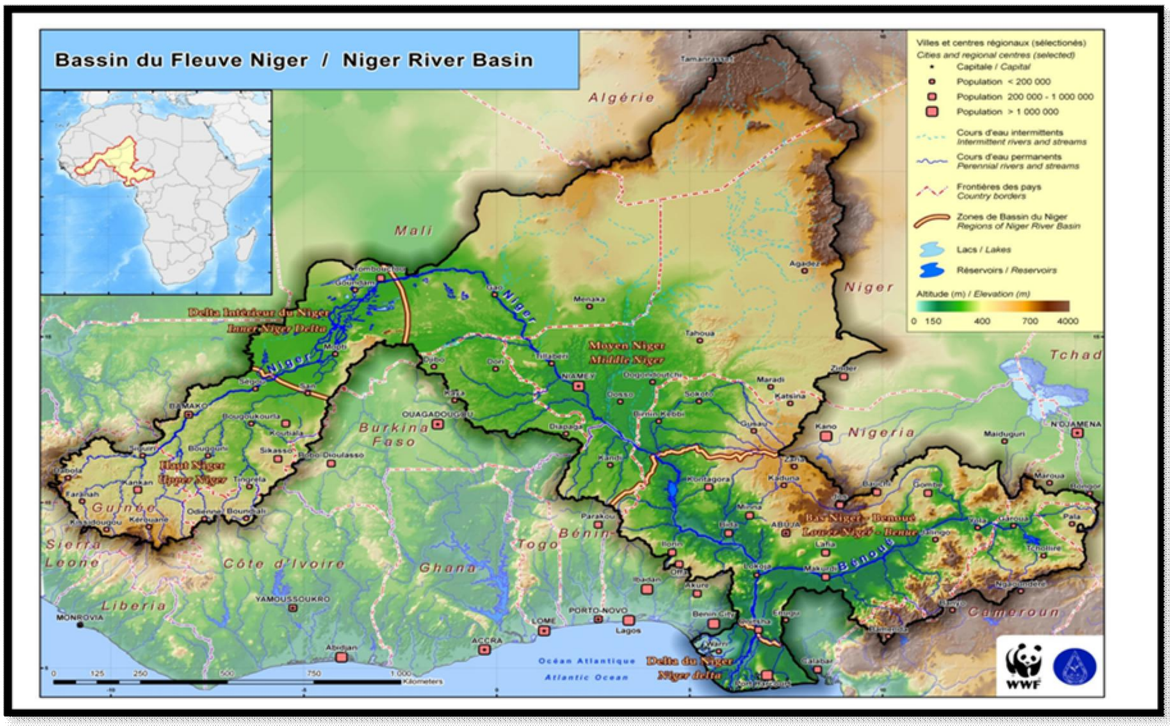


Figure 4: The Niger Basin and other countries in Western Africa

This document provides an inventory of drought monitoring and forecasting systems which cover Africa. The inventory considers systems, networks/ institutions and project and captures the information on a list, fact sheets and detailed descriptions

2 INVENTORY OF EXISTINGDROUGHT MONITORING AND FORECASTING SYSTEMS NETWORKS/ INSTITUTIONS

2.1 DEFINITIONS

The following definitions apply in the context of this report:

- System – A system is a combination of elements or several parts or data, which are linked or interdependent and can form the basis for analyzing droughts. This can be reduced to a model for simplicity.
- Network – A network is a number of organizations/institutions or independent units which share information/knowledge/resources.
- Forum – A forum is a meeting or platform for interaction among stakeholders for specific purposes.

While a project is not a system, network or forum and may be for a short period compared to the duration and lead time for the occurrence of a drought, it might have might have useful results or impacts such interaction and sharing of information, knowledge and resources. Sometimes a system is created in the framework of a project, without having a name except the project name. A distinction is therefore made where a project is included in this report.

2.2 LIST OF DROUGHT MONITORING SYSTEMS, NETWORKS/INSTITUTIONS WITH FACTSHEETS

The monitoring systems networks/institutions identified on this study are listed in **Table 1**. Each system/network forum is assigned an identification number for easy referencing.

Table 1: List of existing drought monitoring systems, networks/institutions (with factsheets)

ID	Location	Name	What is it?	Website	Coverage	Contact Details
Global / USA / Australia						
DMG01	United Kingdom	Global Drought Monitor	System that does quantitative monitoring of drought severity (on an on-going basis) and affected population worldwide	http://drought.mssl.ucl.ac.uk/drought.html?map=%2Fwww%2Fdrought%2Fweb_pages%2Fdrought.map&program=%2Fcgi-bin%2Fmapserv&root=%2Fwww%2Fdrought2%2F&map_web_imagepath=%2Ftmp%2F&map_web_imageurl=%2Ftmp%2F&map_web_template=%2Fdrought.html	Global	Dr. Benjamin Lloyd-Hughes Dept. of Space and Climate Physics University College London Gower Street London WC1E 6BT, UK. Email: blh@mssl.ucl.ac.uk Tel: +44 (0)20 7679 2429 Fax: +44 (0)20 7679 2390
DMG 02	United Kingdom	Water and Global Change (WATCH)	Network, System	http://www.eu-watch.org/	Global	Dr. Tanya A. Warnaars Centre for ecology & Hydrology. Maclean Building, Wallingford. Oxfordshire, OX10 8BB, United Kingdom info-watch@ceh.ac.uk
DMG 03	United States of America (USA)	National Integrated Drought Information System (NIDIS)	Integrated system with the goal to improve the nation's capacity to proactively manage drought-related risks providing. One of focus is maintaining and developing the U.S Drought Portal. This	http://www.drought.gov/portal/server.pt/community/drought_gov/202;jsessionid=364087864208D8E73D20A36551E2EFAF	Global	National Oceanic and Atmospheric Administration (NOAA) 1401 Constitution Avenue, NW Room 5128 Washington, DC 20230 Tel: + 1 (301) 713-3540 Email:Jason.Symonds@noaa.gov

ID	Location	Name	What is it?	Website	Coverage	Contact Details
			gives access to some important systems, presented in more detail posteriorly: U.S. Drought Monitor,, North American Drought Monitor ,, and Drought Impact Reporter and U. S Seasonal Drought Outlook			
DM G 04	United States of America (USA)	National Drought Mitigation Center (NDMC)	An institution that helps people to develop and implement measures to reduce societal vulnerability to drought, preparedness and risk management. The NDMC collaborates with many federal, state, and international agencies.	http://drought.unl.edu/	Global	National Drought Mitigation Center University of Nebraska–Lincoln 819 Hardin Hall 3310 Holdrege St. P.O. Box 830988 Lincoln, NE 68583-0988 phone: (402) 472-6707 fax: (402) 472-2946 e-mail:ndmc@unl.edu
DM G 05	United States of	U. S. Drought Monitor	It´s a system	http://drought.unl.edu/dm/monit	Global	The Drought Monitor

ID	Location	Name	What is it?	Website	Coverage	Contact Details
	America (USA)		blending numeric measures of drought and experts' best judgment into a single map every week	or.html		National Drought Mitigation Center P.O. Box 830988 Lincoln, NE 68583-0988 phone: 402-472-6707 - fax: 402-472-2946 DroughtMonitor@unl.edu
DM G06	United States of America (USA)	North American Drought Monitor (NADM)	Is based on the same philosophy of the U.S. Drought Monitor but is produced a monthly drought monitoring map for the entire continent (was included Canada and Mexico)	http://www.ncdc.noaa.gov/temp-and-precip/drought/nadm/index.html	Global	Climate Services and Monitoring Division NOAA/National Climatic Data center 151 Patton Avenue Asheville, NC 28801-5001 fax: +1-828-271-4876 phone: +1-828-271-4800 email: ncdc.info@noaa.gov
DM G 07	United States of America (USA)	Drought Impact Reporter	Corresponds to an interactive web-based tool, wich principal goal is to collect, quantify, and map reported drought impacts for the United States	http://droughtreporter.unl.edu/	Global	
DM G 08	United States of America (USA)	Seasonal Drought Outlook	The Outlook predicts whether	http://www.drought.gov/portal/server.pt/community/forecasting/209	Global	

ID	Location	Name	What is it?	Website	Coverage	Contact Details
			drought will emerge, stay the same or get better in the next three months.			
DM G 09	Australia	CSIRO - Commonwealth Scientific and Industrial Research Organisation		http://www.csiro.au/science/Water.html	Global	CSIRO Enquiries Locked Bag 10 Clayton South VIC 3169 Australia Phone: +61 3 9545 2176 Fax: +61 3 9545 2175
Europe Plus Africa Continental						
DM EAC 01	Netherlands	EARS Energy and Water Balance Monitoring System (EEWBMS)	System	http://www.ears.nl/evapotranspiration_field.php	Europe, Africa – continental and Asia – Continental	EARS BV, Kanaalweg 1, 2628 EB Delft, The Netherlands Telephone+31-15-2562404 E-mail: info@ears.nl
DM EAC 02	Europe	European Drought Observatory	Is a web portal and map server presenting up-to-date drought relevant information for entire Europe to the public and to decision makers in policy and water resources management.	http://edo.jrc.ec.europa.eu/php/index.php?action=view&id=2	Europe, Africa – continental and Asia – Continental	Institute for Environment and Sustainability Joint Research Centre Via E. Fermi 2749 I-21027 Ispra (VA) Italy Phone: (+ 39)0332 785481 Email: juergen.vogt@jrc.ec.europa.eu

ID	Location	Name	What is it?	Website	Coverage	Contact Details
Europe Plus Northern Africa						
DM ENA01	Italy	XEROCHORE	Network	http://www.feem-project.net/xerochore/index.php	Europe, Northern Africa	Anil Markandya, Fondazione Eni Enrico Mattei (FEEM), Italy. Email: xerochore@feem.it
DM ENA 02	Spain	Mediterranean drought Preparedness Plan (MEDROPLAN)	Network	http://www.iamz.ciheam.org/medroplan/	Europe, Northern Africa	Dunixi Gabiña Mediterranean Agronomic Institute of Zaragoza (CIHEAM-IAMZ), Spain Apartado 202, 50080 Zaragoza. Spain Tel: +34 976 716000 Fax: +34 976 716001 Email:iamz@iamz.ciheam.org
DM ENA 03	Italy	AQUASTRESS	Network, System	http://www.aquastress.net	Europe, Northern Africa continental	Alberto Puddu aquastress.coordinator@irsa.cnr.it
DM ENA 04	Italy	Climate Change and Impact Research in the Mediterranean Environment (CIRCE)	Network, System	http://www.circeproject.eu	Europe, Northern Africa Continental	Navarra, Antonio (Dr) Institutonazionale Geofisica Vulcanologia INGV - Bologna Via di Vigna Murata 605, Italy Tel: +39-0514151413 Fax: +39-0514151499
Africa Continental						
DM AC 01	Italy	Tiger	Network, Forum, Experimental system	http://www.tiger.esa.int/about.asp http://www.itc.nl/external/tiger/ Resources http://www.tiger.esa.int – ESA TIGER http://www.itc.nl/external/tiger/ - CBF capacity Building Facility http://www.tiger.esa.int/pdf/tiger_report09_web.pdf Tiger 2005 - 2008 report http://www.esa.int/esaEO/SEM36RANJTF_index_0.html ESA news (May 2009) http://eopi.esa.int/esa/esa?topSelectedNavigationNodeId=AO	Africa - Continental	Diego Fernandez, Diego.Fernandez@esa.int Earth Observation Application Department – EOP/AEP Via Galileo Galilei - Casella Postale 64 00044 Frascati – Italy

ID	Location	Name	What is it?	Website	Coverage	Contact Details
				S&sideNavigationType=AO&aoid=880&ts=1308126851453&cmd=aodetail&sideExpandedNavigationBoxId=Aos		
DM AC 02	Japan	African Water Cycle Coordination Initiative	Network, Forum, Systems	-	Africa - Continental	Toshio Koike tkoike@hydra.t.u-tokyo.ac.jp Douglas Cripe – dcripe@geosec.org
DM AC 03	United States of America	Experimental African Drought Monitor	System University department (research)	http://hydrology.princeton.edu/monitor http://hydrology.princeton.edu/~justin/research/project_global_monitor/index_africa.html	Africa – Continental	Justin Sheffield Justin@princeton.edu Dept. Civil and Environmental Engineering Princeton University Princeton, NJ 08544 Prof. Eric F. Wood Email: efwood@princeton.edu Phone: (609) 258 4675 Fax: (609) 258 127
			Regional			
DM R 01	Tunisia	Observatory of Sahara and Sahel (OSS)	Forum	http://www.oss-online.org/	SAHEL - Regional	Boulevard du Leader Yasser Arafat, BP 31 Tunis Carthage,1080 Tunisia (+216) 71 206 633/634 (+216) 71 206 636 Email: info@oss.org.tn
DM R 02	Tunisia	Observatory Network for Long Term Ecological Monitoring. (ROSELT)	Network	www.roselt-oss.org	SAHEL - Regional	nabil ben khatra <nabil.benkhatra@oss.org.tn> mourad briki <mourad.briki@oss.org.tn>, sonia abassi <sonia.abassi@oss.org.tn>
DM R 03	Kenya	IGAD Climate Prediction and Applications Centre (ICPAC)		http://www.icpac.net	East Africa - Regional	Prof. Laban Ogallo Address: P O Box 10304 – 00100, Nairobi, Kenya Telephone: +254-20-3514426 Fax: +254-20-3878343
DM R 04	Kenya	Climate Predication and Application Centre (IGAD)		http://www.icpac.net	East Africa - Regional	P.O. Box 10304, 00100, Nairobi, Kenya. Tel.: 254 20 3514426 Fax. 254 20 3878343 Telex:22208

ID	Location	Name	What is it?	Website	Coverage	Contact Details
						E-mail: director@icpac.net
DM R 05	Kenya	USAID Famine Early Warning Systems Network (FEWS NET)	Network	http://earlywarning.usgs.gov/	East Africa - Regional	East AfricaRegional Representative Tel1: +254 20 3861475 Tel2: +254 20 3861476/9 Fax: +254 20 3861480 Email: GHA@fews.net
DM R 06	Botswana	Southern Africa Regional Climate Outlook Forum (SARCOF)	Forum	http://www.sadc.int/dmc/SARCOF/AboutSarcof.htm#	Regional-Southern Africa region	Mr B. Garanganga dmc@sadc.int +267 3953413
DM R 07	South Africa	USAID Famine Early Warning Systems Network (FEWS NET)	Network	http://earlywarning.usgs.gov/	Regional -Southern Africa region	Southern Africa *Regional Representative* Tel 1: +27 12 362-6494 Tel2: +27 12 362-5650 Fax: +27 12 362-5651 Email:SouthernAfrica@fews.net
DM R 08	Burkina Faso	USAID Famine Early Warning Systems Network (FEWS NET)	Network	http://earlywarning.usgs.gov/	West Africa - Regional	West AfricaRegional Representative Tel1: +226 50 37 47 06 Tel2: +226 50 37 41 25 Fax: +226 50 33 54 81 Email: WestAfrica@fews.net
			National – Northern Africa			
DM NNA 01	Algeria	National Office of Meteorology	Meteorological Department	http://www.meteo.dz/	National - Algeria	
DMNNA 02	Algeria	National Agency of Hydrological Resources	National Agency	http://www.semide.dz/fr/themes/structures/anrh.htm	National - Algeria	
DM NNA 03	Egypt	Nile Forecasting System (NFS)			Nile Basin	Planning Sector, 6th Floor of Ministry of Water Resources and Irrigation Building, Korniche El-Nile, Embaba Giza 12666, EGYPT Telephone: +20 2 35449462 Fax: +20 2 35449456
DM NNA 04	Egypt	National Policy to Combat Desertification (ENPCD)		http//ww.drc-egypt.com	National - Egypt	Tel: +202 0123701410, +202 0105146438, P.O. Box 11753 Mataria Egypt_UNCCD_focalpoint@hotmail.com + 202-6332352 202-6335549

ID	Location	Name	What is it?	Website	Coverage	Contact Details
						Fax: 202-6332352 202-6357858
DM NNA 05	Morocco	General Direction of Hydraulics (GDH)	Directorate of the department	http://www.mtpnet.gov.ma/dgh/	National - Morocco	Tél : 212 037 778715 Fax : +212 7 778696 E-mail : dgh@mtpnet.gov.ma
DMNNA 06	Morocco	High Commissariat of water, forests and fight against desertification (HCEFLCD)	Forum	http://www.eauxetforets.gov.ma/fr/index.aspx	National - Morocco	3, rue Haroun Arrachid. BP 605 Rabat-Chellah - Rabat - Morocco Telephone:(212) 5 37.76.00.38/41 Fax: (212) 5 37.76.84.96 Contact: contact@eauxetforets.gov.ma
DM NNA 07	Morocco	National Meteorology Directorate(DMN)	Meteorological Department	http://www.marocmeteo.ma/	National - Morocco	Aéroport Casa-Anfa, Face Préfecture Hay Hassani - B.P. 8106 Casa Oasis - Casablanca - Morocco Tel:(212)522.65.49.00/65.48.00 Fax: (212) 5 22.91.37.97 E-mail: contact@marocmeteo.ma
DM NNA 08	Morocco	Royal Center for Remote Sensing (CRTS)	Department	http://www.crts.gov.ma/	National - Morocco	Avenue Allal El Fassi , angl av Essanaoubar. sect 21. C.P. 10000 - Rabat - Morocco Tel:(212) 5 37.71.54.48/98 Fax: (212) 5 37.71.14.37 E-mail:contact@crts.gov.ma.
DM NNA 09	Morocco	National Drought Observatory (ONS)		http://www.ons.zooshare.com	National - Morocco	Vétérinaire Hassan II BP 6202-Instituts, 10101-Rabat, Morocco. Tel: 212 (05) 37 77 17 45/58/59. Fax: (212) (0)5 37 77.81.35 nasser.alaoui@gmail.com
DM NNA 10	Morocco	Hydraulic Basin Agencies of Sebou (ABH)		http://www.abhsebou.ma http://www.eau-tensift.net http://www.abhoer.ma http://www.abhsm.ma http://www.abhm.ma http://www.abhbc.com	Oum er Rbia	
DM NNA 11	Tunisia	Ministry of Agriculture and Water Resources- National Observatory of Agriculture	Government department	http://www.onagri.nat.tn/	National - Tunisia	
DM NNA 12	Tunisia	National Institute of Meteorology (INM)	Meteorological Department	http://www.meteo.tn/default.html	National - Tunisia	

ID	Location	Name	What is it?	Website	Coverage	Contact Details
DM NNA 13	Tunisia	National Center of remote sensing (CNCT)	Department within CNCT	http://www.cnt.nat.tn/Fr/index.php?m=904	National -Tunisia	BP. 200, 1080 Tunis Cedex Tél : +216 71 761 333 Fax : + 216 71 760 890 e-mail:cnt@defense.tn
National – Eastern Africa						
DMNEA 01	Ethiopia	Relief and Rehabilitation Commission (RRC)			National - Ethiopia	
DM NEA 02	Ethiopia	Disaster Prevention and Preparedness Agency (DPPA)		http://www.dppc.gov.et/	National - Ethiopia	Address: Building 2, Near Ghandi Hospital, Addis Ababa Building 2, Near Ghandi Hospital, Addis Ababa, Ethiopia PO Box 5686 Telephone: 251-11-5517232 Fax: 251-11-5514788
DM NEA 03	Ethiopia	Productive Safety Net Programme (PSNP)			National - Ethiopia	
DM NEA 04	Ethiopia	National Meteorological Agency (NMSA)			National - Ethiopia	P.O.Box 1090, Addis Ababa, Ethiopia nmsa@telecom.net.et Address: P.O. Box 1090, Addis Ababa ETHIOPIA, Telephone: 251-1-512299 Fax: 251-1-517066
DM NEA 05	Ethiopia	Contingency Planning and Financing (CPF)			National - Ethiopia	
DM NEA 06	Sudan	Sudan Meteorological Authority (SMA)		http://www.ersad.gov.sd/	National -Sudan	P.O.Box 574_ Khartoum, Sudan Telephone: +249 183 778837 or +249 183 772992 Fax: + 249 183 772292 or + 249 183 771693
DM NEA 07	Sudan	Desertification Research Institute (DRI)		http://www.ncr.sd/html/aboutEn.asp?pageId=54	National - Sudan	Mohamed Nageeb Street, P.O. Box 6096_Khartoum, Sudan Telephone: + 249 183 476715 Fax: +249 183463416 Mr. Hashim Awad el Kareem Email: hawad@ncr.sd or

ID	Location	Name	What is it?	Website	Coverage	Contact Details
						hasimfadl@hotmail.com Tel: +249 120 976809 Mobile: +249 122255039
DM NEA 08	Sudan	Institute of Environmental Studies (IES)		http://ies.uofk.edu	National - Sudan	Gamhoria street, P.O. Box: 321, Post code: 11115, Khartoum, Sudan Telephone: +249 11 780993 or +249 11 780963 Fax: + 249 11 780993 Essam-Eldin Ibrahim Warrag Email: nesamwarrag-ies@uofk.edu Tel. (office) +2499152912210 Mobile: + 249918383448, Gamhoria street, P.O. Box: 321, Post code: 11115, Khartoum, Sudan
National – Southern Africa						
DM NSA 01	South Africa	South African Weather Services (SAWS)	Meteorological Department of South Africa	http://www.weathersa.co.za/web/	National - South Africa	Pretoria National Forecasting Office - 082 233 9800 - fapr@weathersa.co.za
DM NSA 02	Tanzania	Central Forecasts Central Office (CFO)		http://www.meteo.go.tz	National - Tanzania	Address: P.O. Box 3056 DSM Telephone: +255 222460706 Fax: +255 222460735
DM NSA 03	Tanzania	Disaster Management Department (DMD)		http://www.pmo.go.tz	National - Tanzania	P.O. Box 3021 Dar es Salaam, Tanzania Telephone: +255 2221172266 Fax: +255 2221172266
National – Western Africa						
DM NWA 01	Mali	SAP (Early Warning System)	System	www.sapmali.net	National - Mali	sapmali@afribone.net.ml Tel: +223 20 21 27 28
DM NWA 02	Mali	West Africa Seed Alliance(WASA)	System	www.icrisat.org	National - Mali	Bureau à l'Institut du Sahel, 293, Avenue OUA Badalabougou, Bamako, Mali Email: r.shetty@cgiar.org Tel: +223 20 22 80 86
DM NWA 03	Mali	Information Prediction	System		National - Mali	IER/ Recherche Agronomique, Mali

ID	Location	Name	What is it?	Website	Coverage	Contact Details
		System and Early Warning of Flooding (SPIAC)				kodio_amaga@yahoo.fr Tel: +223 21 43 00 28/ +223 76 33 65 40/ +223 69 56 44 77
DM NWA 04	Mali	Flood Predicting Tool for the Inner Niger Delta (OPIDIN)	System		National - Mali	Wetlands International Department: Wetlands international Africa/ bureau du Mali malipin@abribone.net.ml Tel: +223 21 42 01 22 Fax: +223 21 42 02 42
DM NWA 05	Mali	Geographic information system of water resources in Mali (SIGMA)	System	www.dnh-mali.org	National - Mali	Department: DNH/CDI Email: contact@dnh-mali.org Tel: +223 20 21 27 28

2.3 LIST OF DROUGHT MONITORING SYSTEMS, NETWORKS/INSTITUTIONS WITHOUT FACTSHEETS

The monitoring systems networks/institutions listed in **Table 2** do not have factsheets.

Table 2: List of existing drought monitoring systems, networks/institutions (without factsheets)

ID	Location	Name	What is it?	Website	Coverage	Contact Details
			Global			
DM GE 01	Belgium	FATE-EWS-NILE; Flood and drought risk assessment tools using modelling and Earth observation for early warning systems in the Nile basin	Network	http://cordis.europa.eu/fetch?CALLER=FP6_PROJ&ACTION=D&DOC=10&CAT=PROJ&QUERY=013050684053:bd39:3155b3ab&RCN=86469	Continental Nile basin	Katholieke Universiteit leuvenoude markt 13 Belgium
DM GE 02	Belgium	European Union	Idem	http://europa.eu		
DM GE 03	France	Nemedca Network	Network	http://www.ciheam.org/index.php/en/cooperation/networks/nemedca	Mediterranean area, parts of Asia and Africa	CIHEAM - 11, rue Newton - 75116 Paris - Tel : 33(0)1 53 23 91 00
DM GE 04	Italy	Global Information and Early Warning System (GIEWS) on Food and Agriculture	Information System under Food and Agriculture organisation (FAO) of UN	http://www.fao.org/_giews_/	Regional- Africa divided into four regions. Southern Africa (does not cover the whole of SADC)	Tel: (39) 06 5705 3099 or Fax: (39) 06 5705 4495 giews1@fao.org
DM GE 05	South Asia	South Asia Drought Monitor (SADM)	System	http://dms.iwmi.org/about_swa_dm.asp		
DM GE 06	Switzerland	Global Climate Observing System GCOS/Regional action for the Mediterranean Bassin	System	http://www.wmo.int/pages/prog/gcos		GCOS Secretariat c/o World Meteorological Organization 7 *bis*, avenue de la Paix P.O. Box 2300 1211 Geneva 2 Switzerland Phone(+41 22) 730 80 67 Fax : (+41 22) 730 80 52
DM GE 07	Switzerland	World Meteorological Organisation (WMO)	An Agency of UN which provides	http://www.wmo.int	Continental-Africa (WMO region 1)	Tel.: + 41(0) 22 730 81 11 / Fax: + 41(0) 22 730 81 81 -

ID	Location	Name	What is it?	Website	Coverage	Contact Details
			information on weather forecast and warnings and climate services			wmo@wmo.int
DM GE 08	United States of America (USA)	National Integrated Drought Information System	System	http://www.drought.gov/portal/server.pt/community/drought_gov/202;jsessionid=364087864208D8E73D20A36551E2EFAF		US Drought Portal
DM GE 09	United States of America (USA)	World Bank	*Donors and Development partners* Funding	www.worldbank.org http://web.worldbank.ord		
National – Northern Africa Countries						
DM NAC 01	Algeria	High Commissariat for Steppe Development (HCDS)	Government department	http://www.hcds.dz/	National - Algeria	
DM NAC 02	Algeria	General direction of Forests	Government department	http://www.dgf.gov.dz/	National - Algeria	
DM NAC 03	Algeria	Center of Scientific and Technical research on arid regions	Research Institute	http://www.crstra.dz	National - Algeria	
DM NAC 04	Algeria	Algerian Spatial Agency and National Center for Spatial Techniques (CNTS)	Department within the centre	http://www.asal-dz.org/	National - Algeria	
DM NAC 05	Egypt	Arab water council/Arab Land Data Assimilation system	Network	http://www.arabwatercouncil.org/administrator/Modules/CMS/Arab_Land_Data_Assimilation_System	National - Egypt	Address: 9 Al-Mokhayam Al-Da'em St., Al-Hay Al-Sades, Nasr City, Cairo, Egypt Phone No.: +2 02 2402 3253 - 2402 3276 Fax No.: +2 02 2260 0218 E-Mail:awc@arabwatercouncil.org
DM NAC 06	Morocco	Forum of national experts on drought and water resources management	Forum	http://www.ons.zoomshare.com	National-Morocco	ons@zoomshare.com

ID	Location	Name	What is it?	Website	Coverage	Contact Details
DM NAC 07	Morocco	Arab Water Expert Network	Network	http://www.reseau-arabe.net/Internet-eng.html	National-Morocco	Dr. Youssef Filali Meknassi 35, Av. du 16 novembre BP 1777 Rabat work: +212 537 67 03 72 / 74 Fax: +212 537 67 03 75
DM NAC 08	Morocco	Superior Council for Water and Climate	Directorate within the department	www.mtpnet.gov.ma	National -Morocco	
DM NAC 09	Tunisia	Institute of Dry Regions (IRA)	Research Institute	http://www.ira.rnrt.tn/	National - Tunisia	
National – Eastern African Countries						
DM EAC 01	Burundi	Geographic Institute of Burundi “IGEBU”	Institute includes two departments: Hydrometeorology and Agro meteorology		National - Burundi	
DM EAC 02	Kenya	Drought Monitoring Centre, Nairobi	Department within government		National - Kenya	
DM EAC 03	Rwanda	Ministry of Natural Resources (MINELA)	Government Ministry Policy on environment	www.minela.gov.rw	National - Rwanda	
DM EAC 04	Rwanda	Ministry of Agriculture	Selection of adaptable species	www.minagri.gov.rw	National - Rwanda	
DM EAC 05	Rwanda	Ministry of Infrastructure	Infrastructure development with water and energy in charge	www.mininfra.gov.rw	National - Rwanda	
DM EAC 06	Rwanda	Ministry of Health	Policy on fighting climate related diseases	www.moh.gov.rw	National - Rwanda	
DM EAC 07	Rwanda	Ministry of Disaster Management	Policy on disaster management	www.midmar.gov.rw	National - Rwanda	
DM EAC 08	Rwanda	Ministry of Finance and economic planning	Funding appropriate project to ensure food security	www.minecofin.gov.rw	National - Rwanda	
DM EAC 09	Rwanda	Rwanda Meteorological	*Government*	www.meteorwanda.gov.rw	National - Rwanda	

ID	Location	Name	What is it?	Website	Coverage	Contact Details
		Service	*Agencies* Provide meteorological service (data, weather forecast, etc.)			
DM EAC 10	Rwanda	Rwanda Environmental Management Authority	Implementation of environmental policy	www.rema.gov.rw	National - Rwanda	
DM EAC 11	Rwanda	Rwanda Agricultural Development Authority	Implementation of agricultural policy	www.rada.gov.rw	National - Rwanda	
DM EAC 12	Rwanda	National Forestry Authority	Forestry development	www.nafa.gov.rw	National - Rwanda	
DM EAC 13	Rwanda	National University of Rwanda (NUR)	*Higher learning Institutions* Education, Research and dissemination, with GIS Center.	www.nur.ac.rw	National - Rwanda	
DM EAC 14	Rwanda	Institute of Agriculture and animal Husbandry	Education, Research and dissemination	www.isae.ac.rw	National - Rwanda	
DM EAC 15	Rwanda	Kigali Institute of Science and Technology (KIST)	Education, Research and dissemination	www.kist.ac.rw	National - Rwanda	
DM EAC 16	Rwanda	Kigali Health Institute (KHI)	Education, Research and Dissemination	www.khi.ac.rw	National - Rwanda	
DM EAC 17	Rwanda	Institute of Agriculture,, Technology and Education of Kibungo (UNATEK)	Education, Research and Dissemination	www.inatek.ac.rw	National - Rwanda	
DM EAC 18	Rwanda	Kigali Independent University (ULK)	Education, Research and dissemination	www.ulk.ac.rw	National - Rwanda	
DM EAC 19	Rwanda	Institute of Scientific and Technological Research	*Research Institutions* Research and Dissemination with clean energy and climate change projects.	www.irst.ac.rw	National - Rwanda	
DM EAC 20	Rwanda	Rwanda Agricultural Research Institute	Research and Implementation of Agricultural policy	www.isar.rw	National - Rwanda	
DM EAC 21	Rwanda	UNEP	*UN Agencies* Support in research and implementation	www.unep.org www.rw.one.un.org	National - Rwanda	

ID	Location	Name	What is it?	Website	Coverage	Contact Details
			of environmental policy			
DM EAC 22	Rwanda	WMO	Capacity building and support of RMS	www.mwo.int www.rw.one.un.org	National - Rwanda	
DM EAC 23	Rwanda	WFP	Support in implementing projects to ensure food security	www.wfp.org www.rw.one.un.org	National - Rwanda	
DM EAC 24	Rwanda	UNDP	Support in implementation of development projects	www.undp.org.rw www.rw.one.un.org	National - Rwanda	
DM EAC 25	Rwanda	FAO	Support in implementation of agricultural projects for food security	www.fao.org www.rw.one.un.org	National - Rwanda	
DM EAC 26	Rwanda	Nile Basin Initiative	*Intergovernmental Initiatives* Environmental policy in trans-boundary approach	**www.nilebasin.org** **htt://nelsap**.nilebasin.org	National - Rwanda	
DM EAC 27	Rwanda	East African Community	Policy and support in environment and climate change	www.eac.int	National - Rwanda	
DM EAC 28	Rwanda	Red Cross	*NGOs and Networks* Emergency help in case of drought (mitigation and adaptation)	http://rwandaredcross.org www.**redcross**.int	National - Rwanda	
DM EAC 29	Rwanda	NBCBN-Rwanda Node	Research, Knowledge Dissemination and Capacity Building	www.nbcbn.com	National - Rwanda	
			National – Southern African Countries			
DM SAC 01	Angola	Angola Meteorological Services	Meteorological department of the country	http://www.ifrc.org/docs/appeals/annual09/MAAAo00109ar.pdf	National - Angola	(+244)-2-336114 inamet@netangola.com
DM SAC 02	Botswana	Department of Meteorological Services	Meteorological department of the	http://www.botswanacraft.bw/~mettest/index.html	National - Botswana	Dept. of Meteorological Services

ID	Location	Name	What is it?	Website	Coverage	Contact Details
		Botswana	country			P.O. Box 10100 Gaborone, Botswana Tel. (+267) 395 6281 Fax (+267) 395 6282 E-mail: meteo@gov.bw
DM SAC 03	Botswana	Botswana Water Affairs	Division within the department of water affairs	http://www.water.gov.bw/aboutus.html	National - Botswana	Private bag 0029, Gaborone Tel: +267 3607 100 Fax: +267 3903 508 Email: dwa.enquires@gov.bw
DM SAC 04	Botswana	Directorate of Food Agriculture and Natural Resources	Department in the SADC Secretariat	http://www.sadc.int/fanr/	Regional-SADC region	SADC Secretariat FANR Directorate. Gaborone, Botswana. Tel: +267-3951863; E-mail: fanr@sadc.int
DM SAC 05	Botswana	SADC Climate Services Centre (CSC)	Centre in the SADC Directorate of Infrastructure and Services	http://www.sadc.int/index/browse/page/821	Regional-SADC region	Mr B. Garanganga dmc@sadc.int +267 3953413
DM SAC 06	Lesotho	Lesotho Meteorological Services	Meteorological department of Lesotho	http://www.lesmet.org.ls	National - Lesotho	Lesotho Meteorological Services P.O.Box14515 Maseru Lesotho Tel:+26622325057/ 22317250 Fax:+266 22325057 Email: info@lesmet.org.ls weather@lesmet.org.ls
DM SAC 07	Lesotho	Millennium Challenge Corporation	Foreign institution working with Government of Lesotho	http://www.mca.org.ls/home/contacts.php	National-Lesotho	Contact Person: Brian Baltimore MCC Deputy Resident Country Director Mobile: (266) 58403817 Email: baltimorebt@mcc.gov
DM SAC 08	Madagascar	Madagascar Meteorological Services	Department of Meteorology in Madagascar	http://www.meteo-madagascar.net/	National - Madagascar	meteo@moov.mgmeteo@simicro.mg meteo@wanadoo.mg
DM SAC 09	Malawi	Department of Climate Change and Meteorological Services	Meteorological department in Malawi	http://www.metmalawi.com/	National - Malawi	TEL: (265) 1 822 014 FAX: (265) 1 822 215 E-

ID	Location	Name	What is it?	Website	Coverage	Contact Details
						MAIL: metdept@metmalawi.com Website: www.metmalawi.com
DM SAC 10	Malawi	Disaster Risk Management	Disaster Risk Reduction Programme	http://www.undp.org.mw	National -Malawi	Tapona Msowoya Disaster Risk Reduction Advisor P.O. Box 30135 Lilongwe 3, Malawi Office: +265 (0) 1 773 500, Ext. 242 tapona.msowoya@undp.org
DM SAC 11	Malawi	Water Supply Services	Directorate within ministry of irrigation and water development	http://www.malawi.gov.mw/index.php?option=com_content&view=article&id=11&Itemid=26	National - Malawi	Ministry of Irrigation and Water Development, Tikwere House, City Centre, Private Bag 390, Capital City, Lilongwe 3, Malawi. Telephone: +265 1 770 344 Fax: +265 1 773 737 Email: secretary@irriwater.org
DM SAC 12	Mauritius	Mauritius Meteorological Services	Department of Meteorology in Mauritius	http://metservice.intnet.mu/	National - Mauritius	The Director Meteorological Services St Paul Road, Vacoas, Mauritius Tel: (+230) 686 1031 Fax:(+230)-686-1031 686-1033 meteo@intnet.mu
DM SAC 13	Mozambique	National Institute of Meteorology	Meteorological department of the country	http://www.inam.gov.mz	National - Mozambique	(+258)-1-491064 491150 mozmet@inam.gov.mz http://www.inam.gov.mz/
DM SAC 14	Namibia	Emergency and Disaster Management Unit	Managing and co-ordinating the City of Windhoek's Emergency and Disaster Management	http://www.windhoekcc.org.na/default.aspx?page=62	National - Namibia	Department of Community Services for the City of Windhoek , Sheffield street, in the Northern Industrial area of the City of Windhoek at tel.: (061) 261251) or 290 2811/2 Name: Liz els@windhoekcc.org.na

ID	Location	Name	What is it?	Website	Coverage	Contact Details
DM SAC 15	Namibia	Namibia Meteorological Service	Meteorological department of the country	http://www.meteona.com/	National - Namibia	Private Bag 13224 Windhoek Namibia Fax: +264-(0)61-2877009 Phone: +264-(0)61-2877001 NMS Chief namibiamet@meteona.com fuirab@meteona.com
DM SAC 16	Seychelles	Disaster Management Center	Directorate within the ministry of foreign affairs in Seychelles	http://www.rdmcoe.org	National - Seychelles	Patrick Pillay Minister of Foreign Affairs *Tel:* 248-283500 Fax: 248-225398 *Email:* minisfa@seychelles.net
DM SAC 17	South Africa	National Disaster Management Framework (NDMF)	Disaster Management Department	http://contacts.ndmc.gov.za/	National - South Africa	87 Hamilton Street Arcadia Pretoria Senior Manager : Wiseman Mkhonza Tel : 012 334 0422 Fax : 012 334 0810 Email: wisemanM@ndmc.gov.za
DM SAC 18	South Africa	South African Weather Services (SAWS) - CLIMOS	Department within SAWS	http://www.weathersa.co.za/web/Content.asp?contentID=91	Regional - SADC	Seasonal Forecasts - 082 233 9000 - longrange@weathersa.co.za
DM SAC 19	South Africa	Water Resources Planning System	Directorate within the Department of Water Affairs	www.dwaf.co.za	National - South Africa	Dr Beason Mwaka Director TEL (012) 336 8188 FAX (012) 326 6731 Department of Water Affairs CELL 082 807 6621 Private Bag X313 PRETORIA 0001 EMAIL: MwakaB@dwaf.gov.za
DM SAC 20	South Africa	Hydrological Services	Directorate within the Department of Water Affairs	www.dwaf.co.za	National - South Africa	Directorate: Hydrological Services Address: Private Bag X313, Pretoria, 0001 Fax: +27 12 336-6904 Mr Z Maswuma

ID	Location	Name	What is it?	Website	Coverage	Contact Details
						+27 12 336 8784 maswumaz@dwa.gov.za
DM SAC 21	South Africa	Institute for Soil, Climate and Water (ISCW)	Institute under Agricultural Research Council (ARC)	http://www.arc.agric.za/home.asp?pid=498	National - South Africa	Dr. Mphekgo Maila *Email:* MailaM@arc.agric.za Tel: +27 (0)12 310 2501 Fax: +27 (0)12 323 1157
DM SAC 22	South Africa	Council for Scientific and Industrial Research (CSIR) - Natural Resources and the Environment	Department in the CSIR – Water resources	http://www.csir.co.za/nre/water_resources/mwenge_kahinda.html	Regional - South Africa	Dr Jean-marc Mwenge Kahinda PO Box 395 0001 Pretoria, South Africa Tel: +27 12 841-3105 Email: jmwengekahinda@csir.co.za
DM SAC 23	South Africa		Department in the CSIR – Climate change	http://www.csir.co.za/nre/coupled_land_water_and_marine_ecosystems/index.html	Regional - South Africa	Ms M Bopape P.O. Box 395 0001 Pretoria, South Africa Tel: +27 12 841-3105 Email: MBopape@csir.co.za
DM SAC 24	South Africa			http://www.csir.co.za/nre/coupled_land_water_and_marine_ecosystems/index.html	Regional - South Africa	Dr W. Alandman P.O. Box 395 0001 Pretoria, South Africa Tel: +27 12 841-3105 Email: WAlandman@csir.co.za
DM SAC 25	South Africa	Disaster Management Authority (DMA)	Disaster Management Department	http://www.letsema.org/html/disaster_authority.php	National - Lesotho	Mr. Haretsebe Mahosi, Chief Executivece@dma.gov.ls'M'e Pulane Makitle, Senior Economic Planner e: p.makitle@live.com Ret'selisitsoe Molefe, Acting Senior Logistics Officer dma@leo.co.ls t: +266 2231 2183 f: +266 2231 0141
DM SAC 26	Swaziland	National Meteorological Service	Meteorological department of the country in SD	http://www.swazimet.gov.sz/	National - Swaziland	Ministry of Tourism and Environmental Affairs P.O. Box 2652 - MBABANE -

ID	Location	Name	What is it?	Website	Coverage	Contact Details
						Swaziland Tel.: +(268) 24049468 Fax.: +(268) 24041530 E-mail: weather@swazimet.gov.sz
DM SAC 27	Swaziland	National Disaster Management Unit	Department in the Ministry of Agriculture in SD	www.gov.sz	National - Swaziland	Deputy Prime Minister's Office: Mndzebele Lungile ismndzebele@hotmail.com +268 24047196
DM SAC 28	Tanzania	Disaster Management Department	Directorate within the ministry of state and policy affairs	http://www.tanzania.go.tz/government/disaster.htm#dist	National - Tanzania	Phillip S. Marmo, Minister of State Policy & Parliamentary Affairs, Prime Minister's Office *Tel:* 255-22-2112849 Fax: 255-22-2129041 *Email:* pmarmo@parliament.go.tz
DM SAC 29	Tanzania	Tanzania Meteorological Agency	Meteorological Department in the Country	http://www.meteo.go.tz/	National - Tanzania	3rd Floor, Ubungo Plaza, Dar es Salam Email: met@meteo.go.tz Telephone: +255 22 2460706 Fax: +255 22 2460735
DM SAC 30	Tunisia	African Development Bank (AfDB)	Idem	www.afdb.org		
DM SAC 31	Zambia	Disaster Management and Mitigation Unit (DMMU)	Disaster Management and Mitigation Unit	http://www.usaid.gov/our_work/humanitarian_assistance/disaster_assistance/countries/zambia/template/index.html	National - Zambia	Banda Anderson, Tel 095-838380 anndybanda@dmmuoup.gov.zm
DM SAC 32	Zambia	Zambia Meteorological Department	Meteorological department of the country	http://www.meteo-zambia.net/	National - Zambia	F. A. Banda Tel: 095-768142 Francis-abanda@yahoo.com or zmd@coppernet.zm
DM SAC 33	Zimbabwe	Zimbabwe Meteorological Services	Meteorological department Zimbabwe	http://www.weather.co.zw	National - Zimbabwe	Meteorological Services Department Bishop Gaul Avenue/Corner Hudson Street P.O. Box BE150 Belvedere

ID	Location	Name	What is it?	Website	Coverage	Contact Details
						Harare Tel: 263-4-778173-6 Fax: 263-4-778161 Email: director@weather.utande.co.zw or zimmeteo@weather.utande.co.zw
DM SAC 34	Zimbabwe	Zimbabwe National Water Authority	Water management division within the authority	http://www.zinwa.co.zw	National - Zimbabwe	8th Floor Old Mutual Centre 3rd St/ Jason Moyo Ave P.O Box C.Y 617, Causeway, Harare Tel : 795325 / 796980 Fax : 700732 E-mail: pr@zinwa.co.zw
National – Western Africa Countries						
DM WAC 01	Niger	AGRHYMET	Agency of the Standing Committee of Inter-State for Fighting against Drought in the Sahel	www.agrhymet.ne	National - Niger	Centre Regional Agrhymet, Niamey BP 11011 Niamey, Niger Tel: (227) 20 31 53 16/ 20 31 54 38 Fax: (227) 20 31 54 35 Email: admin@agrhymet.ne
DM WAC 02	Niger	ACMAD: African Centre of Meteorological Application for Development	Weather and Climate Centre with African continental competence		National - Niger	Address: ACMAD: 85, Avenue des Ministeres BP 13184. Niamey , Niger Tel: (227) 20 73 49 72 Fax: (227) 20 72 36 27

2.4 LIST OF EXISTING MODELS AND EARLY WARNING SYSTEMS

The existing models and early warning systems were divided into two groups as follows

- those applied at continental and regional levels which are listed in Table 3
- those applied at local level which are listed in Table 4.

Table 3: List of Models and Early Warning Systems – National, regional and continental

Location	System/Model Name	What is it?	Website	Coverage	Contact
Italy	Windisp	Software to view satellite images	http://www.fao.org/giews/english/windisp/windisp.htm	Global	**Global Information and Early Warning System on Food and Agriculture** Food and Agriculture Organization of the United Nations Viale delle Terme di Caracalla 00100 - Rome, ITALY **Email**: **Giews1@Fao.org** **Tel**: (39) 06 5705 3099 **Fax**: (39) 06 5705 4495
Netherlands	RIBASIM	River basin modelling software	http://www.deltares.nl/en/software/479948/ribasim2	Global	Rotterdamseweg 185, Delft, The Netherlands P.O. Box 177 2600 MH Delft, The Netherlands tel: + 31 (0)88 335 8273 fax : +31 (0)88 335 8582
European Union	Agri4cast	Agricultural modelling software	http://mars.jrc.ec.europa.eu/mars/About-us/AGRI4CAST		
USA	Cropsyst	Agricultural modelling system	http://www.bsyse.wsu.edu/CS_Suite/CropSyst/index	Global	Roger L. Nelson at the Biological

Location	System/Model Name	What is it?	Website	Coverage	Contact
			.html		Systems Engineering Dept., Washington State University, Pullman WA 99164-6120. Phone: (509)335-1578, FAX: (509)335-2722.
USA	NOAA operational environmental satellites	Satellites	http://weather.noaa.gov/weather/current	Global	National Oceanic and Atmospheric Administration National Weather Service 1325 East West Highway Silver Spring, MD 20910
USA	AVHRR-derived indices	Indices derived from satellite images			
USA	SWAT	River basin modelling software	http://swatmodel.tamu.edu/	Global	Grassland, Soil & Water Research Laboratory, USDA-ARS 808 East Blackland Road Temple, Texas 76502 USA
USA	IHACRES	River basin modelling software	http://www.toolkit.net.au/IHACRES	Global	eWater CRC Innovation Centre University of Canberra ACT 2601 Phone: 1300 5 WATER (1300 5 92837) Email: toolkit@ewatercrc.com.au
USA	HEC-HMS	River system modelling software	http://www.hec.usace.army.mil/software/hec-hms/	Global	Department of The Army

Location	System/Model Name	What is it?	Website	Coverage	Contact
					Corps of Engineers Institute for Water Resources, Hydrologic Engineering Center 609 Second Street Davis, CA 95616-4687,Phone: (530) 756-1104 Fax: (530) 756-8250
Spain	AquaTool DMA	Decision support system (DSS) for water resources planning	http://www.upv.es/aquatool/software.html		Universidad Politecnica de Valencia
Algeria	Agro-ecological Information system (SGIIAR)		http://www.sgiiar.org	National - Algeria	
Morocco	SMAPS(Drought Early warning system for Maghreb region)			National - Maghreb	
Morocco	Decision support system for agriculture (SAADA)		http://sites.google.com/site/drylandagriculture/	National - Morocco	
South Africa	Long- lead forecasts	Weather forecast data	http://old.weathersa.co.za/Menus/Research.jsp longrange@weathersa.co.za	National - South Africa	Weather SA
South Africa	SPATSIM	River basin information system and modelling software	http://www.ru.ac.za/static/institutes/iwr/software/spatsim.php	National - South Africa, Asia	IMWI/ Rhodes University
South Africa	Decile rainfall			National - South Africa	

Location	System/Model Name	What is it?	Website	Coverage	Contact
South Africa	Water Satisfaction Index (WSI)			National - South Africa	
South Africa	NOAA NDVI		http://www.fews.net/pages/imageryhome.aspx?pageID=1&l=en	National - South Africa	
South Africa	ZA Model			National - South Africa	
Southern Africa	PUTU Veld Production			National - South Africa	
South Africa	Water Resources Yield Model (WRYM)	Hydrological model for estimating yield available from a water resource		System/Scheme specific	Department of Water Affairs Private Bag X313 Pretoria, 0001 Republic of South Africa Tel: +27 12 336 8188/ +27 12 336 7500 (Switchboard) Fax: +27 12 336 6731 : C. Ntuli (NtuliC@dwaf.gov.za)
	Water Resources Planning Model (WRPM)	Model for allocating water and developing reservoir forecast trajectories		System/Scheme specific	
	Hydrological Drought Assessment Model (HDAM)	Hydrological model for developing reservoir drought operating rules and forecast trajectories	www.wrnyabeze.com	River basin/ System/Scheme specific	osborne@wrnyabeze.com. WRNA PO Box 863 Witkoppen 2068 T+2711 312 7266 F+2711312 2418

Table 4: List of Models and Early Warning Systems – Local level

Location	System/Model Name	Website	What is it?	Coverage	Contact
Southern Africa	Veld/Forest Production	-	Local knowledge system	Specific to local areas	-
Southern Africa	Insect Production	-	Local knowledge system	Specific to local areas	-
Botswana	Department of Meteorological Services Botswana	http://www.botswanacraft.bw/~mettest/index.html	National weather forecasts	National- Botswana	Dept. of Meteorological Services P.O. Box 10100 Gaborone, Botswana Tel. (+267) 395 6281 Fax (+267) 395 6282 E-mail: meteo@gov.bw
Lesotho	Lesotho Meteorological Services	http://www.lesmet.org.ls	National weather forecasts	National - Lesotho	Lesotho Meteorological Services PO Box 14515 Maseru 100 Lesotho Tel:+266 22325057 / 22317250 Fax:+266 22325057 Email: info@lesmet.org.ls
Mozambique	National Institute of Meteorology	http://www.inam.gov.mz	National weather forecasts	National- Mozambique	
South Africa	Weather SA	http://www.weathersa.co.za/web/	National weather forecasts	National- South Africa	General Forecast Enquiries - 082 162 | 083 123 0500 Seasonal Forecasts - 082 233 9000 - longrange@weathersa.co.za
Zambia	Zambia Meteorological Department	http://www.meteo-zambia.net/	National weather forecasts	National - Zambia	
Zimbabwe	Zimbabwe Meteorological Services	http://www.weather.co.zw	National weather forecasts	National- Zimbabwe	Meteorological Services Department Bishop Gaul Avenue/Corner Hudson Street P.O. Box BE150 Belvedere Harare Tel: 263-4-778173-6

Location	System/Model Name	Website	What is it?	Coverage	Contact
					Fax: 263-4-778161 Email: director@weather.utande.co.zw
Swaziland	Department of Climate Change and Meteorological Services	http://www.metmalawi.com/	National weather forecasts	National - Malawi	TEL: (265) 1 822 014 FAX: (265) 1 822 215 E-MAIL: metdept@metmalawi.com Website: www.metmalawi.com
Swaziland	National Meteorological Service	http://www.swazimet.gov.sz/	National weather forecasts	National - Swaziland	Ministry of Tourism and Environmental Affairs P.O. Box 2652 - MBABANE - Swaziland Tel.: +(268) 24049468 Fax.: +(268) 24041530 E-mail: weather@swazimet.gov.sz
Namibia	Namibia Meteorological Service	http://www.meteona.com/	National weather forecasts	National-Namibia	Private Bag 13224 Windhoek Namibia Fax: +264-(0)61-2877009,Phone: +264-(0)61-2877001 NMS Chief,namibiamet@meteona.com

3 FACTSHEETS FOR THE IDENTIFIED DROUGHT MONITORING AND FORECASTING SYSTEMS, NETWORKS/INSTITUTIONS

This section presents available facts about each monitoring system/network/forum. Some of them are identified in Tables 1 to 3. For these the identification number and name of the system/network/forum are repeated in the factsheet for easy referencing.

3.1 FACTSHEETS: DROUGHT MONITORING AND FORECASTING SYSTEMS, NETWORKS/INSTITUTIONS GLOBAL/ USA / AUSTRALIA

This section presents available facts about each of the identified global monitoring systems/networks/fora.

ID: DM –G 01	GLOBAL DOUGHT MONITOR	FACTSHEET No 01

Contact details

Url:http://drought.mssl.ucl.ac.uk

http blh@mssl.ucl.ac.uk

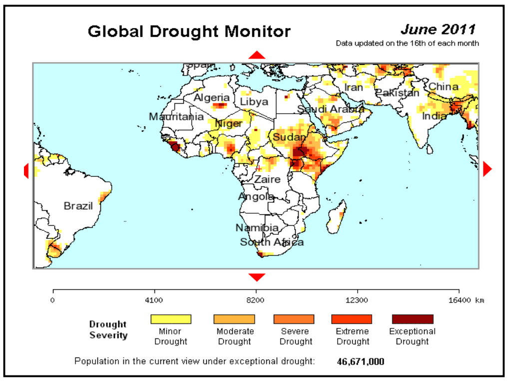
Address department of Space and Climate Physics
University College London
Dr. Benjamin Lloyd-Hughes

Gower Street

London WC1E 6BT, UK.

Tel: +44 (0)20 7679 2429

Fax: +44 (0)20 7679 2390



Description

- **Type:** Experimental system
- **Purpose:** Monitoring
- **Type:** System
- **Purpose:** The system is used for monitoring of current hydrological drought conditions worldwide.
- **Type of drought:** Meteorological (and hydrological) drought
- **Scope:** Global level for current conditions
- **Describe the system**

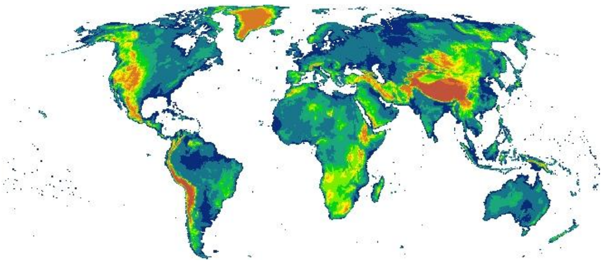
  The purpose of the system is to provide a summary of the current drought conditions worldwide.
- **Input data: [GDP, Precipitation, Elevation etc.]**

- Precipitation (Monthly mean precipitation), Global Precipitation Climatology Centre at Deutscher Wetterdienst
- Temperature (Monthly mean 2m air temperature), ECMWF (2002-now) and ERA40 (1958-2001)
- Soil Water Holding Capacity (NASA/GISS analysis of Bouman et al (1986), United Nations Environmental Programme

- **Output data: [Soil moisture etc.]**

  Drought Severity (classification from minor to exceptional drought) based on the SPI (Standardized Precipitation Index) and PDI (Palmer Drought Index), spatial resolution: [i.e. 0,2 degrees],1 degree (about 100 km)
- **Frequency of outputs:** monthly output

ID:DM G 02	WATER AND GLOBAL CHANGE (WATCH)	FACTSHEET No 02



Contact details:

url: http://www.eu-watch.org/

Dr. Tanya A. Warnaars

Centre for ecology & Hydrology

Maclean Building, Wallingford

Oxfordshire,

OX10 8BB

United Kingdom

info-watch@ceh.ac.uk

Fokke de Jong

Wageningen UR, Earth System Science and Climate Change group

PO Box 47

6708 PB Wageningen

the Netherlands

fokke.dejong@wur.nl

Description ::

- **Type:** EU research project: network and system
- **Purpose:** monitoring and forecasting
- **Type of drought:** meteorological, hydrological, socio-economic
- **Scope:** Global and Europe
- **Describe the system:** WATCH research project brings together hydrological, water resources and climate communities, to analyse, quantify and predict the components of the current and future global water cycles.
- **Spatial resolution:** 0.5 degrees x 0.5 degrees
- **Temporal resolution:** daily and monthly

ID: DM- G 03	National Integrated Drought Information System (NIDIS)	FACTSHEET N°03

Contact details

Url: http://www.drought.gov
Address: National Oceanic and Atmospheric Administration
1401 Constitution Avenue, NW
Room 5128
Washington, DC 20230

Telephone: + 1 (301) 713-3540
Contact:Jason.Symonds@noaa.gov

Description

- **Type:** system
- **Purpose:** monitoring, forecasting, warning, response
- **Type of drought:** Meteorological, agricultural, hydrological and socioeconomic drought
- **Scope:** National level
- **Description of the system:** It is an integrated system with the goal to improve the USA and North-America capacity to proactively manage drought-related risks, by providing those affected, with the best available information and tools to assess the potential impacts of drought and to better prepare for and mitigate the effects of drought.
- **Input data:** Consolidation and aggregation of physical/hydrological data and socio-economic impacts, from various monitoring networks, contributions of people affected by drought.
- **Output data:** Provision of information in an interactive way through an Internet portal (U. S. Drought Portal). This portal gives access to: the U.S. Drought Monitor, North American Drought Monitor, Seasonal Drought Outlook and Drought Impact Reporter. The system also provides fairly information in the form of reports.
- **Frequency of outputs:** weekly**,** monthly, etc.

ID: DM- G 04	National Drought Mitigation Center (NDMC)	FACTSHEET N°04

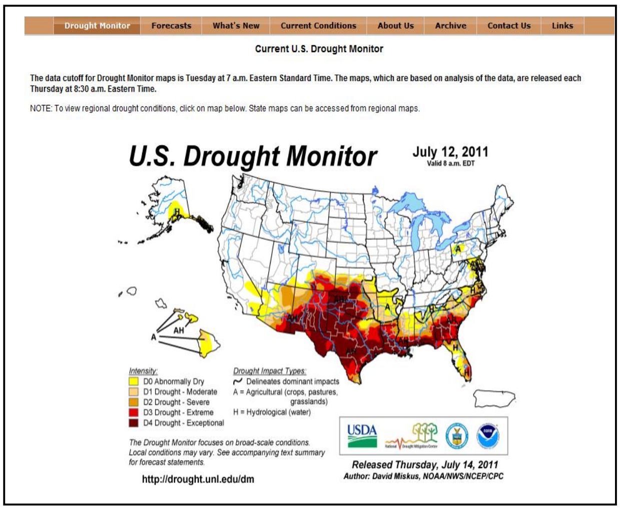
Contact details

Url:
http://drought.unl.edu/about.htm
Address:National Drought Mitigation Center
University of Nebraska–Lincoln
819 Hardin Hall
3310 Holdrege St.
P.O. Box 830988
Lincoln, NE 68583-0988
Telephone:(402) 472-6707
Fax:(402) 472-2946
Contact:ndmc@unl.edu

Description

- **Type:** institution
- **Purpose:** monitoring, forecasting, warning, response
- **Type of drought:** Meteorological, agricultural, hydrological and socioeconomic drought
- **Scope:** National level
- **Description of the system:** The NDMC helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management. The Center participates in many activities such as maintaining a basis of information and Drought Portal, fostering and maintaining the U. S. Drought Monitor, participate on drought planning and mitigation; workshops for federal, state, and foreign governments; organizing seminars, participate in numerous international projects.
- **Input data:** Data of precipitation, stream flow, soil moisture, temperature, etc.
- **Output data:** Articles, reports, drought indices, drought monitor, drought impact reporter, North-American drought monitor, etc.
- **Frequency of outputs:** weekly**,** monthly, etc.

ID: DM G 05	U. S. Drought Monitor	FACTSHEET N°05



Contact details

Url:http://drought.unl.edu/dm/monitor.html
Address:The Drought Monitor
National Drought Mitigation Center
P.O. Box 830988
Lincoln, NE 68583-0988
Telephone:402-472-6707
Fax: 402-472-2946
Contact:DroughtMonitor@unl.edu

Description

- **Type:** system
- **Purpose:** monitoring
- **Type of drought:** Meteorological, agricultural and hydrological drought
- **Scope:** National level
- **Description of the system:** The U. S. Drought Monitor corresponds to a weekly evaluation of the drought for the entire U.S., based on an integrated assessment of different types of indicators and resulting in a map that shows the classification of the severity of drought, which has as background, climate and hydrological information, also incorporating the evaluation and experience of experts and managers from across the country. With this is possible reflect the real impacts observed at local and regional level.
- **Input data:** Physical/hydrological data, observers' reports of how drought is affecting crops, wildlife and other indicators
- **Output data:** A map with a classification of the severity of drought
- **Frequency of outputs:** weekly (every Thursday morning)

ID:DM G 06	North American Drought Monitor (NADM)	FACTSHEET N° 06

Contact details

Url:http://www.ncdc.noaa.gov/temp-and-precip/drought/nadm/index.html
Address:*Climate Services and Monitoring Division*
NOAA/National Climatic Data center
151 Patton Avenue
Asheville, NC 28801-5001
Telephone:*+1-828-271-4800*
Fax: *+1-828-271-4876*
Contact:*ncdc.info@noaa.gov*

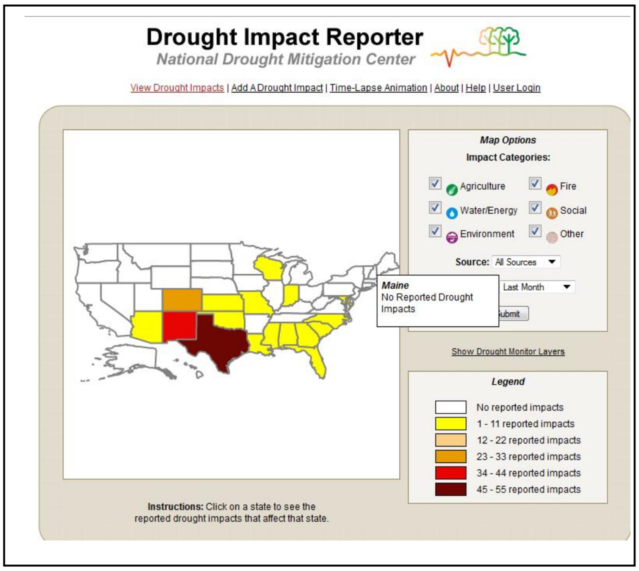
Description

- **Type:** system
- **Purpose:** monitoring and forecasting
- **Type of drought:** Meteorological, agricultural and hydrological drought
- **Scope:** Continental
- **Description of the system:** The U. S. Drought Monitor corresponds to a weekly evaluation of the drought for the entire U.S., based on an integrated assessment of different types of indicators and resulting in a map that shows the classification of the severity of drought, which has as background, climate and hydrological information, also incorporating the evaluation and experience of experts and managers from across the country. With this is possible reflect the real impacts observed at local and regional level.
- **Input data:** Physical/hydrological data, observers' reports of how drought is affecting crops, wildlife and other indicators
- **Output data:** A map with a classification of the severity of drought
- **Frequency of outputs:** Monthly

ID: DM G 07	Drought Impact Reporter	FACTSHEET N° 07

Contact details

Url: http://droughtreporter.unl.edu/map.jsp
Address:The National Drought Mitigation Center, 3310 Holdrege Street, P.O. Box 830988, Lincoln, NE 68583–0988
Telephone: 402-472-8238
Contact:msvoboda2@unl.edu



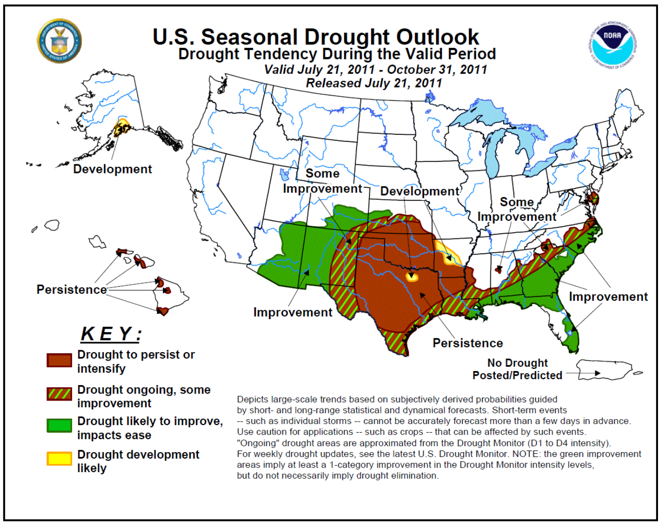
Description

- **Type:** system
- **Purpose:** monitoring
- **Type of drought:** Meteorological, agricultural and hydrological drought
- **Scope:** National level
- **Description of the system:** The Drought Impact Reporter maps the effects of drought, based on reports from media, observers and other sources. It is searchable by state and county, by category of impact, and by time period. Clicking on a state produces a pop-up summary of reported impact types. Clicking on a county (and then scrolling down) yields detail about individual impacts, in many cases linked to the original reports. Users who click down to the county level will find a wealth of stories about drought's effects in specific places and times.
- **Input data:** Information presented in reports from media, observers and other sources.
- **Output data:** A map that represents the number of reported drought impacts over a specified period of time
- **Frequency of outputs:** weekly, monthly and annually.

ID:DM G 08	U. S Seasonal Drought Outlook	FACTSHEET N°08

Contact details

Url:http://www.drought.gov/portal/server.pt/community/forecasting/209
Address:NOAA/National Weather Service
National Centers for Environmental Prediction
Climate Prediction Center
5200 Auth Road
Camp Springs, Maryland 20746
Telephone: 301-763-8000
Contact:Joe.Harrison@noaa.gov



Description

- **Type:** system
- **Purpose:** forecasting and warning
- **Type of drought:** Meteorological, agricultural and hydrological drought
- **Scope:** National level
- **Description of the system:** The Outlook predicts whether drought will emerge, stay the same or get better in the next three months. This prediction of 3 months is released twice a month, along with forecasts of seasonal climate changes. Taking as a starting point areas classified in U.S. Drought Monitor as being under drought conditions, evaluate potential improvements or worsening trends based on seasonal weather conditions, when the influence of fluctuations as the ENSO cycle are more pronounced, and / or medium-term projections of the evolution of PDSI in other cases.
- **Input data:** Information based on the U. S. Drought Monitor and climatic trends
- **Output data:** A map that presents the development drought conditions for the later three months
- **Frequency of outputs:** Twice a month

ID:DM G 09:	CSIRO - Commonwealth Scientific and Industrial Research Organisation	FACTSHEET N° 09

Contact details

url: http://www.csiro.au/science/Water.html
Hosting organization: CSIRO - Commonwealth Scientific and Industrial Research Organisation
Address: CSIRO Enquiries; Locked Bag 10; Clayton South VIC 3169; Australia
Tél : +61 3 9545 2176
Fax : +61 3 9545 2175
e-mail :Enquires@csiro.au

Description

- **Type:** public direction
- **Purpose:** Monitoring, Warning and Response
- **Type of drought:** Hydrological and meteorological
- **Scope:** National
- **Describe the system:**

CSIRO is Australia's national science agency and one of the largest and most diverse research agencies in the world.

CSIRO has established ten National Research Flagships: Climate Adaptation, Energy Transformed, Food Futures, Future Manufacturing, Light Metals, Minerals Down Under, Preventative Health, Sustainable Agriculture, Water for a Healthy Country and Wealth from Oceans Flagships.

- **Input data:** Not applicable
- **Output data**:

Main research projects in drought related areas

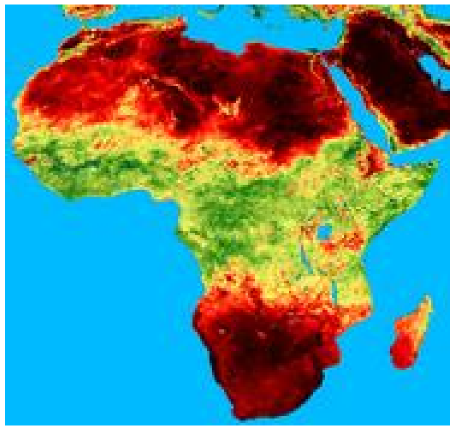
- Sustainable Water Information Models
- Water data transfer standards
- Hydrologists workbench
- Precipitation and actual evapotranspiration products
- One-second SRTM digital elevation model
- Water resources assessment and water use accounting
- Short-term water forecasting and prediction
- Seasonal and long-term water forecasting and prediction

- **Frequency of outputs:** Not applicable

3.2 FACTSHEETS: DROUGHT MONITORING AND FORECASTING SYSTEMS, NETWORKS/INSTITUTIONS - EUROPE AND THE AFRICAN CONTINENT

This section presents available facts about each of the identified continental monitoring system/networks/fora

ID: DM EAC 01	EARS ENERGY AND WATER BALANCE MONITORING SYSTEM (EEWBMS)	FACTSHEET No 10



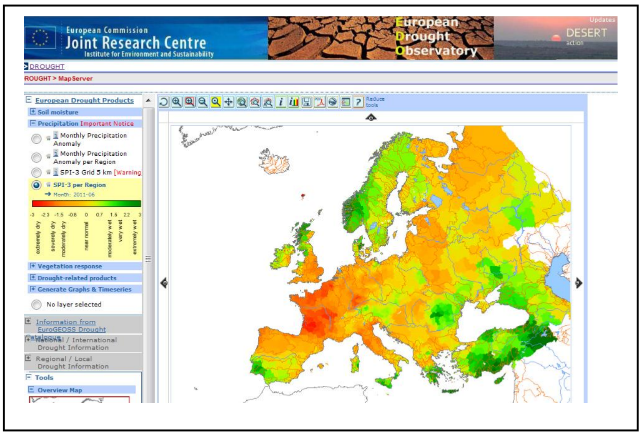
Contact details
url: http://ears.nl
e-mail: info@ears.nl

EARS B.V.
Kanaalweg 1
2628 EB DELFT, the Netherlands
+31-15-2562404

Description

- **Type:** System
- **Purpose:** Monitoring
- **Type of drought:** Meteorological, agricultural and hydrological drought
- **Scope:** regional to continental
- **Describe the System:** EWBMS combines hourly MSG and FY2c satellite data with WMO-GTS information in complex process steps, resulting in useful datasets.
- **Input data:** EARS operates an MSG receiving station, covering Europe and Africa, and is operationally receiving Meteosat-7 and FY2c satellite data over Asia.
- **Output data:** relevant for flow & flood forecasts, drought/ desertification indices, crop yield forecasts
- **Spatial Resolution:** 3 km
- **Frequency of outputs:** Hourly inputs are recalculated to weekly and decadal outputs

ID: DM EAC 02	European Drought Observatory	FACTSHEET N° 11



Contact details

Url:
http://edo.jrc.ec.europa.eu/php/index.php?action=view&id=2

Address:Institute for Environment and Sustainability
Joint Research Centre
Via E. Fermi 2749
I-21027 Ispra (VA)
Italy
Telephone:(+39) 0332 785481
Contact:juergen.vogt(at)jrc.ec.europa.eu

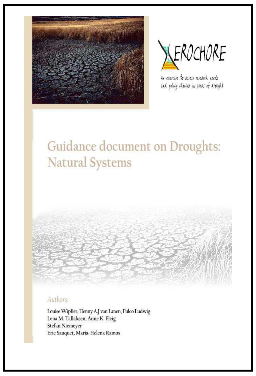
Description

- **Type:** system
- **Purpose:** monitoring and forecasting
- **Type of drought:** Meteorological and hydrological drought
- **Scope:** Continental
- **Description of the system:** The EDO is used to provide near real time monitoring, analysis and forecasting capacities. This system is based on handling, processing, and analysis of large amounts of real-time meteorological and hydrological data as well as on running complex models for the surface water balance, soil moisture, and run-off. In addition, EDO foresees the operational exchage of data between entities at the European, Member State and River Basin levesl, requiring strong competencies with respect to data standards and exchange protocols.
- **Input data:** Data of precipitation, temperature, soil moisture
- **Output data:** Web-based information system (a map server), integrating information from various sources and disciplines relevant to monitor and detect droughts throughout Europe
- **Frequency of outputs:** daily**,** monthly, etc

3.3 FACTSHEETS: DROUGHT MONITORING AND FORECASTING SYSTEMS, NETWORKS/INSTITUTIONS - EUROPE AND NORTHERN AFRICA

This section presents available facts about each of the identified monitoring system/networks/for a covering Europe and North Africa.

ID: DM ENA 01	XEROCHORE	FACTSHEET No 12



<u>Contact details</u>

Url: http://www.feem-project.net/xerochore/index.php

Coordinated by Anil Markandya, Fondazione Eni Enrico Mattei (FEEM), Italy.Eleven partners from Europe

Contact: xerochore@feem.it

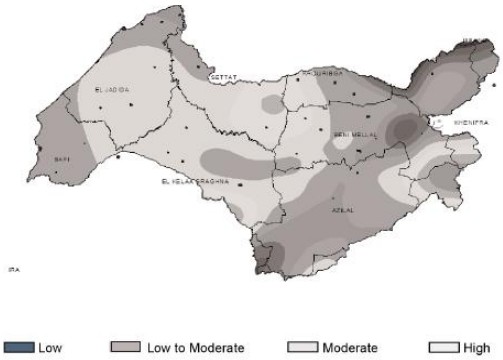
<u>Description</u>

- **Type:** Project and people network
- **Purpose:** Policy support

  XEROCHORE is a support action aimed at assisting in the development of a European Drought Policy in accordance with the EU-Water Framework Directive (EU-WFD)
- **Type of drought:** meteorological, hydrological, agricultural or socio-economic
- **Scope:** European continent with special attention to the Mediterranean region
- **Description**

  XEROCHORE is a Support Action aimed at assisting in the development of a European Drought Policy in accordance with the EU-Water Framework Directive (EU-WFD). It aims among others at providing policy relevant knowledge on drought's physical causes, economic and social impacts and future trends.

ID: DM ENA 02	MEDITERRANIAN DROUGHT PREPAREDNESS PLAN (MEDROPLAN)	FACTSHEET No 13



Example; Agricultural drought vulnerability of Oum Er Rbia Basin (Morocco)

Contact details

Url:http://www.iamz.ciheam.org/medroplan/

Coordination: Mediterranean Agronomic Institute of Zaragoza and Universidad Politécnica de Madrid

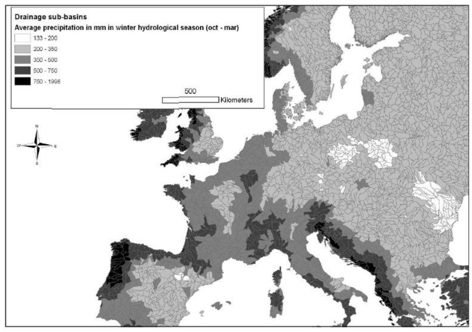
Dunixi Gabiña
Mediterranean Agronomic Institute of Zaragoza (CIHEAM-IAMZ), Spain
Apartado 202, 50080 Zaragoza. Spain
Tel: +34 976 716000 Fax: +34 976 716001
Email:iamz@iamz.ciheam.org

Ana Iglesias, Universidad Politécnica de Madrid, Spain
Email:ana.iglesias@upm.es

Description

- **Type:** Project
- **Purpose:** Guidelines for Drought Preparedness Plans
- **Type of drought:** Meteorological, hydrological, agricultural or socio-economic
- **Scope:** Mediterranean region at national and local level
- **Describe the system:**
  The purpose of the project is to develop guidelines for Drought Preparedness Plans and to set up a Drought Preparedness Network for the Mediterranean countries.

ID: DM ENA 03	AQUASTRESS	FACTSHEET No 14



Contact details

Url: http://www.aquastress.net/

Consiglio Nazionale delle Ricerche (Coordinator)

34 partners from Europe and 2 partners from North Africa (IAV from Morocco and INAT from Tunisia)

Alberto Puddu

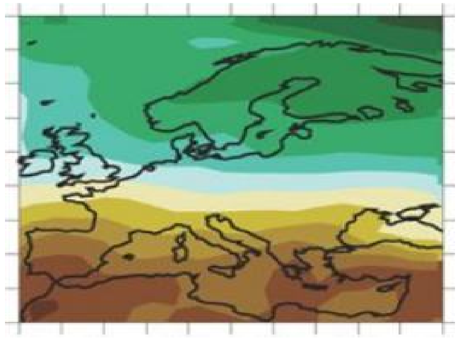
aquastress.coordinator@irsa.cnr.it

www.irsa.cnr.it

Description

- **Type:** EU FP6 research project, network and experimental system
- **Purpose:** Mitigation of Water Stress through new Approaches to Integrating Management, Technical, Economic and Institutional Instruments. The project aimed at delivering interdisciplinary methodologies enabling actors at different levels of involvement and at different stages of the planning process to mitigate water stress problems.
- **Type of drought:** Meteorological, hydrological, agricultural or socio-economic droughts.
- **Scope:** Continental (Europe), catchment scale but also local scale
- **Describe the system:** To compare water stress related information among drainage sub-basins.
- **Input data:** Precipitation, evapotranspiration, net precipitation, soil permeability, permeability, mean slope, groundwater recharge potential, natural background quality (salinity, arsenic), presence of extraction sites, presence of active volcanoes, runoff, river density, open water bodies
  Domestic water use per capita, percentage of population with formal access to water supply, irrigated versus total agricultural area, ratio of irrigated to irrigable land etc.
- **Output data :** Resembling sub-basins depending on input criteria
- **Spatial Resolution:** European drainage sub-basins (Vogt et al. 2003)

ID:DM ENA 04	CLIMATE CHANGE AND IMPACT RESEARCH IN THE MEDITERRANEAN ENVIRONMENT (CIRCE)	FACTSHEET No 15



Contact details

http://www.circeproject.eu

NAVARRA, Antonio (Dr)

Istituto Nazionale di Geofisica Vulcanologia

INGV - Bologna

Via di Vigna Murata 605, Italy

Tel: +39-0514151413

Fax: +39-0514151499

Dr. Laurance Tubiana

Institut du Développement Durable et des Relations Internationales(IDDRI), France

info@circeproject.eu
communication@circeproject.eu

Description

- **Type:** EU research project: Forum, Network and System
- **Purpose:** Monitoring, forecasting
- **Type of drought:** meteorological, hydrological, socio-economic
- **Scope:** Global and the Mediterranean from present - 2050
- **Describe the system**: CIRCE will identify and describe recent observed modifications in the climate variables and detected trends and then will compare them with a series of possible explanations.
- **Spatial resolution:** ~25 km, 0.1 degree to 1 degree
- **Temporal resolution:** 1 day or monthly

3.4 FACTSHEETS: DROUGHT MONITORING AND FORECASTING SYSTEMS, NETWORKS/INSTITUTIONS – THE AFRICAN CONTINENT

This section presents available facts about each of the identified monitoring system/networks/for a covering the whole of the African continent.

ID: DM AC 01	TIGER	FACTSHEET No 16

Contact details

url:http://www.tiger.esa.int/about.asp

http://www.itc.nl/external/tiger/

e-mail: tiger@esa.int

Hosting organization: ESA

Diego Fernandez, Diego.Fernandez@esa.int

Earth Observation Application
Department – EOP/AEP
Via Galileo Galilei - Casella Postale 64
00044 Frascati – ITALY

Implementing organisation: ITC

Prof. Dr. Z. (Bob) Su - b_su@itc.nl
Department. of Water Resources
P.O. Box 217
7500 AE Enschede - The Netherlands

Main partners: AMCOW, CEOS, UNESCO, African Development Bank, CSIR, CRTM, Ramsar-Africa, South African Department of Water Affairs, ITC

Description:

- **Type:** Network, experimental system
- **Purpose:** capacity building in monitoring, forecasting and warning
- **Type of drought:** meteorological, hydrological, agricultural
- **Scope:** Africa
- **Describe the system:** TIGER assists African countries to overcome problems faced in the collection, analysis and use of water related geo-information by exploiting the advantages of Earth Observation (EO) technology.

ID: DM AC 02	AFRICAN WATER CYCLE COORDINATION INITIATIVE (AFWCCI)	FACTSHEET No 17

Contact details

Toshio Koike tkoike@hydra.t.u-tokyo.ac.jp

Douglas Cripe – dcripe@geosec.org

Description

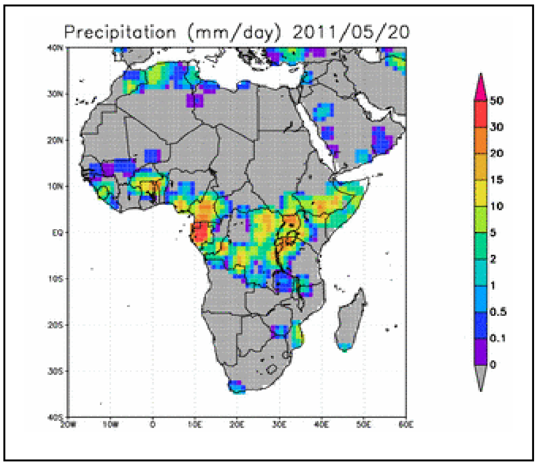
- **Type:** Network, forum, experimental systems
- **Purpose:** coordination and capacity building in monitoring, forecasting and warning
- **Type of drought:** meteorological, hydrological, agricultural and socio-economic
- **Scope:** Africa
- **Describe the system:** AfWCCI brings convergence and harmonization in existing earth observation efforts in Africa.

ID: DM AC 03	EXPERIMENTAL AFRICAN DROUGHT MONITOR	FACTSHEET No 18

Contact details

Url:http://hydrology.princeton.edu/monitor

Address:Princeton University, Land Surface Hydrology Group
Dept. Civil and Environmental Engineering,Princeton University
Princeton, NJ 08544 , USA
Contact: Justin Sheffield, justin@princeton.edu



Description

- **Type:** Experimental system
- **Purpose:** Monitoring

  The system is used for near real time monitoring of land surface hydrological conditions.
- **Type of drought:** Meteorological (and hydrological) and agricultural drought
- **Scope:** Continental level for current conditions.
- **Describe the system**

  Provides experimental, near real-time (2-3 days behind) drought monitoring products. These products are based on the output of the large scale hydrological model VIC (Variable Infiltration Capacity model).
- **Input data:**

- Precipitation (PERSIANN, TMPA and GFS datasets). PERSIANN stands for 'Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks'. TMPA stands for 'Tropical Rainfall Measuring Mission Multi satellite Precipitation Analysis'. GFS is the NCEP Global Forecast System analysis field.
- Temperature and windspeed (Global Telecommunications System (GTS) gauge reports).

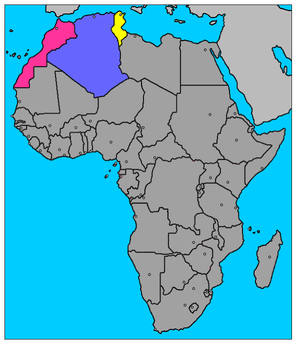
- **Output data:**

  Precipitation, temperature, windspeed, evapotranspiration, runoff, baseflow, snow water equivalent, soil moisture and soil moisture quantile
- **Spatial resolution:** 1.0 degree (upgrading to 0.25 degree in 2011)
- **Frequency of outputs:** Daily, 2 days behind real-time depending on data availability

3.5 FACTSHEETS: DROUGHT MONITORING AND FORECASTING SYSTEMS, NETWORKS/INSTITUTIONS – REGIONAL

This section presents available facts about each of the identified monitoring system/networks/for a covering some regions in Africa.

ID: DM R 1	SAHARA AND SAHEL OBSERVATORY (OSS).	FACTSHEET N°19



Contact details

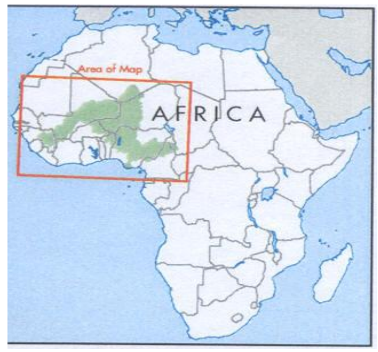
url: www/oss-online.org
Hosting organization: EU (OSS)
Main partners: OSS: 22 countries, (5 North, 17 south).
SMAS: Morocco, Algeria, Tunisia
Address: OSS: Boulevard du leader Yasser Arafat, BP 31, Tunis, Carthage, Tunisia, 1080
Telephone: 71 206 633/634
Fax: 71 206 636:

Description

- **Type: OSS:** Independent international organization. **SMAS**: Project
- **Purpose: OSS:** monitoring, forecasting, warning, response. **SMAS**: warning. Maghrebian Drought Early Warning System (SMAS)
- **Type of drought:** Meteorological, hydrological, agricultural, socio-economic
- **Scope:** Regional
- **Describe the system :**

  OSS: International organisation of North-South-South cooperation which would ensure effective monitoring and protection of the Sahel and Sahara by giving impetus to the combat against desertification and the mitigation of drought. **SMAS** is under OSS coordination, the project aims to construct warning drought indicators in Morocco, Algeria and Tunisia. 2006-2009.
- **Input data:** Meteorological data, Remote sensing data, Agricultural and forests data, Socio-economic data
- **Output data:** SPI, RA (Precipitation deviation/normal); actual water stress, VCI, TCI; SWSI, SWI; seed prices, commodity prices, quantity sold and price of livestock food and straw, rural migration.
- **Frequency of outputs:** monthly

ID:DM R 02	OBSERVATORY NETWORK FOR LONG-TERM ECOLOGICAL MONITORING (ROSELT)	FACTSHEET No 20

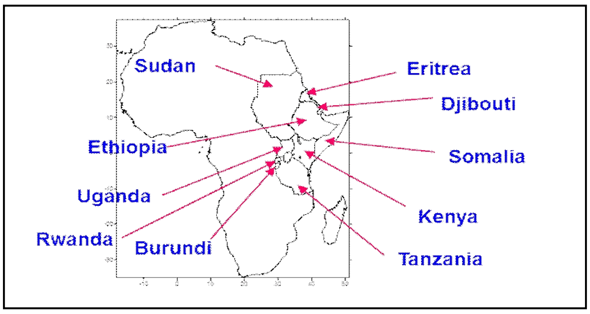


Contact details
url: http://www.roselt-oss.org/
Hosting organization: Observatory of the Sahara and Sahel, Tunis, Tunisia
Main partners: Algerian Space Agency, CNTS, DDC, FFEM, MEDD
Name: ROSELT
Department: OSS/ ROSELT

Description

- **Type: network**
- **Purpose:** Answering to the needs expressed by our member countries to have reliable data on the state of the environment.
- **Type of drought:** Socio-economics, Agriculture, etc.
- **Scope:** Regional and local
- **Describe the system:** ROSELT was designed for long-term monitoring of ecological systems. It is intended to improve our knowledge of interactions between local people and their environment.
- **Input data:**
- **Output data:**
  - thematic maps such as maps of land use, maps relating to physical characteristics, risk index cards to desertification, satellite imagery and aerial photographs have sometimes been used to refine these maps;
  - information system on the local environment(SIEL)
  - metadata that allows areal sharing of data across the network;
  - the kit of indicators at local and regional authorities;
  - scientific and technical collection ROSELT / OSS which includes, among others, methodological guides and national scientific and technical reports;
  - synthesis sub-regional and regional environmental change and socio-economic.
- **Spatial Resolution:** Mali, Niger, Senegal et Tunisia with some activities in Algeria, Morocco and Kenya
- **Frequency of outputs:** In general on an annual basis

ID:DM R 03	IGAD CLIMATE PREDICTION AND APPLICATIONS CENTRE (ICPAC)	FACTSHEET No 21



Contact details

Url: http://www.icpac.net

Hosting organization: National Meteorological Services of the Greater Horn of Africa Countries (ten countries)

Name: Prof. Laban Ogallo

Address: P O Box 10304 – 00100, Nairobi, Kenya

Telephone: +254-20-3514426

Fax: +254-20-3878343

Description

- **Type:** Pubic Institution
- **Purpose:** *Monitoring, Forecasting and Warning*
- **Type of drought:** *Meteorological*
- **Scope:** *Regional*
- **Describe the system:** The system is made up of a network of national meteorological and hydrological services (nmhs) of ten greater horns of Africa countries including Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. the network develops the early warning products and organize forum bringing them together with the users of the information
- **Input data:** *Precipitation*
- **Output data:** Soil moisture indices, Standardised precipitation indices, Pentads
- **Spatial Resolution:** Point Information
- **Frequency of outputs:** Monthly , Seasonal

ID:DM R 04	CLIMATE PREDICTION AND APPLICATION CENTRE, KENYA (IGAD)	FACTSHEET No 22

Contact details

Director, IGAD Climate Prediction and Applications Centre (ICPAC). P.O. Box 10304, 00100, Nairobi, KENYA

Tel.: 254 20 3514426

Fax. 254 20 3878343 ,Telex:22208

E-mail: director@icpac.net

Website: www.icpac.net

Description

- **Type:** Institution
- **Purpose:** Monitoring, forecasting, and early warning
- **Type of drought:** Meteorological
- **Scope: regional**
- **Describe the system: NA**
- **Input data: climate and remote sensed data;** Derived from international weather systems and National meteorological stations
- **Output data:** Hazards and climate risk maps
- **Spatial Resolution:** No information at the moment
- **Frequency of outputs:** 10 day and monthly. Annual climate summaries.

ID: DM R 05	FAMINE EARLY WARNING SYSTEM NETWORK, KENYA (FEWS NET)	FACTSHEET N° 23

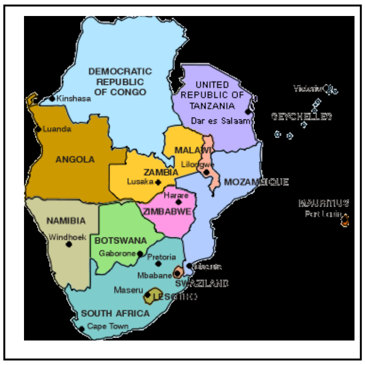
Contact details

URL: http://www.fews.net/
Host: **Kenya** Country Office
Tel1: +254 20 3861475
Tel2: +254 20 3861476/9
Fax: +254 20 3861480
Email: Kenya@fews.net

Description

- **Type:** Network
- **Purpose:** monitoring, forecasting, warning and response
- **Type of drought:** Agricultural and socio-economic droughts
- **Scope:** continental, regions, and local
- **Input data:** Rainfall, moisture index, land use , Elevation
- **Output data:** Livelihood zone maps and profiles

ID: DM R 06	SOUTHERN AFRICA REGIONAL CLIMATE OUTLOOK FORUM (SARCOF)	FACTSHEET N° 24



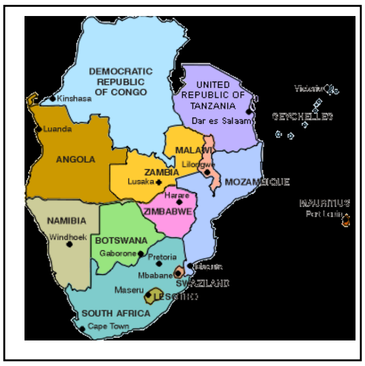
Contact details

Url: http://www.sadc.int/dmc/SARCOF
Address: Drought Monitoring Centre
P/bag 0095, Gaborone, Botswana
Telephone: +267 395 3143
Fax: +267 397 2848
Contact:dmc@sadc.int

Description

- **Type:** Public institution
- **Purpose:** Climate information and prediction services
- **Type of drought:** Meteorological drought
- **Scope:** National and regional levels
- **Description of the institution:** The institution facilitates and information exchange as well as interaction among forecasters, decision-makers and climate information users. Its main objective is to promote technical and scientific capacity building in the region in producing, disseminating and applying climate forecast information in weather sensitive sectors of the regions economic activities.
- **Data collected:** Temperatures(air, min, max, soil), Precipitations, Atmospheric pressures, Wind direction and speed, Evaporation, Humidity
- **Output data:** Meteorological bulletins, average seasonal temperatures and accumulated precipitations for the season
- **Frequency of outputs:** Seasonal reports

ID: DM R 07	FAMINE EARLY WARNING SYSTEM NETWORK, KENYA (FEWS NET)	FACTSHEET N° 25

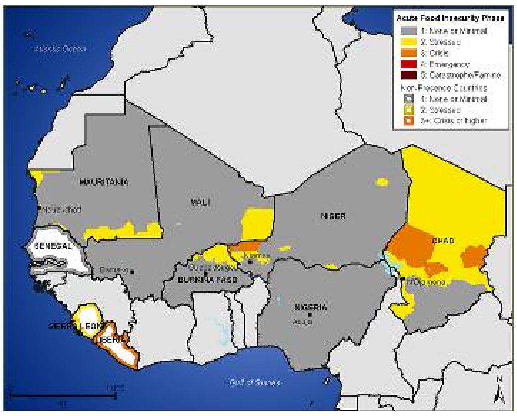


Contact details
URL: http://www.fews.net/
Southern Africa Regional Representative
Tel 1: +27 12 362-6494
Tel2: +27 12 362-5650
Fax: +27 12 362-5651
Email:SouthernAfrica@fews.net

Description

- **Type:** Network
- **Purpose:** monitoring, forecasting, warning and response
- **Type of drought:** Agricultural and socio-economic droughts
- **Scope:** continental, regions, and local
- **Input data:** Rainfall, moisture index, land use , Elevation
- **Output data:** Livelihood zone maps and profiles

ID: DM R 08	FAMINE EARLY WARNING SYSTEM NETWORK, KENYA (FEWS NET)	FACT SHEET N° 26



Contact details

URL: http://www.fews.net/
West Africa
Regional Representative
Tel1: +226 50 37 47 06
Tel2: +226 50 37 41 25
Fax: +226 50 33 54 81
Email: WestAfrica@fews.net

Description

- **Type:** Network
- **Purpose:** monitoring, forecasting, warning and response
- **Type of drought:** Agricultural and socio-economic droughts
- **Scope:** continental, regions, and local
- **Input data:** Rainfall, moisture index, land use , Elevation
- **Output data:** Livelihood zone maps and profiles

3.6 FACTSHEETS: DROUGHT MONITORING AND FORECASTING SYSTEMS, NETWORKS/INSTITUTIONS – NATIONAL

This section presents available facts about each of the identified national monitoring system/networks/fora.

ID: DM NNA 01	NATIONAL OFFICE OF METEOROLOGY (ONM)	FACTSHEET N° 27

Contact details

url: http://www.meteo.dz
Address: BP 153 avenue Khemisti,Dar Elbeida, Algiers
Tel : 021 50 73 93
Fax:021 50 88 49
Contact: contact@meteo.dz

Description

- **Type:** PublicInstitution with an industrial and commercial character
- **Purpose:** Monitoring and forecasting national weather
- **Type of drought:** Meteorological and Agricultural drought
- **Scope:** National and regional levels
- **Description of the institution:** The main missions of the ONM are to monitor and forecast the national weather and thus contribute to meteorological drought monitoring. It provides meteorological assistance to the main socio-economic sectors in the country.
- **Data collected:** Temperatures (air, min max, soil), Precipitations, Atmospheric pressures, Wind direction and speed, Evaporation, Hygrometry
- **Output data:** Daily and PeriodicalMeteorological bulletins, decadal, monthly and annual average temperatures and accumulated of precipitations, Seasonal forecasts
- **Frequency of outputs**: every hours, daily, decades, monthly, annually

ID: DM NNA 02	HYDRAULIC RESOURCES NATIONAL AGENCY (ANRH)	FACTSHEET N° 28

Contact details

url:www.anrh.dz
Hosting organization: Ministry of Water resources
Address: 40, Avenue Mohammedi clairbois. Bir Mourad Rais. Algier
Telephone:(021) 54/25/56, 54/25/58
Fax: (021) 54/25/42, 54/25/43
E-mail:anrh@anrh.dz

Description

- **Type:** Public Institution
- **Purpose:** Water Resources Management
- **Type of drought:** Hydrological and meteorological droughts
- **Scope:** National and regional
- **Describe the system:** The ANRH is a public institution of administrative character with a scientific and technical vocation attached to the Ministry of Water Resources and based at Algiers. Its main missions are to collect, analyse and update all the data related to water and soil resources in the country, monitor water resources in terms of quantities and quality, and preserve and protect these resources from any kind of degradation.
- **Input data:**

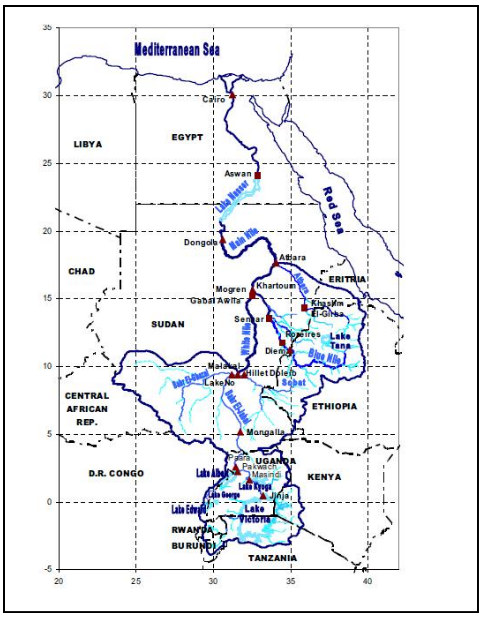
- Climatologic data: temperature, humidity, wind speed, atmospheric pressure, rainfall: daily, monthly and annual data
- Streams run off: (daily, mean and annual data) and other hydrological data

- **Output data:**

Daily and monthly rainfall bulletins, monthly bulletin of dam's water quality, map-making of ground water

- **Frequency of outputs:** daily, monthly

ID: DM NNA 03	NILE FORECAST SYSTEM, EGYPT (NFS)	FACT SHEET No 29



Contact details

Nile Planning Sector, MWRI
url: not available

Hosting organization: Planning Sector of the Ministry of Water Resources and Irrigation (MWRI), Giza, Egypt
main partners: University of Hull (UK), the FAO and NFC staff
Address: Planning Sector, 6th Floor of Ministry of Water Resources and Irrigation Building, Korniche El-Nile, Embaba
Giza 12666, **EGYPT**
Telephone: +20 2 35449462
Fax: +20 2 35449456

Description

- **Type:** system
- **Purpose:** forecasting

The NFS is a real-time distributed hydro-meteorological forecast system designed for forecasting Nile flows at designated key points within the Nile.

- **What can the system/network/forum do?**
  1. Rainfall Estimation
  2. Water Balance Model, Hillslope Model, Channel Routing Model, Reservoir Model, Swamp Model, Lake Model, Reach Routing, Abstractions
  3. The Meteorological Office Surface Exchange Scheme (MOSES)
- **Type of drought:** meteorological
- **What class/type of drought is it involved with?** meteorological and hydrological
- **Scope: regions and local**
- **What is its level of operation?** National level and basin level
- **Describe the system**

A conceptual distributed hydrological model of the Nile system including soil moisture accounting, hillslope and river routing, lakes, wetlands, and man-made reservoirs.

- **Input data:** The main inputs data are:
  1. Rainfall and potential evapotranspiration. Satellite remote sensing technology for estimating rainfall over the basin.
  2. Meteorological observations and weather forecasts from the ECMWF, which provides, inter alia, recent rainfall observations from five or six synoptic stations in the Ethiopian highlands.
  3. Database of rain gauge data, as part of the NBHIS which also holds flow records at all key river gauges.
- **Output data:**

  Rainfall in the upper Blue Nile basin from CCC data, short-term and medium term streamflow forecasting; estimates of inflows to Lake Nasser for short-term operational decisions.
- **Spatial Resolution:** 5 km x 5 km pixels
- **Frequency of outputs:** daily, weekly, short term, long term

ID:DMNNA 04	EGYPT NATIONAL POLICY TO COMBAT DESERTIFICATION (ENPCD)	FACTSHEET No 30

<u>Contact details</u>
The Desert Research Center, Egypt
url: WWW.drc-egypt.com
Main partners:
Prof. Dr. Abdel Moneim Hegazi,(+202 0123701410),
Dr. Ahmed Abdel Ati Ahmed (+202 0105146438),
Prof. Dr. Saad El-Demerdashe,
Prof. Dr. Mahmoud Y. Affifi, Prof. Dr. Mostafa A. El-Shourbagy,Prof. Dr. Ahmed A. Metwalli. Prof. Dr. Ismail Abdel-Galil chairperson of the Desert Research Center, UNCCD Focal Point,
Name:Ismail Abdel Galil Hussain
Address:DRC- 1 Mathaf El Mataria St., Cairo –Egypt P.O. Box 11753 Mataria
Egypt_UNCCD_focalpoint@hotmail.com
Telephone: 202-6332352 202-6335549
Fax: 202-6332352 202-6357858

<u>Description</u>

- **Type:** National Action Program
- **Purpose:** monitoring, forecasting, response
- What can the system/network/forum do?

Mention whether the system/network/forum/institution is used for monitoring or forecasting or warning or response or a combination of these four functions

- **Type of drought:** meteorological
- **Scope:** national
- **What is its level of operation?**

Desertification assessment and monitoring for the country will be carried out at three levels: national, provincial and on sites representing the local level. On the national and provincial levels, the plan of action will be revised every five years. Monitoring aims at (a) assessing extent, rate and intensity of desertification and, (b) evaluating impact of corrective measures.

ID:DM NNA 05	GENERAL DIRECTORATE OF HYDRAULICS (GDH)	FACTSHEET N° 31

Contact details

url:www.mtpnet.gov.ma/dgh/
Hosting organization: State Secretary To Water and Environment
Address: Rue Hassan Benchekroun Rabat Agdal.
Tél :212 0537 778715.
Fax : +212 537 778696.
e-mail : dgh@mtpnet.gov.ma.

Map of locationlocation/situation

Description

- **Type:** public direction
- **Purpose:** Monitoring, Warning and Response
- **Type of drought:** Hydrological and meteorological
- **Scope:** National
- **Describe the system:** The General Directorate of Hydraulics(DGH), is one of the four main administrative organizations directly concerned with water policy at the national level. It contributes to the planning, mobilization, management, and quality of water resources and is also in charge of the management of large hydraulic works and the allocation of drinking water and agricultural water.
- **Input data:** Rainfall and climatic data, Exploitation capacity of wells and boreholes, Piezometric levels, Dams water balance, stream flows
- **Output data**:
  - Calculation of sudden flows, daily flows, monthly statistics,
  - Dam monthly statistics and water resource balance sheet
  - State of the water table and potential for withdrawal.
- **Frequency of outputs:** daily, monthly, annually

ID: DM NNA 06 24	HIGH COMMISSARIAT OF WATER, FOREST AND FIGHT AGAINST DESERTIFICATION (HCEFLCD)	FACTSHEET N° 32

Contact details

url:http:// www.eauxetforets.gov.ma
Address: 3, rue Haroun Arrachid. BP 605 Rabat-Chellah - Rabat - Morocco
Telephone:(212) 5 37.76.00.38/41
Fax: (212) 5 37.76.84.96
Contact: contact@eauxetforets.gov.ma

Description

- **Type**: Public Institution
- **Purpose**: Monitoring, warning and response
- **Type of drought:** Forest, Pasture and Rangelands droughts, Socio-economic Drought
- **Scope:** National and local levels
- **Description of the institution: T**he High Commissariat of Water, Forest and Fight against Desertification (HCFWFD) is a public institution responsible of the preservation and the development of forest, the fight against the desertification and the preservation of water resources. This includes the implementation of a permanent watch of forest resources and desertification process and the development of an integrated and sustainable system to monitor assess and diffuse all the information related to that observation as well as data and information related to on-going projects and action programs.

  Data collected: Meteorological data, Soil parameters: soil texture, soil depth and soil moisture, Vegetation: structure, composition, moisture level, Socio-economic, data, remote-sensing data
- **Output data:**

- Reduction degree of forests and rangelands areas
- Rangelands productivity
- Drought monitoring indicators from satellite data
  - Standardized Vegetation Index(SVI),
  - Vegetation Condition Index(VCI),
  - Temperature Condition Index(TCI)
  - Vegetation Health(VH)

ID: DM NNA 07	NATIONAL DIRECTORATE OF METEOROLOGY (DMN)	FACTSHEETN° 33

Contact details

Url: http://www.marocmeteo.ma/
Address: Aéroport Casa-Anfa, Face Préfecture Hay Hassani - B.P. 8106 Casa Oasis - Casablanca - Morocco
Telephone:(212)522.65.49.00/65.48.00
Fax: (212) 5 22.91.37.97
Contact: contact@marocmeteo.ma

Description

- **Type:** Public Institution
- **Purpose:** Weather Monitoring and Forecasting
- **Type of drought:** Meteorological and Agricultural drought
- **Scope:** National and regional levels
- **Description of the institution:** The main missions of the DMN are to monitor and forecast the national weather. 4 regional directions (Center, South, North and North-east) have been created in order to offer services more adapted to each part of the country. In addition, the DMN is now oriented towards the development of a sectorial meteorology developing specific programs for different economic sectors such as agriculture, hydrology and environment.
- **Data collected:** Temperatures(air, min, max, soil), Precipitations, Atmospheric pressures, Wind direction and speed, Evaporation, Humidity
- **Output data:** Meteorological bulletins, average seasonal temperatures and accumulated precipitations for the season, RAN, SPI, PSDI indices
- **Frequency of outputs:** 24, 48 and 72 hours, 5 days, decadal, monthly, annual bulletins

ID: DM NNA 08	ROYAL CENTRE FOR REMOTE SENSING (CRTS)	FACTSHEET N° 34

Contact details

url:http://www.crts.gov.ma
Adress: Avenue Allal El Fassi , angl av Essanaoubar. sect 21. C.P. 10000 - Rabat - Morocco
Telephone:(212) 5 37.71.54.48/98
Fax: (212) 5 37.71.14.37
Contact:contact@crts.gov.ma.
Hosting organization: Ministry of Defense

Description

- **Type:** Institution
- **Purpose:** Forecasting, warning
- **Type of drought:** Meteorological, hydrological and Agricultural drought
- **Scope:** National and regional levels
- **Description of the institution:** The Royal Centre for Remote Sensing (CRTS) is the national institution responsible for the promotion, use and development of remote sensing applications in Morocco. CRTS coordinates and carries out the national program of remote sensing in collaboration with ministerial departments, private operators and universities. CRTS uses operational systems to collect, produce and analyze data from Earth observation satellites and other sources.
- **Data collected:** Spatial data: Space cartography and geometrics, geographical data, remote sensing, GIS, positioning, telecommunications
- **Output data:** NDVI, SVI, VCI, TCI, VH
- **Spatial Resolution:**

- A local monitoring by using high resolution data allowing a specific management and development of models to extrapolate results to other sites
- A national monitoring (low resolution data) allowing to reply to national plan objectives.

- **Frequency of outputs:** continually

ID: DM NNA 09	NATIONAL DROUGHT OBSERVATORY (ONS)	FACTSHEET N° 35

Contact details

url: http://www.ons.zooshare.com

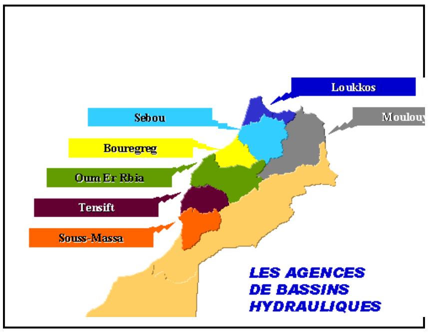
Address: Institut Agronomique et Vétérinaire Hassan II BP 6202-Instituts, 10101-Rabat, Morocco.

Telephone : 212 (05) 37 77 17 45/58/59.
Fax: (212) (0)5 37 77.81.35
Contact: nasser.alaoui@gmail.com

Description

- **Type:** Public entity attached to the General Secretary of Ministry of Agriculture and Maritime Fisheries (MAPM)
- **Purpose:** Drought monitoring, alert and response
- **Type of drought:** Meteorological, Hydrological, Agricultural and socio-economic droughts
- **Scope:** National and local levels
- **Description:** The National Drought Observatory (NDO) 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). The main mission of the Observatory were to provide decision makers with decision support tools for drought management and to advise on strategic drought planning, preparedness, mitigation and response.
- **Data collected:** Hydrological, meteorological, agricultural, socio-economic data from the DMN, from the DGH/ABH, the MAPM and the CRTS.
- **Output data:** Drought indices (deviation from normal precipitation, deciles analysis, SPI, Surface Water Supply index), Spatialization of drought hazard, drought vulnerability assessment, mapping of drought vulnerability

ID: DM NNA 10	HYDRAULIC BASIN AGENCIES OF SEBOU(ABH)	FACTSHEET N ° 36



Tensift,
Oum er Rbia,
Souss- Massa,
Moulouya,
Bouregreg-Chaouia
Loukkos

Contact details:
http://www.abhsebou.ma
http://www.eau-tensift.net
http://www.abhoer.ma
http://www.abhsm.ma
http://www.abhm.ma
http://www.abhbc.com
Hosting organization: State Secretary for water and environment

Description

- **Type:** Autonomous public institutions
- **Purpose:** The hydraulic Basin Agencies contribute to both drought monitoring and mitigation through management of water resources
- **Type of drought:** Meteorological and Hydrological drought
- **Scope**: Hydrological River basin level
- **Describe the system:** The Hydraulic Basin Agencies are autonomous public institutions which group all the water stakeholders and users in the region. They are charged to manage the water resources at the basin level and monitor quantity and quality of surface and underground water. They also contribute to the management of drought and adjust water allocation according to the resource available.
- **Input data:** Rainfall and climatic data, Exploitation capacity of wells and boreholes, Piezometric levels, Dams hydraulic balance, stream flows
- **Output data**:
    - Calculation of sudden flows, daily flows, monthly statistics,
    - Dam monthly statistics and water resource balance sheet
    - State of the water table and potential for withdrawal.
- **Frequency of outputs:** daily, monthly, annually

ID: DM NNA 11	MINISTRY OF AGRICULTURE, HYDRAULIC RESOURCES AND FISHERIES (MARHF)	FACTSHEET No 37

Contact details

url: http://www.onagri.nat.tn
Address: 30, av. A. Savary - 1002, Tunis Belvédère, Tunis
Telephone: 18 73 - 71 78 68 33
Fax: 71 76 61 07
Contact:mag@ministeres.tn

Description

- **Type:** Public institution
- **Purpose:** monitoring, warning and response
- **Type of drought:** meteorological, hydrological, agricultural and socio-economic droughts
- **Scope:** National and Regional
- **Describe the system:** In Tunisia, the complexity of the water system results in an intricate institutional water management framework, where the water competencies and responsibilities are spread among several services, departments and institutions supervised by the MARHF. Consequently, most of those institutional bodies are involved in drought management processes and some of them to hydrological and meteorological drought monitoring. Agricultural departments of the MARHF such as the National Observatory of Agriculture (ONAGRI),are involved in the agricultural drought monitoring process.
- **Input data:**
  - Rainfall, temperature; evaporation, wind direction and speed, albedo
  - Piezometric levels, reservoir levels, inflow, runoff
  - Data on agricultural conjuncture
- **Output data:**
  - Pluviometric indices (SPI, Drought index), ETP,
  - Reservoir levels, Runoff, inflows, dams balance, piezometric levels
  - Crop yield previsions, impacts from parasitical attacks
  - Forests and rangelands areas evolution
- **Frequency of outputs:** monthly, annually

ID: DM NNA 12	NATIONAL INSTITUTE OF METERORОLOGY (INM)	FACTSHEET N°38

Contact details

url : www.meteo.tn
Address: Avenue Mohamed Ali Akid, Cité Olympique, El Khadra, 1003 – Tunis-Tunisia
Telephone : 71 773 400
Fax: 71 772 609
Contact: admin@meteo.tn Hosting **Organization**: Ministry of Transport

Description

- **Type:** Public, non-administrative establishment
- **Purpose:** Forecasting, monitoring and warning
- **Type of drought:** Meteorological
- **Scope:** National and regional levels
- **Description of the institution:** The INM is the main precipitation network in Tunisia and its main missions are to ensure the meteorological observations, particularly weather forecasting, Climatology, and applied meteorology
- **Input Data:** rainfall, temperature, wind, direction and speed and precipitation
- **Output data:** Albedo, SPI, evaporation, and statistics of the measured data
- **Frequency of outputs**: hourly, daily, weekly, decadal and monthly

ID: DM NNA 13	NATIONAL CENTRE FOR MAPPING AND REMOTE SENSING (CNCT)	FACTSHEET N° 39

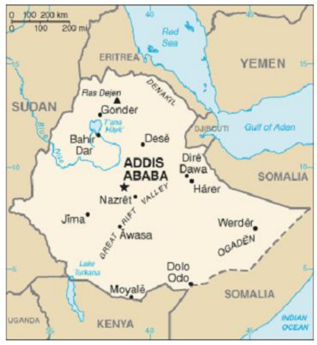
Contact details

url: www.cnct.nat.cn
hosting organization: Ministry of Defense
Address: BP. 200, 1080 Tunis Cedex-Tunisie
Telephone: 216 71 761 333
Fax: 216 71 760 890

Description

- **Type:** Public, non-administrative establishment
- **Purpose:** forecasting, warning
- **Type of drought:** Meteorological, hydrological, agricultural drought
- **Scope:** National and regional levels
- **Describe the system:** The main CNCT mission is to develop methods based on space technologies in the country's economic sectors having priority, in particular in the fields of Agriculture**,** Urban planning and Environment
- **Input data:**
  - data images,
  - spatial maps,
  - digital elevation models,
  - topographic maps
- **Output data :**
  - NDVI, SVI, VCI, TCI and VH
- **Frequency of outputs:** continually

ID: DM NEA 01	RELIEF AND REHABILITATION COMMISSION, ETHOPIA (RRC)	FACT SHEET No 40



Contact details

url: N A

hosting organization: Government
main partners: the Government of **Ethiopia** (Government) and the United States of America acting through the Agency for International Development (USAID)

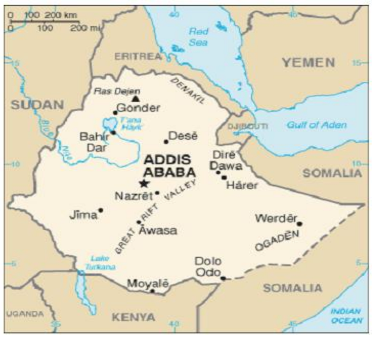
Description

- **Type: Institute**
- **Purpose: response**

Immediate responsibilities included mobilizing relief resources from domestic and international sources and providing the same to areas affected by drought.

- **Type of drought: meteorological**
- **Class/type of drought is it involved in:** Mobilizing domestic relief resources, organizing humanitarian supplies from abroad, and undertaking relief rehabilitation measures disproportionately took time and resources.
- **Scope:** Local, Wollo and Tigary, the northern administrative province
- RRC was overwhelmed with the huge task of relief operation and reaching out affected people by the famine.

ID: DM NEA 02	DISASTER PREVENTION AND PREPAREDNESS AGENCY, ETHOPIA (DPPA)	FACT SHEET No 41



Contact details

url: http://www.dppc.gov.et/

hosting organization: Ministry of Agriculture and Rural Development, which is headed by the Deputy Prime Minister

main partners: Agriculture, Finance, Health, Defense, Economic Development and Cooperation, Public and Urban Development, and the Commissioner of DPPC

Address: Building 2, Near Ghandi Hospital, Addis Ababa Building 2,
Near Ghandi Hospital,
Addis Ababa, **Ethiopia**
PO Box 5686
Telephone: 251-11-5517232
Fax: 251-11-5514788

Description

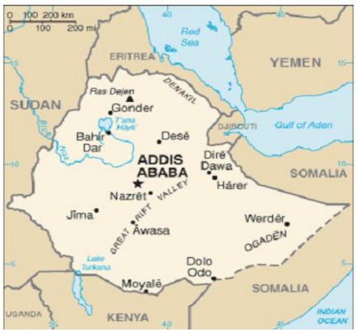
- **Type: Institution**
- **Purpose:** disaster prevention, preparedness, and response
- **What can the system/network/forum do?**

Prevention measures aim to tackle the root causes of people's vulnerability, improving their ability to manage periods of difficulty. Response activities take place during an emergency, and include the provision of food, water, shelter, and medical services. Preparedness activities aim both to reduce the impacts of disasters and to allow the response to be more effective.

- **Type of drought:** meteorological
- **What class/type of drought is it involved with?** national, regional, and local levels
- **What is its level of operation?** National, Local and regional.
- **Describe the system**

The DPPC has five department, Early Warning, Aid Programmes Co-ordination and Monitoring, Policy, Plan and Programme, Property Administration and Transport Coordination, and Fund Raising and Public Relations.

ID: DM NEA 03	PRODUCTIVE SAFETY NET PROGRAM, ETHOPIA (PSNP)	FACTSHEET No 42



Contact details

url: NA

hosting organization: Federal administrative structure of the **Ethiopian** Government

Name: NA

Department: NA

Description

- **Type: program**
- **Purpose: [monitoring, forecasting, warning, response]**
- **What can the system/network/forum do?**

It ultimately proved possible to agree on the following set of design principles:

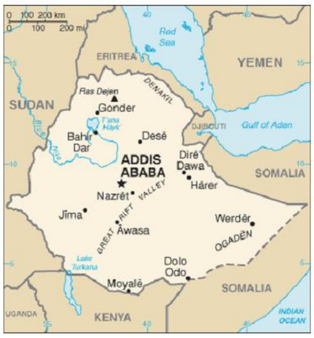
(a) Safety net transfers to households need to be predictable and reliable.

(b) Transfers need to be well timed to be effective.

(c) A shift to cash transfers should be encouraged.

- **What is its level of operation? National, Local and regional.**
- **Describe the system [few lines]**
- **Safety nets in drought-prone areas:** The PSNP is a safety net tailored to agrarian contexts while promoting longer term improvements in rural productivity prices and decreasing supply, but also because of concerns that food aid may be delivered too late, may not respond adequately to household needs, and may negatively affect rural production and marketing decisions. In contrast, households can often use cash to better respond to their needs. The PSNP affords lessons learned from one of the world's few large-scale efforts to shift from food to cash-based transfers.
- **Input data:** N/A
- **Output data:** Food for work
- **Spatial Resolution: NA**
- **Frequency of outputs: NA**

ID: DM NEA 04	NATIONAL METEREOLOGICAL SERVICES AGENCY (NMSA)	FACTSHEET No 43



Contact details:

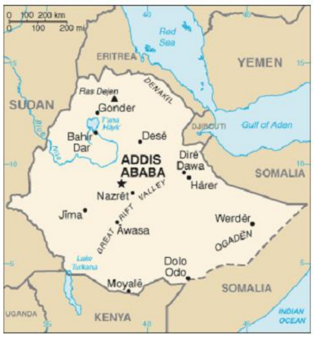
National Meteorological Services Agency of Ethiopia,
P.O.BOX 1090, ADDIS ABABA, ETHIOPIA
E.Mail: nmsa@telecom.net.et
url: NA
hosting organization:
Name: Tesfaye Haile, General Manager
NMSA
Department: NA
Address: P.O. Box 1090, Addis Ababa **ETHIOPIA**,
Telephone: 251-1-512299
Fax: 251-1-517066

Description

- **Type: institution**
- **Purpose:** Early Warning System
- **What can the system/network/forum do?** Training; Information; Non-formal Education

- **Type of drought: meteorological**
- **Scope:** national
- **What is its level of operation? NA**
- **Describe the system**
  National Meteorological Services Agency [NMSA] is preparing and disseminating Agro Meteorological Advisory Bulletins at real time basis, which can assist planners, decision makers and farmers at large. The agency disseminates agro meteorological reports on ten daily, monthly and seasonal in which all the necessary current information relevant to agriculture is compiled. NMSA also issues agro-meteorological bulletins through World Agro Meteorological Information Service Web site. The government decision-makers are using their recommendations to alter agricultural practices on relatively short notices in order to maximize the value of the forecasted rains and minimize the impacts of forecasted droughts (Nicholls & Katz, 1991).
- **Input data:**
  Rainfall, Maximum Temperature, Minimum Temperature, Relative Humidity, Wind speed & direction, Sunshine duration, Evaporation etc.
- **Output data:** Early warning
- **Spatial Resolution: NA**
- **Frequency of outputs:** daily, monthly and yearly

ID: DM NEA 05	CONTIGENCY PLANNING AND FINANCING, ETHOPIA (CPF)	FACTSHEET No 44



Contact details

url:

hosting organization: DPPC

Name: Disaster Prevention and preparedness committee

Department: NA

Description

- **Type:** contingency fund
- **Purpose:** response
- **What can the system/network/forum do?**
- **Type of drought:** meteorological
- **What class/type of drought is it involved with?** national
- **Scope:** national
- **What is its level of operation?** national

ID: DM NEA 06	SUDAN METEOROLOGICAL AUTHORITY (SMA)	FACTSHEET No 45

Contact details:

url: http://www.ersad.gov.sd/

hosting organization: Ministry of Environment and physical development

Address: P.O.Box 574_ Khartoum, **Sudan**

Telephone: +249 183 778837 or +249 183 772992

Fax: +249 183 772292 or + 249 183 771693

Description

- **Type:** System
- **Purpose:** monitoring, forecasting, warning
- **Type of drought:** Meteorological drought
- **Scope:** Regional, national
- **Describe the system**

The SMA is governmental body work in monitoring, Forecasting the weather parameters and it is consider as an advisor for policy makers in all issues about climate and weather. The SMA also provides data and information for Public uses and for scientific researches and also work as consultants for some organizations and companies.

- **Input data:** All weather parameters
- **Output data:** Rainfall, temperature, sunshine duration and radiation, wind, relative humidity, evaporation,
- **Spatial Resolution:** for the monitoring of the weather data there is around 34 stations (in capital cities in the country). Spatial resolution for rainfall forecasting 0.24 degrees.
- **Frequency of outputs:** hourly, daily, monthly and annual basis

ID: DM NEA 07	DESERTIFICATION RESEARCH INSTITUTE (DRI)	FACTSHEET No 46

<u>Contact details:</u>

url:

http://www.ncr.sd/html/aboutEn.asp?pageId=54

Hosting organization: Ministry of Science and Technology,
National centre for Research
Address: Mohamed Nageeb Street,
P.O. Box 6096_Khartoum, **Sudan**
Telephone: + 249 183 476715
Fax: +249 183463416

<u>Description</u>

- **Type:** system
- **Purpose:** Monitoring and response
- **Type of drought:** hydrological, agricultural or socio-economic droughts
- **Scope:** National and local level
- **System Description**

The DRI is research institute it is work focus on two axis Socio-economic and Basic and Applied research to achieve the institute objectives which are: Formulation and execution of basic and applied research in dry and desertified lands putting livelihood in top agenda; Applied research to develop drought and disease resistant crops and improve productivity and dissemination of research results and developed techniques

- **Input data:** climate parameters, fauna, flora, soils, annual discharge of wadis, crops, forestry, and data about vegetation cover.
- **Output data:** The DRI provide data about new crop varieties resistant to drought and quick maturing varieties, soil reclamation and conservation, water harvesting techniques, annual discharge of wadis
- **Spatial Resolution:** Not available
- **Frequency of outputs:** differ according to the research project

ID: DM NEA 08	INSTITUTE OF ENVIRONMENTAL STUDIES (IES)	FACTSHEET No 47

Contact details

url: http://ies.uofk.edu
hosting organization: University of Khartoum
Department: arid land management, urban and rural environments; fresh water; coastal zones management; Sustainable Development.
Address: Gamhoria street,
P.O. Box: 321, Post code: 11115,
Khartoum, **Sudan**
Telephone: +249 11 780993 or +249 11 780963
Fax: + 249 11 780993

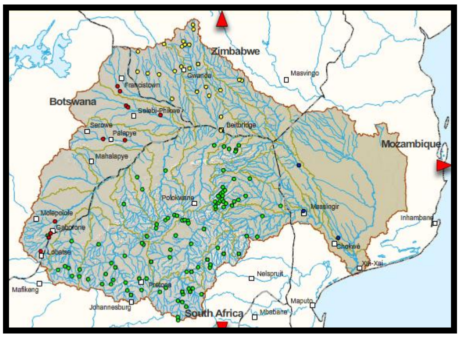
Description

- **Type:** Institute
- **Purpose:** The institute has special interest and experience in educational and research in monitoring, environmental awareness and how the community's response to drought.
- **Type of drought:** meteorological, hydrological, Agricultural and socio-economic
- **Scope:** local level
- **System Description:** The IES is an institute encompass both training and research activities. Currently, the IES offers the following degrees:
    - M.Sc. in Environmental Sciences (by courses)
    - M.Sc. in Environmental Sciences (by research)
    - M.Sc. in Meteorological Sciences (by course and complementary research)
    - Ph.D. in Environmental Sciences (by research)

Also Training Courses in The Environmental Impact of Development and Women, Environment and Development
IES also involved in Consultancies work
    - Baseline Survey and Monitoring Programme for North Kordofan Rural Water Supply Project,
    - Evaluation of the UNICEF - supported Drinking Water Project in South Kordofan Project - Surface Water, UNICEF
    - US-AID Pre-assessment of National Resources with help from MAB and Clark University
    - Anti-desertification Actions in the Sudan - Sahelian Region :
    - Environmental Impact of the Southern Stock Route, supported by USAID,
    - Environmental Review for the Western Sudan Agricultural

- **Input data:** Meteorological data, animal population data, Rangeland data, hydrological data
- **Output data:** Data about environmental impact assessment, biodiversity, Dryland husbandry.

ID:DM NSA 01	SOUTH AFRICA WEATHER RSERVICE (SAWS)	FACTSHEET N° 48



Contact details

Url: http://www.weathersa.co.za/web/
Address: Johannesburg South Africa
Telephone: 082 162 0500 / 083 123 0500 and 0822339000
Contact:longrange@weathersa.co.za

Description

- **Type:** Public Institution
- **Purpose:** Weather and Climate information
- **Type of drought:** Meteorological drought
- **Scope:** National and regional levels
- **Description of the institution:** the South African Weather Services ensures the ongoing collection of meterological data over South Africa and surrounding oceans and be a custodian for climatological record.
- **Data collected:** Temperatures(air, min, max,), Precipitations, Atmospheric pressures, Wind direction and speed, Evaporation, Humidity
- **Output data:** Meteorological bulletins, average seasonal temperatures and accumulated precipitations for the season
- **Frequency of outputs:** 12hr, 24hr Weekly, Monthly, Quarterly, Annual and Seasonal reports

ID: DM NSA 02	CENTRAL FORECASTS OFFICE, TANZANIA (CFO)	FACTSHEETNo 49

Contact details

Url: http://www.meteo.go.tz
hosting organization: TMA
main partners: PMO; MoAFS; FAO; FEWS; WMO
Name: Tanzania Met. Agency
Department: Forecasting Services
Address: P.O. Box 3056 DSM
Telephone: +255 222460706
Fax: +255 222460735

Description

- **Type:** *System*
- **Purpose:** Monitoring, forecasting and warning functions
- **Type of drought:** The system is for meteorological and agricultural droughts
- **Scope:** The use is national and regional (zone) levels.
- **Describe the system:** The system uses statistical and dynamical methods to produces seasonal rainfall forecast by involving assessment of the global climate systems and its implications to the upcoming season in the regions of Tanzania
- **Input data**: Observed Sea Surface Temperatures (SSTs) in the tropical Pacific Ocean and over the tropical Atlantic and Indian Oceans obtained from World Meteorological Organisations (WMO)
- **Output data:** Seasonal rainfall amounts, which is the summation of daily (24 hours) rainfall accumulation over the entire season
- **Spatial Resolution:** Zonal
- **Frequency of outputs:** Daily, monthly and seasonal

ID: DM NSA 03	DISASTER MANAGEMENT DEPARTMENT, TANZANIA(DMD)	FACTSHEET No 50

<u>Contact details</u>

url: http://www.pmo.go.tz

hosting organization: PMO

main partners: TMA, MoAFS, UN/International organisations, MoW, Media, NGOs/CBOs, Tanzania Red Cross Society

Name: Prime Minister's Office

Department: DMD

Address: P.O. Box 3021 Dar es Salaam, **Tanzania**

Telephone: +255 2221172266

Fax: +255 2221172266

<u>Description</u>

- **Type:** *System*
- **Purpose:** The system is used for monitoring, forecasting, warning and response functions. It oversees and coordinates the activities of government on matters related to prevention, preparedness and response to all disaster management in the country.
- **Type of drought:** The system for meteorological, hydrological and agricultural droughts
- **Scope:** The use is national wide
- **Describe the system:** The system has two sections all headed by assistant Directors. These sections are operation and coordination, and planning and research.
- **Input data:** Climatic forecasts and warning from TMA
- **Output data:** Maps on hazards prone areas; developed strategies for resource mobilization and their implementation; planned and conducted public awareness programmes
- **Spatial Resolution:** Country wise
- **Frequency of outputs:** Event based

ID: DM NWA 01	EARLY WARNING SYSTEM (SAP)	FACTSHEET No 51

Contact details

url: [http://www.sapmali.net]

hosting organization: Mali Government

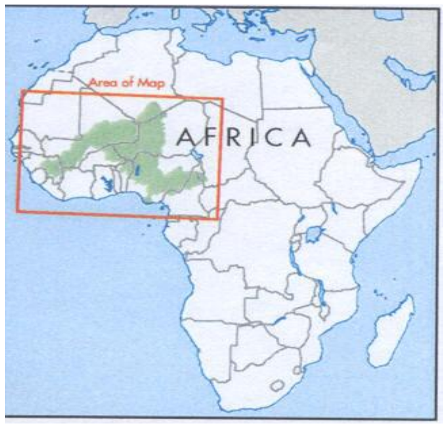
main partners: DRPSIAP, PAM, OMA, AGRHYMET

Name : SAP

Department : DNS/ SAP

Address: sapmali@afribone.net.ml

Telephone: +223 20 21 27 28



Description

- **Type: System**
- **Purpose:** The system can prevent a food crisis. The SAP is an early warning system for natural disasters such as floods, drought and others
- **Type of drought:**

The system is based on the agricultural and socio-economic fields

- **Scope:** It is for national use. The operability of the system is national
- **Describe the system** The early warning systems in Mali are mainly focused on monitoring agro-climatic shocks and their impacts on food production
- **Input data:** Rainfall and floods, pests, agriculture production, livestock breeding and fishing production, crop prices on the market, population migration, habits and food stocks, and health status. These data are provided by the Government Technical Departments
- **Output data:** Rainfall and floods, pests, food production, food habits, food stocks, health and nutrition, food and nutritional status of the population, indicators are the height of water levels measured at some stations, price of agriculture products, morbidity and mortality at health centres.
- **Spatial Resolution: t**he SAP is represented in all regions of Mali.
- **Frequency of outputs:** the frequency is quarterly and biannual

ID: DM NWA 02	WEST AFRICA SEED ALLIANCE (WASA)	FACTSHEET No: 52

Contact details

Hosting organization: ICRISAT

Main partners: USAID, ICRISAT, CNFA, SSC-ISU

Name: WASA

Department: ICRISAT/WASA, Mali

Address: Bureau à l'Institut du Sahel, 293, Avenue OUA Badalabougou, Bamako, Mali

Email: r.shetty@cgiar.org

Telephone: +223 20 22 80 86

Description

- **Type: System**
- **Purpose:** The search for adaptation to climate change in relation to crops, orientation towards the professionalization and diversification seed.
- **Type of drought:** The system is created to fit the seed varieties to climate change.
- **Scope:** Regional (6 countries: Burkina Faso, Ghana, Mali, Niger, Nigeria, Senegal)
- **Describe the system** WASA is a system, whose primary role is the adaptation of seeds to the climate condition imposed by climate change in West Africa.
- **Input data:** The seeds for the experiment : the experiment reflects the standard rainfall recorded at local or regional levels.
- **Output data:** Seeds for Rice (Khaoguen; DM16), Sorghum (CSM63E; Diakounbé), Millet (torogniou; Indiana), Cowpea (krobole), Peanut (fleur 11)
- **Spatial Resolution:** Burkina Faso, Ghana, Mali, Niger, Nigeria, Senegal
- **Frequency of outputs:** Annual

ID :DM NWA 03	INFORMATION PREDICTION SYSTEM AND EARLY WARNING OF IND FLOOD (SPIAC)	FACTSHEET No:53

Contact details

Main partners :IER, ORM, OPM, DRH, DRA, AGRHYMET
Name : DRH
Department: IER/ Recherche Agronomique, Mali
Address: kodio_amaga@yahoo.fr
Telephone: +223 21 43 00 28/+223 76 33 65 40 +223 69 56 44 77

Description

- **Type:** System
- **Purpose:** Flood Warning in the IND (Inner Niger Delta)
- **Type of drought:** Hydrology
- **Scope:** National
- **Describe the system**

The SPIAC provides information and indicators about the extent of an existing drought.

- **Input data:** Number of days of moving flood
  - The flood height
  - Duration of the flood
  - The magnitude of the flood
  - Speed of the wave of the flood

Information is obtained from the Regional Departments.

- **Output data:** Alert on the hydrological situation of one year

  Climate: Rainfall, Flood, Inundation

  Agriculture: Livestock, Fishing
- **Spatial Resolution:** Located between the coordinates 0°30' et 7°30 of longitude West and 13° à 17° of latitude North
- **Frequency of outputs:** monthly

ID: DM NWA 04	FLOOD PREDICTING TOOL FOR THE INNER NIGER DELTA (OPIDIN)	FACTSHEET No:54

Contact details

Hosting organization: Regional Directorate of Hydraulics
Main partners: DNH, DRH-Mopti, DRP-Mopti, DRPIA-Mali, ONGs, ORM,
Name :Wetlands International
Department: Wetlands international Africa/ bureau du Mali
Address: malipin@abribone.net.ml
Telephone: +223 21 42 01 22
Fax: +223 21 42 02 42

Description

- **Type:** System
- **Purpose:** Forecasting inundations and flood recession
- **Type of drought:**

Models typically the hydrological and socio-economic status (restoration Echinochloa stagnina fields, type of grass)

- **Scope:** At the level of the Inner Niger Delta
- **Describe the system**

OPIDIN is a tool that can give the prediction of the maximum flood that allows users to plan their activities.

- **Input data:**

The elevation for the prediction of the flood recession, the date and the level for the prediction of maximum flood.

- **Output data:**

Maximum height of water at a specific date.

- **Spatial Resolution:**

Located between the coordinates -5.3 and -4.2 of longitude West and 14.0 and 15.4 of latitude North. (coordinates are decimal degrees)

- **Frequency of outputs:**

Every 10 days and from August to September

ID: DM NWA 05	GEOGRAPHIC INFORMATION SYSTEM FOR WATER RESOURCES IN MALI (SIGMA)	FACTSHEET No:55

Contact details
url: [http://www.dnh-**mali**.org]
Main partners Cooperation Française, AFD, GTZ
Name: National Directorate of Hydraulics (DNH)
Department: DNH/CDI (documentation and information centre)
Address: contact@dnh-mali.org
Telephone: +223 20 21 25 88

Description

- **Type:** System
- **Purpose:** Monitoring

  It gives information about the location points of water (coordinated joint membership, feature, geological section, rates of population coverage, etc.).
- **Type of drought:**

  Hydrological and hydrogeological model
- **Scope:** National, regional and local
- **Describe the system**

  The SIGMA is a system that provides information on the existing drinking water infrastructures
- **Input data:**

  Existing water infrastructures (Wells, Drinking water supply, Forage, Pumping Equipment, etc.)
- **Output data:**

  The drinking water provision rate, mapping the location, population, etc

  Spatial Resolution:

  The entire Mali.
- **Frequency of outputs:** Quarterly

4 DETAILED DESCRIPTIONS OF DROUGHT MONITORING AND FORECASTING SYSTEMS/NETWORKS/ INSTITUTIONS – GLOBAL / USA / AUSTRALIA AND CONTINENTAL LEVELS

4.1 ID: DM G 01 FACTSHEET 01- GLOBAL DROUGHT MONITOR

4.1.1 General information

The Global Drought Monitor is created and maintained by the award-winning Meteorological Hazards and Seasonal Forecasting group at the Benfield UCL Hazard Research Centre.
It was set up in 2007 and is meant to give an overall picture of the drought severity at the global scale with a resolution of about 100 km. It is a free internet application, which monitors the severity of drought worldwide on an on-going basis. The purpose of this product is to aid humanitarian relief by assisting warnings of potential food, water and health problems but also to benefit the general public, government and industry by improving awareness of droughts and their impacts. The project is funded by UCL Futures (formerly the UCL Friend's Programme) for Humanitarian Relief.

4.1.2 Who uses the system/network/forum?

The system is managed by the department of Space and Climate Physics of the University College of London. Currently the contact persons are Dr. Benjamin Lloyd-Hughes and Professor Mark Saunders. Contact details are available through the website.
The products are available to the public through a free internet application and can be exported to KML files for projection on Google earth.

4.1.3 Description of how system/network/forum functions

The SPI (Standardized Precipitation Index), (McKee et al. 1993) is calculated using precipitation data. It is based on the probability of an observed precipitation deficit occurring over a given period of time.
The Palmer Drought Severity Index (Palmer, 1965) is calculated using precipitation and temperature data. Using both indices, all grid cells are then classified according to the five categories described in the table below; minor, moderate, severe, extreme and exceptional drought.

4.1.4 Assessment of spatial coverage

The output grids provided through the free internet application cover the world at a scale of 1 degree (roughly 100 km)

4.1.5 Description of the Inputs to system/network/forum

As described on the website of the Global Drought Monitor, the data used as input to the system are the following;
Precipitation; the monthly mean precipitation (1986 to date) is provided by the Global Precipitation Climatology Centre at Deutscher Wetterdienst.
Temperature; The monthly mean 2m air temperature is taken from the ECMWF operational forecast (2002 to date). Historic data (1958-2001) are from the ERA40 reanalysis. Both data sets are provided by the British Atmospheric Data Centre, from their website at http://www.badc.rl.ac.uk

Soil Water Holding Capacity; The soil water holding capacity is taken from the NASA/GISS analysis of Bouman et al (1986) which is supplied by the United Nations Environmental Programme as dataset GNV25.
Population; The gridded Population of the World version 2 is used. These data have been adjusted to match the UN national estimated population for each country in 1995. Available from: http://sedac.ciesin.columbia.edu/plue/gpw/index.html?main.html&2

4.1.6 Description of the methods/techniques/models and outputs

The drought severity output available through the website is being classified according to the table below. The classification is based on the following two Drought Monitoring Indices; the SPI (Standardized Precipitation Index and the PDI (Palmer drought Index).

Drought severity classification (* NMDC is the National Drought Mitigation Centre in USA)

Drought Severity	Return Period (years)	Description of Possible Impacts	Drought Monitoring Indices		
			Standardized Precipitation Index (SPI)	NDMC* Drought Category	Palmer Drought Index
Minor Drought	3 to 4	Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.7	D0	-1.0 to -1.9
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-0.8 to -1.2	D1	-2.0 to -2.9
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-1.3 to -1.5	D2	-3.0 to -3.9
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions.	-1.6 to -1.9	D3	-4.0 to -4.9
Exceptional Drought	44+	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies.	less than -2	D4	-5.0 or less

The output produced is updated on a monthly basis. Different drought assessment periods can be selected (1, 3,6,9,12,18, 24 or 36 months). Additionally the Palmer Drought Severity Index (PDSI) can also be selected and projected on the interactive map. The number of people affected by exceptional drought within a user-defined area can be displayed.

4.1.7 Information available from the system/network/forum

Users can access the information through the free internet application at http://drought.mssl.ucl.ac.uk.

4.1.8 Evaluation: Assessment of System/Network Capabilities

As stated on the website, the Global Drought Monitor provides the 'overall drought picture' on a ~100km spatial scale. The maps are not designed to depict local conditions or to replace drought warnings and watches issued by local or regional governments. Local or regional entities may be monitoring different indicators than those used in the Global Drought Monitor. Its main purpose should therefore be to create awareness of droughts and its impact among governments, international institutions and the public.

The product builds on the group's (Meteorological Hazards and Seasonal Forecasting group at the Benfield UCL Hazard Research Centre) expertise in drought assessment, drought prediction and on-line tracking and display of severe weather.

In the context of the Global Drought monitor, there are both advantages and disadvantages regarding the use of PDSI and SPI as drought indicators.
The advantages of the SPI are that it can be computed for different time scales and can provide early warning of drought and help assess drought severity. The SPI is less complex than the Palmer Drought Severity Index. The disadvantage is that the SPI is sensitive to the quantity and reliability of the data used to fit the distribution. McKee et al. (1993) recommend using at least 30 years of high-quality data. Applicability of the SPI depends on a suitable theoretical probability distribution being found to model the raw precipitation data prior to standardization.

The advantage of the PDSI is that its 'standardized' nature facilitates the quantitative comparison of drought incidence at different locations and at different times of the year. The PDSI is the first comprehensive drought index developed in the United States. Its disadvantage is that it may lag emerging droughts by several months. The empirical relationships used to define the PDSI were determined by observations taken from just nine US climate stations. The limited nature of the original PDSI source training data brings the general applicability of the PDSI into question (UCL, 2011).

4.2 ID: DM G 02: FACTSHEET 02: INTEGRATED PROJECT ON WATER AND GLOBAL CHANGE

4.2.1 General information

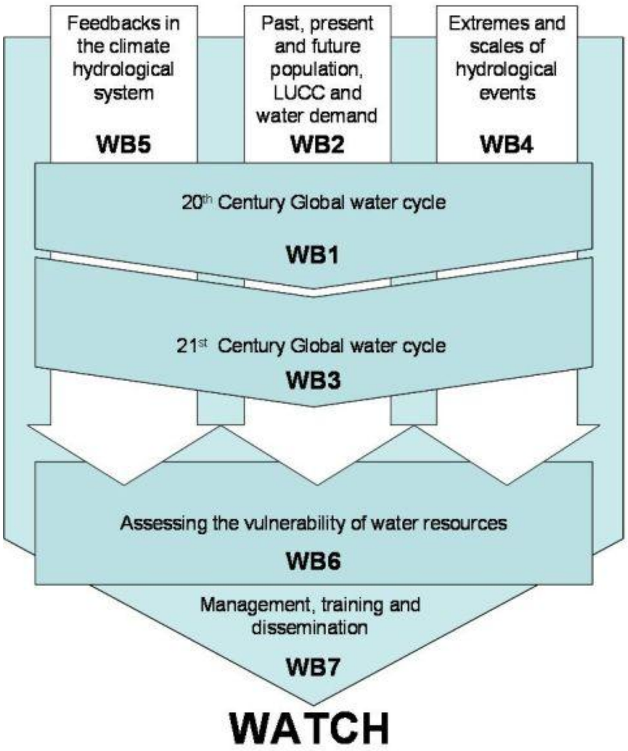
The Integrated Project Water and Global Change (WATCH) was initiated under EU FP6 Priority 6.3: Global Change and Ecosystems. The project takes place from 01-02-2007 until 31-07-2011. The project received 9.98 million euro funding and cost is estimated at 13.88 million euro.

The aim of the project is to

a. bring together hydrological, water resources and climate communities;
b. to analyse, quantify an predict the components of the current and future global water cycles and related water resources states;
c. evaluate their uncertainties and clarify the overall vulnerability of global water resources related to the main societal and economic sectors (read more about the work).

WATCH is relevant for policy makes because it provides a consistent and clear assessment of flows, floods and droughts for present and future scenarios.

The WATCH project is divided into seven work blocks (WB). WB1 to 6 concentrate on scientific research while management and training fall under WB7. The work blocks are interdependent as the outputs of past and future scenarios are cross-cutting across Feedbacks (WB5), Extremes (WB4) and population and land use (WB2).



Watch Work Block Scheme

- **WB1** consolidates gridded data sets, improves the hydrological representation of hydrology in hydrological models and investigates the 20th century global water cycle using a combination of models and data.
- **WB2** provides gridded estimates of population, land use and water requirements for the 20th and 21st centuries for use in the other Work Blocks.
- **WB3** produces multi-model based projections for the terrestrial components of the global water cycle for the 21st century. This includes projections globally and for two contrasting regions and an uncertainty analysis.
- **WB4** focuses on the impact of global change on hydrological extremes, including spatial and temporal patterns of **droughts** and large-scale floods.
- **WB5** provides a global and regional analysis of feedbacks between the land surface and climate system using a fusion of models and data.
- **WB6** develops a unified water resources modelling and risk assessment framework, and uses it to generate more reliable, consolidated, quantitative assessments of the past and future states of water resources.
- **WB7** accounts for management, training and dissemination activities under WATCH.

4.2.2 Who uses the system/network/forum?

WATCH is coordinated by the Centre for Ecology and Hydrology located in Wallingford, UK and the Wageningen UR, Earth System Science and Climate Change group in Wageningen, the Netherlands. Other participating institutes are:

Institute	abbr.	Country
KWR WATER BV		NETHERLANDS
NOREGS VASSDRAGS- OG ENERGIDIREKTORAT		NORWAY
VYZKUMNY USTAV VODOHOSPODARSKY T.G. MASARYKA		CZECH REPUBLIC
OBSERVATOIRE DE PARIS		FRANCE
CONSEJO SUPERIOR DE INVESTIGACIONES		SPAIN

CIENTIFICAS		
UNIVERZITA KOMENSKEHO V BRATISLAVE		SLOVAKIA
FUNDACAO DA FACULDADE DE CIENCIAS DA UNIVERSIDADE DE LISBOA		PORTUGAL
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE		FRANCE
INTERNATIONAL INSTITUTE FOR APPLIED SYSTEM ANALYSIS - IIASA		AUSTRIA
THE CHANCELLOR, MASTER AND SCHOLARS OF THE UNIVERSITY OF OXFORD		UNITED KINGDOM
UNIVERSITAT DE VALÈNCIA		SPAIN
UNIVERSITETET I OSLO		NORWAY
TECHNICAL UNIVERSITY OF CRETE		GREECE
ZAKLADU BADAN SRODOWISKA ROLNICZEGO I LESNEGO POLSKEIJ AKADEEMII NAUK		POLAND
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	MPI-M	GERMANY
MET OFFICE		UNITED KINGDOM
THE ABDUS SALAM INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS		ITALY
JOHANN WOLFGANG GOETHE UNIVERSITAET FRANKFURT AM MAIN		GERMANY
CENTRE NATIONAL DU MACHINISME AGRICOLE, DU GENIE RURAL, DES EAUX ET DES FORETS		FRANCE
DANMARKS METEOROLOGISKE INSTITUT.	DMI	DENMARK
VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS, WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG		NETHERLANDS
WAGENINGEN UNIVERSITEIT	WUR	NETHERLANDS
UNIVERSITAET KASSEL		GERMANY
POTSDAM INSTITUT FUER KLIMAFOLGENFORSCHUNG		GERMANY

The work packages are coordinated by the following persons and institutes:

WB1	Graham Weedon & Nicola Gedney	UK Meteorological Office
WB2	Gunther Fischer&David Wiberg	International Institute for Applied Systems Analysis
WB3	Stefan Hagemann	MPI-M
	Jens H. Christensen	DMI
WB4	Henny van Lanen	WUR
	Lena M. Tallaksen	University of Oslo
	Eleanor Blyth	Centre for Ecology and Hydrology (NERC)
	Ronald Hutjes	WUR
WB6	Pavel Kabat	WUR
	Joseph Alcamo	Kassel University

The following data users are listed for WATCH forcing Data:

June 2011	Steve Hancock	Durham University	Durham University is part of the NERC National Centre for Earth Observation and aims to investigate the behaviour of snow in the JULES model and test changes.
March 2011	Dr. Ad De Roo	Action Leader Floods: European Commission - Joint Research Centre	Testing the setup of their Global model in addition in a pan-African application. The main use of the data is flood forecasting and early warning purposes (as opposed to climate studies).
March 2011	Dr. Richard Valentini (CMCC Director of Division IAFENT) and Dr. Antonio Bombelli (Department of Forest Environment and Resources, University of Tuscia, Italy)		CLIMAFRICA, a new EU FP7 project, aims to generate decadal climate forecasts for Africa, to assess its impacts on ecosystem services, to develop an early warning system and to evaluate vulnerabilities and adaptation strategies.
December 2010	Dr Christian Beer and Markus Reichstein	Max Planck Institute for Biogeochemistry Biogeochemical Model-Data	CARBO-Extreme proposes to perform ecosystem model runs up to 2100 using regional climate model results from ENSEMBLES.
November 2010	Dr. Ton Manders Head	PBL Netherlands Environmental Assessment Agency	use WATCH forcing data for the Integrated Assessment Model IMAGE

4.2.3 Description of how system/network/forum functions

WB3 (Impact climate change on global water cycle), WB4 (Multi-Model Analysis of Extremes) and WB6 (Water Resources) all involve modelling which is done following a modelling protocol. A similar protocol is used for Water Model Intercomparison Project (WaterMIP).

Participants to the global model are:

Model name	**Participant - Modeling Group**
GWAVA	Centre for Ecology and Hydrology (NERC CEH)
H08	University of Tokyo / National Institute for Environmental Studies
HTESSEL	Centro de Geofisica da Universidade de Lisboa (FFCUL)
Jules	UK Meteorological Office (UKMO) / NERC CEH
LPJmL	Potsdam Institute for Climate Impact Research (PIK)
MacPDM	University of Reading
MATSIRO	University of Tokyo
Orchidee	Laboratoire de Météorologie Dynamique (LMD)
SL scheme/HD model (MPI-HM)	Max Planck Institute for Meteorology (MPI-M)
VIC	VIC community
WaterGAP	University of Kassel (CESR)

4.2.4 Description of the Inputs to system/network/forum

The WATCH model protocol is described as follows on the project website:

- **Atmospheric forcings**

WATCH Forcing Data (WFD), 1958-2001 (from WATCH WB1) can be found on the WFD ftp site at IIASA (password protected). The main variables are in 6-hourly or 3-hourly time steps, and at daily time step, in net-CDF format. These can be converted using FORTRAN codes so that models can be run with a diurnal cycle.

WATCH Forcing Data, 1900-1957: is available from the WFD IIASA ftp site. In addition to the 3-hourly/6-hourly net-CDF files described previously, daily average files are available.

Forcings from WATCH WB3, 1960-2100 are available from the WATCH ftp site. Daily time steps are available. For precipitation and temperature, the bias corrected fields should be used. The WATCH daily disaggregation code, which allows creation of realistic sub-daily data from the daily averages of the forcing variables from the 1960-2100 GCM runs, is available from the WFD ftp site at IIASA from the WFD code directory.

- **Spatial resolution and land mask**

The spatial resolution for the global modelling is 0.5 degrees latitude by longitude, and the land areas of the globe (excluding Antarctica) are covered. The grid cell midpoints are located at .25 and .75 latitude/longitude. A standardized land mask (CRU) is used by all models, available from the WFD ftp site at IIASA.

- **Elevation, land use/cover, soil information**

Each model will use their "own" elevation, land use/cover and soil information. Land use/cover information, especially LAI data, should be reported when submitting the data. It is recommended to use CRU elevation information as well as the Harmonized World Soil Database, a 30 arc-second raster database.

- **Routing network**

The provided DDM30 routing network, which is mapped to the CRU land mask, should be used by all modelling groups. The network includes flow direction, slope, and basin numbers, and is available on the WATCH ftp site. The routing network includes large lakes not included in the provided land mask, but only for stream flow purposes.

- **Human impacts**

The models that can take human impacts like dams and water uses into account should perform simulations both with and without human impacts. Time periods and requested variables are different for the human impact runs than those requested for the naturalized runs. For the human impact rounds, the modellers include all water uses appropriate for their model. For those interested, the global land and wetlands database (GLWD1), which also includes information on reservoirs, can be found on the WATCH ftp site.

- **Simulation and reporting periods**

All simulations include a spin-up period of at least 5 years.
The following simulations are done under WATCH:
Using WFD:

- Simulation period 1958-2001
  - Reporting period, daily fields (WATCH WB4 Multi-Model Analyses of Extremes): 1963-2001, naturalized runs
  - Reporting period, monthly fields (WaterMIP): 1971-2000 (naturalized and human impact runs)
- Simulation period 1900-1957
  - Reporting period, daily fields (WATCH WB4 Multi-Model Analyses of Extremes: 1905-1957, naturalized runs
  - No simulation results requested for WaterMIP

Using forcings from WATCH WB3:

- Naturalized runs, simulation period 1960-2100
  - Reporting period, daily fields (WATCH WB4 Multi-Model Analyses of Extremes): 1965-2100
  - Reporting period, monthly fields (WaterMIP): 1971-2100
- Human impact runs (WaterMIP, monthly fields): Reporting periods 1971-2000 and 2071-2100.

4.2.5 Evaluation: Assessment of System/Network Capabilities

Considerable expertise has been developed during the WATCH project by the participants who together form a network. Expertise exists in data exchange in net-CDF format and calculating and comparing results.
Under WATCH, the following Technical Reports (TR) were produced:

- TR 11: Indices for different types of droughts and floods at different scales
- TR 24: Indicators For Drought Characterization on a Global Scale
- TR 25: Comparison of three drought monitoring tools in the USA
- TR 26: Simulation of low flows and drought events. In WATCH test basins Impact of different climate forcing datasets

Several meetings were held on global modelling, and participants of WATCH have disseminated their products at many occasions (WATCH summer School, GEWEX Symposium on Evaporation and Climate).

The WATCH forcing data is being used by several research groups, some of which are focussing on Africa.

The resolution at which WATCH operates (0.5 x 0.5 degrees) however does seem to be very coarse and can easily be improved with now that computer become faster and computing times are reduced.

4.3 ID: DM G 03 - FACTSHEET Nº 03- NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM (NIDIS)

4.3.1 General information

In 2004, through the reporting "Creating a Drought Early Warning System for the 21st Century: The National Integrated Drought Information System", the Westerns Governors' Association made clear the need for a coordinated, integrated drought monitoring, forecasting, and early warning information system, NIDIS. This system, established by federal law in 2006, is envisage as a dynamic and accessible drought risk information system that provides users with the capacity to determine the potential impacts of drought, and the decision support tools needed to better prepare for and mitigate the effects of drought. Thus, the NIDIS Implementation team has conducted workshops and meetings with federal, state and local agencies, academic researchers, and other stakeholders. A national conference was sponsored by the Geological Society of America (GSA) and twenty other scientific and technical organizations in Longmont, CO, in September 2006. The conference organizers presented their recommendations to the U.S. Congress in July 2007, along with a factsheet and report ("The National Integrated Drought Information System Implementation Plan"). The NIDIS implementation plan has five key elements:

- Develop the leadership and networks to implement an integrated drought monitoring and forecasting system at federal, state, and local levels
- Foster and support a research environment focusing on risk assessment, forecasting, and management
- Create an "early warning system" for drought to provide accurate, timely, and integrated information
- Develop interactive systems, such as the Web Portal, as part of the early warning system
- Provide a framework for public awareness and education about droughts

A NIDIS Program Office has been established in Boulder, Colorado, and the NIDIS web portal, U. S Drought Portal, has been launched in late 2007 (http://www.drought.gov). As a step towards developing a drought early warning system, NIDIS implementation team members conducted several conferences and workshops in 2008. These permited to perceive: the status of Drought Early Warning Systems across the United States; information needs in the drought-stricken Southeast; reconciliation of wide-ranging Colorado River flow projections for the 21st century; and contributions of remote sensing to drought monitoring. In October 2008, the first NIDIS drought early warning and information system pilot in the Upper Colorado River Basin was successfully launched. This information is more detail in the first edition of the NIDIS Newsletter, published in the fall of 2009. The second edition of the NIDIS Newsletter (published in the winter of 2011) gives up-dated information of the drought early warning systems on course in the Apalachicola-Chattahoochee-Flint River Basin and the Upper Colorado River Basin, as well as drought early warning Pilot activities in California and tribal lands in the western U.S.

4.3.2 Who uses the system/network/forum?

NIDIS draws on the personnel, experience, and networks of the National drought Mitigation Center (NDMC), the National Oceanic and Atmospheric Administration (NOAA) Regional Climate Centers (RCCs), and the regional Integrated Sciences and Assessments (RISAs), Western Governors' Association, Western States Water Council, National Conference of State Legislatures, National League of Cities, American Association of State Climatologists, Regional Climate Centers and Native American Tribal Governments.

The federal agencies and departments listed below have been identified as critical components of a NIDIS partnership:

- U.S. Army Corps of Engineers
- U.S. Department of Agriculture (USDA)
  - Agricultural Research Service
  - Cooperative State Research, Education
  - Farm Service Agency
  - Forest Service
  - National Agricultural Statistics Service
  - Natural Resources Conservation Service
  - Risk Management Agency
- U.S. Department of Commerce (DoC)
  - International Trade Administration
  - National Oceanic and Atmospheric Administration
- U.S. Department of Energy (DoE)
  - Office of Electricity Delivery and Energy Reliability
  - Office of Energy Efficiency & Renewable Energy
  - Office of Science
- U.S. Department of Homeland Security (DHS)
  - Federal Emergency Management (FEMA) Directorate
- U.S. Department of the Interior (DoI)
  - Bureau of Indian Affairs
  - Bureau of Land Management
  - Bureau of Reclamation
  - National Park Service
  - U.S. Fish and Wildlife Service
  - U.S. Geological Survey
- U.S. Department of Transportation (DoT)
  - Federal Aviation Administration

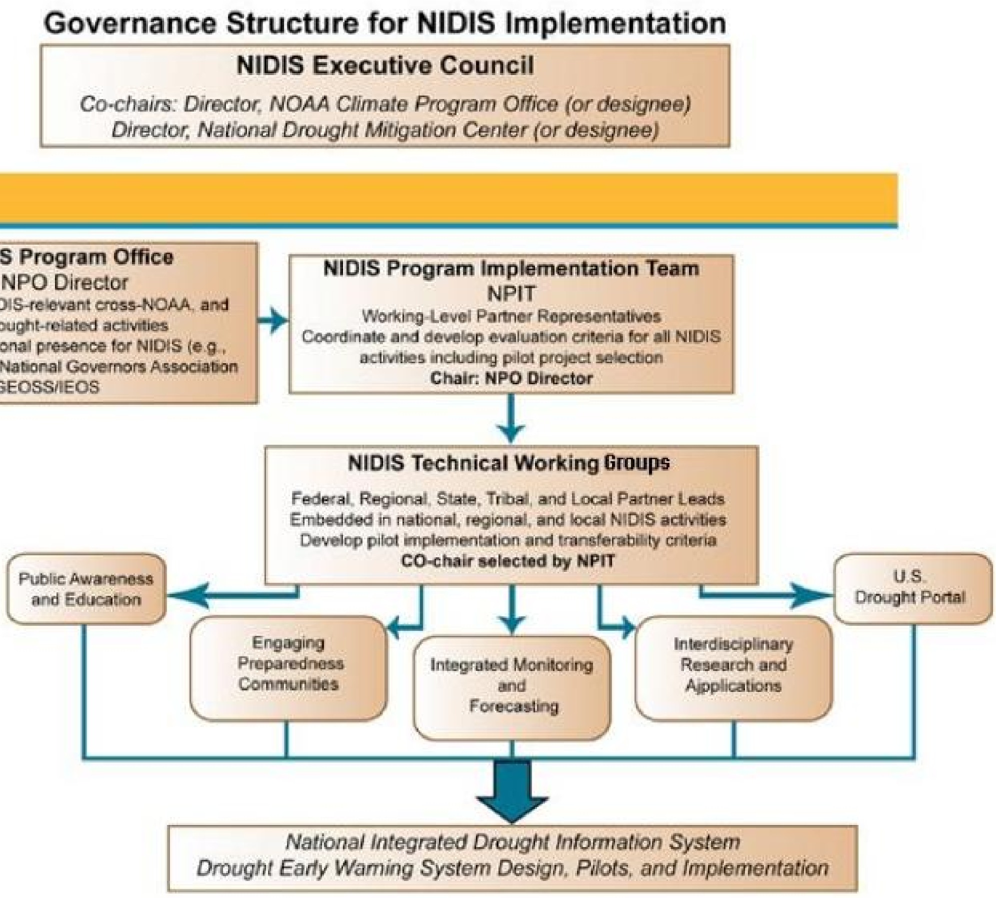
- Federal Highway Administration
- Surface Transportation Board

- Environmental Protection Agency (EPA)
- Farm Credit Administration (FCA)
- Federal Energy Regulatory Commission (FERC)
- Internal Revenue Service (IRS)
- International Trade Commission (USITC)
- National Aeronautics and Space Administration (NASA)
- National Science Foundation (NSF)
- Small Business Administration (SBA)

4.3.3 Description of how system/network/forum functions

The system is used with the goal to improve the nation's capacity to proactively manage drought-related risks, by providing those affected, with the best available information and tools to assess the potential impacts of drought and to better prepare for and mitigate the effects of drought. Thus, NIDIS is being developed to consolidate data on drought's physical, hydrological and socio-economic impacts on an on-going basis, to develop drought decision support and simulation tools for critical, drought-sensitive areas, and to enable proactive planning by those affected by drought.

NIDIS is governed under three interacting components (i) the NIDIS Executive Council, (ii) the NIDIS Program Office, and (iii) the NIDIS Program Implementation Team. The NIDIS's organization respects the following scheme:



4.3.4 Assessment of spatial coverage

NIDIS's spatial coverage is the region of USA and different counties, Canada and Mexico (in the North American Drought Monitor).

4.3.5 Description of the Inputs to system/network/forum

Consolidation and aggregation of physical/hydrological data and socio-economic impacts, from various monitoring networks. For example, this system incorporates data from the SNOTEL (SNOw TELemetry) network of the U.S. Department of Agriculture's Natural Resources Conservation Service, reservoir and streamflow levels from the U.S. Department of the Interior and the U.S. Army Corps of Engineers, and river forecasts from the National Weather Service. The system inputs are also obtained through contributions of people affected by drought.

4.3.6 Description of the methods/techniques/models and outputs

Information is provided in an interactive way through an Internet portal (U.S. Drought Portal) which gives access to the systems: U.S. Drought Monitor, North American Drought Monitor, Seasonal Drought Outlook, Drought Impact Reporter. These systems are discussed in more detail below. Some information is also presented in reports.
The frequency of outputs is every week, month, etc.

4.4 ID: DM G 04 - FACTSHEET Nº 04 - NATIONAL MITIGATION CENTER (NDMC)

4.4.1 General information

The National Drought Mitigation Center (NDMC), established in 1995, is based in the School of Natural Resources at the University of Nebraska–Lincoln. The NDMC helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management. Most of the NDMC's services are directed to state, federal, regional, and tribal governments that are involved in drought and water supply planning. The NDMC's activities include maintaining an information clearinghouse; drought monitoring, including participation in the preparation of the U.S. Drought Monitor and maintenance of the U.S. Drought Monitor website; drought planning and mitigation; drought policy; advising policy makers; collaborative research; K–12 outreach; workshops for federal, state, and foreign governments and international organizations; organizing and conducting seminars, workshops, and conferences; and providing data to and answering questions from the media and the general public. The NDMC is also participating in numerous international projects, including the establishment of regional drought preparedness networks in collaboration with the United Nations' Secretariat for the International Strategy for Disaster Reduction.

4.4.2 Who uses the system/network/forum?

The institutional partnerships are: University of Nebraska-Lincoln, School of Natural Resources; National Integrated Drought Information System (NIDIS); Government Partnerships, federal and state; and International Agencies and Governments. The NDMC helps people and institutions to develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management. This institution are directed to state, federal, regional and tribal governments that are involved in drought and water supply planning.

4.4.3 Information available from the system/network/forum

- Drought Impact Reporter
- Drought Monitor DSS
- Drought Planning Tools for Ranchers
- Drought Risk Atlas
- Economic Impacts of Drought
- Enhancing the Advanced Hydrologic Prediction Service
- GRACE Water Storage Data
- GreenLeaf
- Incorporating NASA Satellite Data into the Drought Monitor
- Mitigating the Economic Risk of Stock Reduction During Drought
- Real-Time Ground Water Monitoring Network for Nebraska
- Republican River Basin
- Seasonal Predictive Capabilities for Drought Mitigation Decision Support System
- Soil Moisture Research Project
- VegDRI/VegOut

4.5 ID: DM G 05 - FACTSHEET Nº 05- U.S. DROUGHT MONITOR

4.5.1 General information

The U.S. Drought Monitor is unique, blending numeric measures of drought and experts' best judgment into a single map every week, for different U.S.A regions, locations where: (i) we are witnessing the trigger of a drought, (ii) the drought persists and its under development, or (iii) it is anticipated that a drought will take place. It started in 1999 as a federal, state, and academic partnership, growing out of a Western Governors' Association initiative to provide timely and understandable scientific information on water supply and drought for policymakers. The U.S. Drought Monitor blends science and art. There is no one 'correct' way to measure drought. Drought indices are used to detect and measure droughts, but different indices measure drought in different ways, and no single index works under all circumstances. So the Drought Monitor concept was developed as a process that synthesizes multiple indices, outlooks and local impacts, into an assessment that best represents current drought conditions. The final outcome of each Drought Monitor is a consensus of federal, state and academic scientists.

4.5.2 Who uses the system/network/forum?

Main federal partners:

- Joint Agricultural Weather Facility (U.S. Department of Agriculture and Department of Commerce/National Oceanic and Atmospheric Administration)
- Climate Prediction Center (U.S. Department of Commerce/NOAA/National Weather Service)
- National Climatic Data Center (DOC/NOAA)

Academic partner:

- National Drought Mitigation Center (University of Nebraska-Lincoln)

Other participants:

- U.S. Geological Survey (U.S. Department of Interior)
- National Water and Climate Center (USDA/Natural Resource Conservation Service)
- Climate Diagnostics Center (DOC/NOAA)
- Regional Climate Centers
- National Weather Service Hydrology (DOC/NOAA)
- State Climatologists
- additional local, state and federal experts

Key audiences:
- National Weather Service
- Farm Service Agency, U.S. Department of Agriculture
- state water agencies and other resource management institutions and organizations
- The Weather Channel and other specialized media
- general media and the general public

4.5.3 Description of how system/network/forum functions

This system enabled the development of a map that integrates information from various indexes, trying to be easy to read and understand, with a color code indicating the severity of the drought. It incorporates a system of classification and typology of the intensity of drought similar to that used for other meteorological phenomena such as hurricanes. For this reason, combines basic climatic information with the evaluation of specialists and water managers at local and regional level, to produce a weekly severity drought classification. The map mentioned indicate the places most affected, regarding to agriculture namely vegetation, pastures and meadows (identified with the letter A) and also for the hydrological component (identified with the letter H).

The spatial resolution of this evaluation map includes 344 divisions across the country, being, however, complemented with a more local level, through new tools for satellite, higher resolution, enabling a more accurate and localized state of the vegetation around the country.

The categories of drought severity presented in the map are defined from five index: Palmer Drought Severity Index (PDSI), Standardized Precipitation Index (SPI), CPC Soil Moisture Model, USGS Weekly Streamflow, Short and long term Drought Indicator Blends.

4.5.4 Assessment of spatial coverage

The spatial coverage is USA region.

4.5.5 Description of the Inputs to system/network/forum

Physical/hydrological data, observers' reports of how drought is affecting crops, wildlife and other indicators.

4.5.6 Description of the methods/techniques/models and outputs

The output of the U.S. Drought Monitor is a map, with a color code, that shows the severity of the drought every week (it is released each Thursday morning).

The final outcome of each Drought Monitor is a consensus of federal, state and academic scientists.

4.6 ID: DM G 06 - FACTSHEET Nº 06- NORTH AMERICAN DROUGHT MONITOR

4.6.1 General information

The North America Drought Monitor (NADM) is a cooperative effort between drought experts in Canada, Mexico and the United States to monitor drought across the continent on an ongoing basis. The program was initiated at a three-day workshop in April 2002 and is part of a larger effort to improve the monitoring of climate extremes on the continent. The NADM is based on the highly successful U.S. Drought Monitor (USDM), and as such, is being developed to provide an ongoing comprehensive and integrated assessment of drought throughout all three countries.

Although all three countries have active climate and drought monitoring programs, until recently there has been only limited cooperation and coordination between the countries' drought experts. Past drought assessments typically have stopped at each country's borders as differences in resources and policy objectives as well as differing methods for monitoring drought in each country effectively prevented an integrated view of drought conditions across the continent. The NADM program is being designed to overcome these past limitations with the objective of providing monthly operational assessments of drought severity across the continent since March 2003 (the first NADM map was released in March 2003). The United States started off as the only country to author and organize the map, while Canada began authoring in January 2006, and Mexico only in October 2008.

4.6.2 Who uses the system/network/forum?

The major participants in the NADM include, in United States: National Drought Mitigation Center, National Climatic Data Center, Climate Prediction Center and United States Department of Agriculture. In Mexico are: National Meteorological Service of Mexico (SMN-Servicio Meteorologico Nacional) and CONAGUA (Comision Nacional del Agua). In the case of Canada are: Agriculture and Agrifood Canada, Environment Canada and Meteorological Service of Canada.
NADM lead authorship rotates amongst the participants. The lead author integrates national drought assessments from each country, prepares continental monthly map and narrative.

4.6.3 Description of how system/network/forum functions

The NADM is a consolidation of indices and indicators into one comprehensive national drought map, thus its system capture: drought’s magnitude (duration and intensity), spatial extent and impacts. This system permit identify impacts (A, H), assessment of current conditions, etc. It is important to note that he basis of this operating system is identical to the U.S. Drought Monitor mentioned above.

4.6.4 Assessment of spatial coverage

The system covers the USA, Canada and Mexico.

4.6.5 Description of the Inputs to system/network/forum

The input of the system is similar to the U. S. Drought Monitor. It should be noted that this system (such as U.S Drought Monitor) includes several types of data and information flow, so it is recommended the familiarization with a variety of indicators.

4.6.6 Description of the methods/techniques/models and outputs

The system's output is a monthly drought monitoring map for the entire continent that has been produced in cooperation with Canada and Mexico.

4.7 ID: DM G 07 - FACT SHEET Nº 07 - U.S. DROUGHT IMPACT REPORTER

4.7.1 General information

The National Drought Mitigation Center developed the Drought Impact Reporter (on-line since July 2005) in response to the need for a national drought impact database for the United States. Drought impacts are inherently hard to quantify, therefore there has not been a comprehensive and consistent methodology for quantifying drought impacts and economic losses in the United States. The Drought Impact Reporter is intended to be the initial step in creating a comprehensive database. The principal goal of the Drought Impact Reporter is to collect, quantify, and map reported drought impacts for the United States and provide access to the reports through interactive search tools.

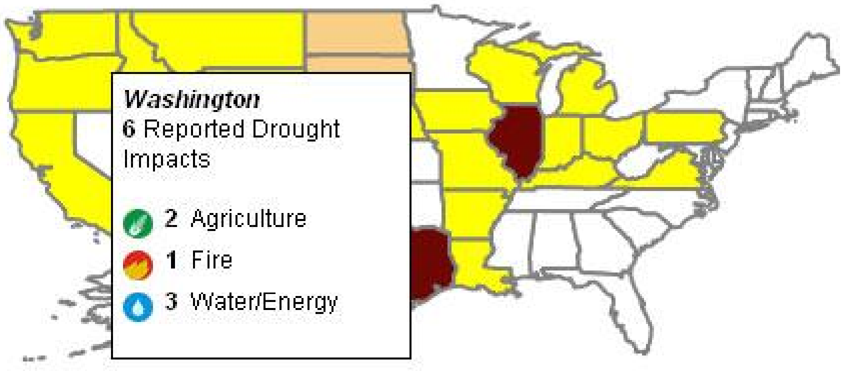
Improved information on drought impacts will help policy and decision makers identify what types of impacts are occurring and where. In addition, the Drought Impact Reporter will aid them in understanding the magnitude of the impacts by providing access to reported drought impacts. More precise estimates of drought impacts will aid the government in instituting programs before drought occurs, as opposed to incurring high expenditures on post-drought relief.

4.7.2 Who uses the system/network/forum?

The National Drought Mitigation Center is managing the system. The users of the system are the public, decision makers/resource managers, media, etc.

4.7.3 Description of how system/network/forum functions

In the Drought Impact Reporter website exists a menu toolbar with the following items: *View Drought Impacts, Add a Drought Impact, Time-Lapse Animation, About, Help and User Login*. The *View Drought Impacts* is linked to the Drought Impact Reporter Map Interface, which display is a map that represents the number of reported drought impacts over a specified period of time. The default view displays the reported impacts from all sources and all impact categories for the last month at the national level. At the national level, states are shaded in colors based on the number of reported impacts in each state. When the user "mouses" over a particular state, a small pop-up box will appear listing the number of drought impacts by impact category for that state.



Each drought impact report is classified into one (or more) of six impact categories: Agriculture; Water/Energy; Environment; Fire; Social; and, Others. The map default displays the reported impacts from all categories.

Actually is being developed a new version of Drought Impact Reporter, with enhancements: more user-friendly design (more efficient use of screen space, improved searching and mapping), change in category names, distinguishes between reports and impacts (society & public health, agriculture, disasters declarations & aid, energy water supply & quality, wildfire, plants & wildlife, Other business & Industry, Tourism & Recreation, General Awareness).

4.8 ID: DM G 08- FACT SHEET Nº 08 – U. S. SEASONAL DROUGHT OUTLOOK

4.8.1 General information

The Outlook predicts whether drought will emerge, stay the same or get better in the next three months. This prediction of 3 months is released twice a month, along with forecasts of seasonal climate changes. Taking as a starting point areas classified in U.S. Drought Monitor as being under drought conditions, evaluate potential improvements or worsening trends based on seasonal weather conditions, when the influence of fluctuations as the ENSO cycle are more pronounced, and / or medium-term projections of the evolution of PDSI in other cases. It should be noted that recently was developed an interactive version of the U. S. Drought Outlook.

4.8.2 Who uses the system/network/forum?

The system is managed by NOOA (National Weather Service - Climate Prediction Center).

4.8.3 Description of how system/network/forum functions

As mentioned above, the Seasonal Drought Outlook predicts whether drought will emerge, stay the same or get better in the next three months. This prediction of 3 months is released twice a month, along with forecasts of seasonal climate changes. Taking as a starting point areas classified in U.S. Drought Monitor as being under drought conditions, evaluate potential improvements or worsening trends based on seasonal weather conditions, when the influence of fluctuations as the ENSO cycle are more pronounced, and / or medium-term projections of the evolution of PDSI in other cases . It should be noted that recently was developed an interactive version of the U. S. Drought Outlook. This interactive version has a toolbar that permit selects a drought monitor date, an area (upper Colorado River Basin, lower Colorado River Basin) and a basin (Alaska, Hawaii, etc.) (and also it is possible to zoom in and zoom out).

4.8.4 Assessment of spatial coverage

The spatial coverage is USA region.

4.8.5 Description of the Inputs to system/network/forum

Information and data are based on the U. S. Drought Monitor (namely, information of precipitation, indicators, temperature, evaporation, soil moisture) and climatic trends.

4.8.6 Description of the methods/techniques/models and outputs

A map that represents the development drought conditions for the later three months (since it is issued, what happen twice a month).

4.9 ID: DM G 09- FACT SHEET 09- CSIRO - COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

4.9.1 General information

Australia has committed to ambitious and world-leading water reforms, led through the National Water Initiative. CSIRO is strategically positioned to provide research, information and technology to underpin these reforms.

CSIRO's water research is carried out in the Water for a Healthy Country Flagship with water-related projects also being done in the Sustainable Agriculture Flagship, Climate Adaptation Flagship, Minerals Down Under Flagship and the Petroleum and Geothermal Portfolio.

The capability for water research in CSIRO is provided by the divisions of Land and Water; Ecosystem Sciences; ICT Centre; Mathematics, Informatics and Statistics; Marine and Atmospheric Research; and Materials Science and Engineering.

CSIRO's researchers are providing the scientific basis for water managers and governments to develop policy and make informed decisions to ensure that Australia’s valuable water resources are sustainably managed.

Through collaborative partnerships with governments, industries and research organisations, CSIRO continues to deliver research outcomes best matched to the needs of clients and stakeholders.

Science – impartial, peer-reviewed, rigorous and based on the latest research – has a critical role to play to help inform and support society.

For the past 80 years, CSIRO's science has been actively providing decision-makers with the best available science to help make better, more informed decisions for now and into the future.

4.9.2 Who uses the system/network/forum?

CSIRO's customers include partners from:

- Commonwealth, State and Territory governments and their agencies
- Australian and global business, industries and research organisations
- The Australian and International community.

4.9.3 Description of how system/network/forum functions

CSIRO is an Australian Government statutory authority constituted and operating under the provisions of the Science and Industry Research Act 1949. CSIRO's primary functions under the Act are to carry out scientific research to benefit Australian industry and the community, and to contribute to the achievement of national objectives.

CSIRO is accountable to the Minister for Innovation, Industry, Science and Research and is part of the Innovation, Industry, Science and Research portfolio.

The CSIRO Board is responsible to the Australian Government for the overall governance, strategy and performance of the Organisation.

4.9.4 Information available from the system/network/forum

CSIRO is actively researching in the area of water:

- Water for cities and towns
    - Integrated water systems analysis
    - Recycling and diversified supply
    - Distributed systems
    - Advanced water treatment
    - Sustainable asset management
    - Intelligent networks
    - Urban water environments
    - Sustainable cities and coasts
- Rural and regional water
    - Investigating water security risks associated with climate and land use change
    - Research to understand Australia's groundwater system
    - Sustainable management of northern Australia's water resources
    - Irrigation, economics and environment: improving water management
    - Modeling river systems across Australia
    - Decision support for natural resource policy and investment appraisal
    - Researching water use efficiency for increased grain yield
- Water for the minerals and energy sector
    - Driving sustainability through systems innovation
    - Geothermal energy
    - Technologies for reducing fresh water usage
- Water for the environment
    - Environmental water
    - Catchment and aquatic health
    - Environmental contaminants
    - Advancing agricultural productivity and environmental health
- Water information systems
    - Integrating information systems to monitor Australia's water

- o Water resources assessment and water use accounting
- o Short-term water forecasting and prediction
- o Seasonal and long-term water forecasting and prediction
- o Measuring the water footprint of crops from 'paddock to plate'

4.10 ID: DM GE 03: NETWORK ON DROUGHT MANAGEMENT FOR THE NEAR EAST AND CENTRAL ASIA (NEMEDCA)

4.10.1 General information

NEMEDCA was created in 2002 by agreement between CIHEAM, ICARDA, and FAO-RNE. Its Secretariat is based in ICARDA (Aleppo, Syria). It covers counties in the Mediterranean area, parts of Asia and Africa. The overall objective of the network is to enhance technical cooperation among concerned national, regional and international organizations in the region. Specific objectives include:

- Promoting risk, vulnerability and impact assessment of drought effects;
- Contributing to the creation, development and coordination of drought preparedness and mitigation plans;
- Facilitating the development of national, sub-regional and regional project proposals to address drought priority areas;
- Streamlining exchange of information on monitoring tools and data on early warning among members.

The Network is based on establishing inter-country cooperation within the ongoing national programs. The collaborative research is a part of the national programs which are budgeted for each member institute and prepared to defray from its own budget, whatever expenses (for staff, equipment, etc.) could be needed to make its scientific contribution to joint projects, as well as for the purpose of the agreed cooperation in the field of documentation. The inter-country technical meetings and training courses, which a country agrees to host, require national funds to meet the cost in local currency.

4.10.2 Who uses the system/network/forum?

NEMEDCA Network consists of the following:

- A Network Coordinator will have the support of his Institution to carry out his task
- A Steering Committee (SC) composed of: The Network Coordinator, Representatives of each of the 6 regions, Representatives of each of ICARDA, FAO and CIHEAM
- The Members of the Network.

The following can be members of the network:

- Institutions, and individuals within these institutions, including public sector, NGOs and private sector in the Region's countries,
- Regional and international organizations involved in similar activities and operating in the region,
- Other relevant organizations or bodies, decided by the network

ICARDA, FAO and CIHEAM

- Support and sponsor the plan for the establishment of the Network in collaboration with the participants;
- Have a catalytic role in this Network to promote exchange of information

within available budgetary resources, they provide technical assistance and advice to Network participants;
- Support, technically and financially, meetings that may take place in any country of the Geographic Regions;
- Within available budgetary resources that may consider covering part of the cost of technical meetings, workshops and consultations;
- Contribute to the maintenance of the NEMEDCA Web site.

The countries which are served by the Network are:
- Algeria, Libya, Mauritania, Morocco, and Tunisia (North Africa);
- Djibouti, Egypt, Eritrea, Ethiopia, Somalia, and Sudan (the Nile Valley and the Red Sea);
- Iraq, Jordan, Lebanon, Palestine, Syria, and Turkey (West Asia);
- Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United ArabEmirates (Arabian Peninsula);
- Iran Islamic Republic, Kazakhstan, Pakistan, Tajikistan Turkmenistan, and Uzbekistan (Central Asia);
- Europe: (especially Mediterranean European countries);
- Additional countries may be considered for membership upon request.

4.10.3 Description of how system/network/forum functions

In 2007, this network was adapted to the new scenario drawn up by the project **MEDROPLAN** (Mediterranean drought preparedness and mitigation planning), financed by the European Union's MEDA-Water program. MEDROPLAN ran from 2003 to 2008 and involved ten partners from six Mediterranean countries. Its main outcome was the publication of the **"Drought Management Guidelines"**, which provide a methodology for the preparation of proactive drought management plans that could be adapted to different geographical and socio-economic contexts. When the MEDROPLAN project ended in June 2008, the NEMEDCA network took over the task of ensuring ongoing cooperation on drought and enabling members of the MEDROPLAN consortium, together with scientists, stakeholders and officials in other Mediterranean countries

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4.10.4 Assessment of spatial coverage

NEMEDCA has a regional coverage

4.10.5 Assessment of drought monitoring and forecasting systems capabilities

The previous points provide a description of the main national (Morocco, Algeria and Tunisia) institutions which monitor droughts in each country and the Observatory of Sahara and Sahel which implemented through the SMAS project a Drought Early Warning System for the Maghreb Region. This DEWS is the only existing regional system in terms of drought monitoring. Thus, in the Maghreb countries, the overall drought monitoring schema is very similar since the different types of droughts are monitored by institutions with similar missions:

- National Meteorological services: DMN (Morocco), ONM (Algeria) and INM (Tunisia) are in charge of meteorological drought monitoring and weather forecasting. They produce also seasonal drought forecasts.
- Water resources management departments: DGH/ABH (Morocco), ANRH/ABH (Algeria), MARHF (Tunisia) are in charge of hydrological drought and contribute to meteorological drought monitoring thanks to their own climatic stations network.

- Remote Sensing institutions: CRTS (Morocco), ASAL (Algeria) and CNCT (Tunisia) collect, produce and analyze data from Earth observation satellites and other sources in order to monitor meteorological, hydrological and agricultural droughts.
- Agricultural departments: MAPM, HCEFLCD (Morocco),MADR (Algeria) and MARHF (Tunisia) are in charge of agricultural drought and contribute to socio-economic drought monitoring.

Meteorological services of the region have a major role. In the Maghreb region, they seem well equipped and well sited, representative for major agro ecologic and agricultural production areas. Nevertheless, we noticed during the preparation of this report that the information is not used to monitor drought, but rather to characterize the climate during the ongoing year, month, part of the year, or agricultural year. They still define generally drought as a negative anomaly from normal precipitation, in terms of absolute or percentile deviations and the utilization of the well-established drought indicators such as the Palmer Drought Severity Index (PDSI), the Standardized Precipitation Index (SPI), or deciles is not yet generalized. There are no regular bulletins that target the agricultural user community or other stakeholders in drought mitigation through interpretation of the available raw data and communication in terms of impact and seasonal outlook. The national hydrological and agricultural services monitor water resources in terms of quantities and quality, the agricultural season circumstances but do not systematically translate these data in terms of reliable drought indicators.

We also would like to draw the attention on the fact that, in each country:

- Drought monitoring do not figure among the major missions of all these institutions, departments and services.
- The coordination and sharing of data and information between these services is limited and occurs generally in the frame of punctual common projects.

Morocco have moved to a further step by creating the national drought observatory which is a permanent coordinating body with a legal status and mandate, and with a small multidisciplinary core staff, drawn from different ministries. Drawing inspiration from the international monitoring system, which successfully integrates multiscale, multi-institutional and multidisciplinary data sources, this coordinating unit is at the apex of a “virtual” structure composed of technical experts from different government administrations, dealing with different aspects of drought management through technical committees and working groups.

On the Maghreb level, the SMAS project is the only integrated system which draws different types of indicators (meteorological, hydrological, agronomic and forest, social-economic) as well as extrapolation tools (GIS and remote sensing) to assess drought. During its 3 years duration, it encouraged and promoted the collaboration of national partners as well as cooperation between partners of the 3 different countries.

Future Needs

On the national and regional levels, the National Drought Observatory in Morocco and the Maghrebian Drought Early warning system implemented by the SMAS project represent currently the only examples of integrated drought monitoring systems. The inter-institutional partnerships that are required to produce regularly specialized drought information bulletins are much hampered by the common practice of meteorological services of the region to charge for meteorological data, even to other government departments. With exceptions, the charges are often prohibitive and make no economic sense. As a result, the meteorological

data bases, which are indispensable for basic analyses, such as drought risk assessment, cannot be accessed by the agricultural user and research community, which has the highest data requirements but the lowest financial resources of all potential users of meteorological data. In return, agricultural research institutes are not sharing their growing in-house expertise in agricultural applications with meteorological services. Thus, the exorbitant charging by meteorological services for data is one of the major handicaps to be overcome in order to set up effective early warning systems.
It is then essential for a better assessment of drought in the region to strengthen the inter-institutional cooperation and partner-ship at both national and regional levels in order to implement a large and efficient regional data base. This implies a full collaboration between Meteorological, Hydrological, Environmental, Agricultural, and Remote-sensing Services.

4.11 ID:DMGE 04: FAO GLOBAL INFORMATION AND EARLY WARNING SYSTEM (GIEWS)

4.11.1 General information

The Global Information and Early Warning System (GIEWS) on Food and Agriculture was established in 1975 in the response to the request of the 1973 Food and Agriculture Organisation (FAO) Conference and the 1974 World Food Conference in the wake of the world food crisis of the early 1970's.
The system goal is to provide policy makers and policy-analysts with the most up-to-date and accurate information available on all aspects of food supply and demand. The GIEWS warns of any imminent food crises and shortages, droughts and hunger at individual country or sub-regional level. Thus, the system provided timely warnings of famine in the horn of Africa in the early 80's, of drought-induces crop failures in southern Africa both in 1991-92 and 1994-95. Since its inception, the system has issued 285 special alerts and 122 special reports to the international community of impending food emergencies due to man-made and/or natural disasters in various parts of the world.

4.11.2 Who uses the system/network/forum?

GIEWS is located in the Commodities and Trade Division of FAO.

Since 1975, institutional links and information-sharing agreements have been established with several UN organizations, 115 governments, 4 regional organizations and 61 NGOs. Numerous international research institutes, news services, private sector organizations and specialized government agencies also collaborate.
Donors of food assistance are among the main users of GIEWS, but also fulfil an important role in the provision of information as well as support for the development of the system itself. Bilateral donors are committed to informing GIEWS of all pledges and deliveries of food aid. Several donors have invested in strengthening the capacity of GIEWS. Among the main users of the system figure the European Commission, the USAID's Famine Early Warning System (FEWS). A worldwide network of Non-governmental organizations uses information from the system and the media also make extensive use of GIEWS Reports and Alerts posted on FAO web pages.

4.11.3 Description of how system/network/forum functions

GIEWS is an open forum for the exchange of information on food security. The system continually receives economic, political and agricultural information from a wide variety of official and unofficial sources. A small unit in FAO's Rome Headquarters is responsible for coordination with participating organisations:

- Within FAO

- The system's crop monitoring activities are supported by FAO's Environment and natural Resources Service which provides real-time satellite images through FAO's Africa real Time Environmental Information System (ARTEMIS) and also agro meteorological assessments conducted by the Agrometeorology group.
- The Emergency Centre for Locust Operations (ECLO) and the Emergency Prevention System for transboundary Animal and Plant Pests and Diseases (EMPRES) provide GIEWS with information on migratory pests movements and control operations on a regular basis.
- The system draws on analyses provided by commodity specialists within the Commodities and Trade Division, for information on a variety of food commodities.
- Regular contact is also maintained with Food security and Agricultural Projects Analysis Service.
- The system also plays an important part in FAO's Emergency Coordination Group (ECG) which has the specific responsibility of formulating the Organization's response to emergencies.

- Within the member countries

Most FAO member countries and a few non-members are a part of GIEWS. In countries without an EWFIS, GIEWS relies on direct flow of information from the appropriate technical services within the government, on FAO field staff and on NGO's. Efforts are continually being made to cultivate and consolidates these links but gaps sometimes occur in the system's information coverage, and it is necessary to dispatch specialized information-gathering missions.

- Donor Organizations

Donors of food assistance are among the main users of GIEWS, but also fulfil an important role in the provision of information as well as support for the development of the system itself.

- International Organizations

- The World Food Program (WFP) plays an integral role in GIEWS through periodic coordination meetings, joint missions and informal and official contact on a regular basis. While GIEWS publications provide an input into WFP's planning process, the System benefits from WFP's weekly field reports and other information on emergency food interventions. There is also close collaboration between GIEWS and WFP's Vulnerability Assessment and mapping (VAM) Unit, particularly in sharing software, technical expertise and data.
- GIEWS also works closely with the UN office for the Coordination of Humanitarian Affairs (OCHA), which is the main UN coordinating body for emergency interventions and has developed collaboration with the United Nations Development Programme (UNDP).
- The United nations High Commissioner for refugees (UNHCR) supplies data on refugee numbers and location

- The World Meteorological Organization (WMO) provides climate and weather data
- The International Labour Organisation (ILO) provides information on unemployment and poverty levels.
- The United-Nations Children's Fund (UNICEF) often provides input and support to GIEWS missions.
- Information on the global market, export prices and freight rates is shared with the International Grains Council.
- Numerous other UN agencies and international organizations such as the Organization for Economic Co-operation and Development (OECD), the World bank and the International Monetary Fund (IMF) are also active in the System.
- The system exchanges data and information with the United Nations Environment Programme's Global Resource information Database (UNEP/GRID)

▪ Non-Governmental Organizations

GIEWS includes a worldwide network of (NGO's) as providers of information. The system acknowledges the ever-increasing prominence of NGOs in food information and early warning, particularly at the subnational level. NGO's are often a crucial source of data in countries where government information services have collapsed.

▪ The Media

GIEWS reports have a high media profile and are widely cited in the international press. The system also uses various local and international press sources, including on-line news services, journals and newspapers for the monitoring of food trade and food policy changes.

4.11.4 Assessment of spatial coverage

The system has a true global coverage, though particular emphasis is placed on countries and regions where food emergencies are most likely to occur. It also has a continental, national and sub-national coverage.

4.11.5 Description of the Inputs to system/network/forum

In order to achieve drought and food insecurity monitoring, GIEWS makes extensive use of the two types of satellite derived data: ***Cold Cloud Duration*** (CDD) and ***Normalized Difference Vegetation Index*** (NDVI). Both images are produced and made available on a decadal and monthly basis. The satellite images are supplied by the ARTEMIS that became operational in August 1988 as the *Africa Real Time Environmental Monitoring Information System*.

- ***Cold Cloud Duration*** (CDD): METEOSAT data are received directly and daily by ARTEMIS from the European Satellite through a Primary Data user station.
- ***Normalized Difference Vegetation Index*** (NDVI): the NDCI imagery used by the GIEWS comes from two sources:
  - 7.6 km resolution Global Area Coverage (GAC) NDVI images for Africa and Latin America and the Caribbean are produced from the data collected by the Advanced Very High Resolution radiometers (AVHRR° sensor aboard polar orbiting NOAA satellites.
  - Since 1998, FAO has been acquiring the NDVI data derived from the VEGETATION (VGT) instrument aboard the SPOT-4 and 5 satellites every 10 days, covering the entire landmass of the globe-i.e. the 4 km imagery covers

globally, whilst the selected windows of regions of NDVI images are at the resolution of 1 km.

In addition to satellite derived data, GIEW also uses a number of ground base data:

- **Environment**
  - *Weather:*
    - ✓ Precipitation,
    - ✓ Temperature,
    - ✓ Soil moisture
    - ✓ Unusual Occurrences/Disasters
  - *Vegetation*
  - *Pest and Diseases*

- **Primary Production**
  - *Crop Situation*
    - ✓ Crop calendar, Starting date, Crop development, Peak season period, Harvest period
  - *Rangeland,* Biomass, Carrying capacity, Waterpoint
  - *Livestock:* Numbers, Migration, Health
  - *Fisheries*
    - ✓ Catches per unit of effort, Landings

- **Socio-Economic**

  - *<u>Trade</u>*

✓ Agricultural Exports and Imports,

✓ Non-Agricultural Exports and Imports

✓ Exchange Rate; Tariff and TRQ, Transportation cost

  - *<u>Domestic Market</u>*

✓ Food Prices and Consumer Price Index

  - *<u>Input Accessibility</u>*

✓ Overall Input Accessibility

✓ Fertilizer Prices and Fertilizer Quantity

✓ Seed Prices and Seed Quantity

  - *<u>Food and Other Aid</u>*

✓ Emergency Assistance Provided

  - *<u>Health</u>*

✓ Epidemic impact

✓ HIV-AIDS impact

✓ Political

  - **Political**

✓ Openness

✓ Transparency

✓ Extent of corruption

✓ Negative impact of elections Environment

4.11.6 Description of the methods/techniques/models and outputs

The processing techniques applied on CDD data are based on the work of the TAMSAT group of the University of Reading. The Dutch Aerospace Laboratory integrated the software components into one, highly automated and operational system. The CDD data are used to trace the evolution of the rainy season on a 10-day and cumulative basis from the start-of-season through harvest. When combined with rain gauge station data through spatial interpolation techniques, the CDD imagery can be further processed to derive estimated rainfall images and estimated numbers of rainy days.

The data collected by the AVHRR sensor are processed using a sub-system based on the work of the Global Inventory Monitoring and Modeling Studies group at the NASA Goddard Space Flight Center. These images are provided to the GIEWS through ARTEMIS every 10 days.

In order to maintain its diverse information base, GIEWS developed an integrated information system known as the “GIEWS Workstation”. The GIEWS Workstation is a web mapping application that gives access to food security related information and serves as main information management tool at global, regional and national levels. The aim of the Workstation is to harmonize food security and early warning data within/across countries and to strengthen analytical capacity of key national institutions to support food security policy formulation and emergency interventions. The workstation handles different types of information such as remote sensing data, GIS layers, databases and texts. This allows GIEWS analysts to consult various crop calendars, crop statistics, administrative maps and demographic information. The application also includes software tools to analyze food security implications of natural and man-made disasters. These tools allow users to process historical and recent data in order to detect anomalies of environmental and economic factors (e.g. drought; excessive increase of market prices) that may reduce local populations’ capacity to access key food items. **Windisp**, which is a public domain, easy to use software package for the display and analysis of satellite images, maps and associated databases, with an emphasis on early warning for food security figure among these tools. The application also includes text management tools that facilitate the compilation and dissemination of early warning messages. The Workstation is structured as a network in which individual instances of the application (e.g. Workstations installed in the countries) represent the nodes of this network. The network architecture is the base for information sharing.

4.11.7 Procedures for developing and interpreting indicators

FAO has developed various techniques for extracting information on crop growing conditions using the up-to-date CDD and NDVI images available on a decadal and monthly basis, which provides an indication of yields and crop production expected at the end of the growing season. These include creating simple difference images, a technique which is often used to assess the difference in vegetation vigor at critical periods throughout the growing season. In a similar fashion, with a sequence of current year CDD images, the arrival and retreat of rain clouds can be clearly indicated, providing information on the duration and performance of the crop growing season.

Another effective means of analyzing the NDVI and CCD data is to extract average NDVI or CDD values over known area. The extracted data can then be visualized as a time series and compared with an average trend calculated from the historical archive, or to trends from previous years. The values are often extracted for crop zones or by administrative area.

In addition to the time-series analysis and comparison of images, both NDVI and CDD can be used as an input into other models. These include agro-meteorological models and various image clustering methods

- Agro-meteorological models: Artemis imagery is also used for crop forecasting. The *Agrometshell* allows crop water balance calculations and estimates if and when a crop will experience water shortages, eventually leading to reduced crop yields based on rainfall, evapotranspiration and crop data. Crop conditions are further analysed by using satellite imagery, agro-meteorological data and user's knowledge on cropping areas. (www.hoefsloot.com/agrometshell.htm)
- Clustering of image series is a method to integrate both time and space components of an image series through a multi-temporal classification. It can be done using directly the image values or by using the difference with a reference data set. The result of such analysis is an image indicating the areas with similar temporal behaviour.

The satellite images can also be used to corroborate field reports, or as a substitute for other sources of agro-meteorological information normally used to estimate crop yields in countries where the required information is weak or incomplete. For many parts of Sub-Saharian Africa and for developing countries in other regions, the decadal and monthly composite satellite data have provided a cost-effective and efficient solution for monitoring the current crop season allowing GIEWS crop assessment mission teams to effectively identify areas suffering from low rainfall and drought, and to timely schedule their field missions accordingly.

4.11.8 Information available from the system/network/forum

The GIEWS provides

- information on current food production/supply, utilization, import requirements and food aid needs in all countries
- early warning on production facing unfavourable prospects, current food emergencies, trend and analysis Information from GIEWS is disseminated through a number of core publications: "**Food outlook**" and "**Food crops and Shortages**" are published 5 times a year in Arabic, Chinese, English, French and Spanish and are distributed in hardcopy and electronically through the internet. The first one provides a global perspective on the production, stocks, and trade of cereals, other basic food commodities and fertilizers. The second one provides readers with specific country summaries on factors affecting current food production, trade, sticks and consumption. Special attention is paid to countries that face exceptional food shortages or where the prospects for current crops are unfavourable.
- "**Food Supply Situation and Crop Prospects in Sub-Saharan Africa**" is issued 3 times a year in English. It highlights the major food emergencies in the region and draws attention to the countries where the need for donor assistance is most urgent.
- The "**Sahel report**" is issued every month throughout the growing season, which lasts from June to October. The report describes the seasonal weather conditions, pest infestations and crop prospects in this drought-prone zone.

- In order to provide timely alerts, the System rapidly issues short "**special reports**" and "**special alerts**" on the food supply and agricultural situation in countries or sub-regions experiencing particular food supply difficulties GIEWS has developed an on-line database on food and agriculture for Africa with funding and support from France and the EC. The on-line database contains maps and up-to-date satellite images as well as information on crops, climate, and population for many countries in Africa.

5 DETAILED DESCRIPTIONS OF DROUGHT MONITORING AND FORECASTING SYSTEMS/ NETWORKS/ INSTITUTIONS IN EUROPE COVERING THE AFRICAN CONTINENT

5.1 ID: DM EAC 01: FACTSHEET 10: EARS-E2M

5.1.1 General information

EARS are a high-tech remote sensing company specialized in remote and near sensing techniques. Activities are carried out in two daughter companies. EARS Plant Photosynthesis Monitoring B.V. (EARS-P2M) carries out near sensing activities which focus on the use of plant chlorophyll fluorescence signal for photosynthesis monitoring since 1983.

EARS Earth Environment Monitoring B.V (EARS-E2M) operates an MSG receiving station, covering Europe and Africa, and is operationally receiving Meteosat-7 and FY2c satellite data over Asia. The company has developed a continental scale Energy and Water Balance Monitoring system (EWBMS) which produces daily agro- and hydro-meteorological data fields for these regions. The company has developed application sub-systems for Crop Yield Forecasting and Rainfall-runoff forecasting. Besides providing data, implementation projects are carried out in China and Mongolia. E2M is also experienced in fire, forest and photosynthesis monitoring.

5.1.2 Who uses the system/network/forum?

EARS Earth Environment Monitoring B.V. is a for-profit organisation falling under EARS Holding B.V.

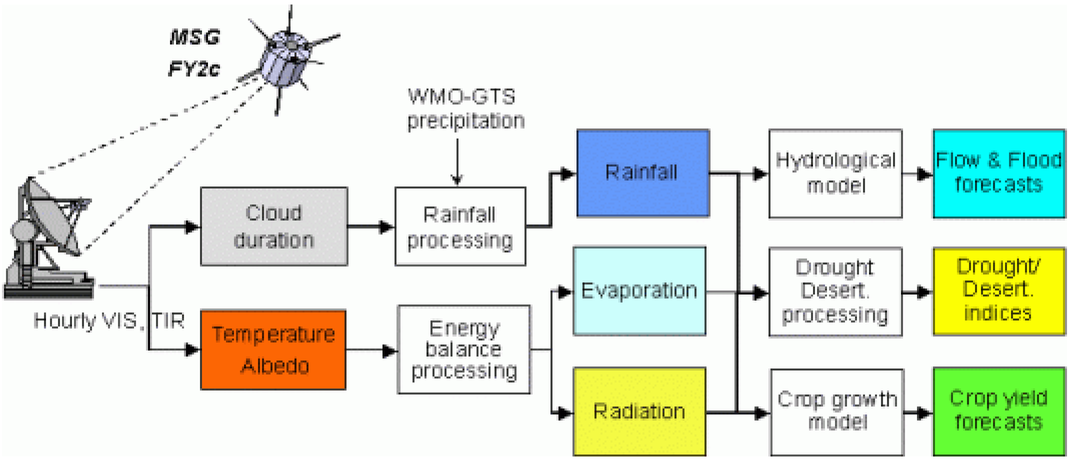
EARS have worked on projects with partners/clients who included: the European Space Agency (ESA), the Netherlands Remote Sensing Board, FAO, the European Union, the European Commission, and EU DG XII FP6.

Subscriptions can be obtained for a number of data products including Crop yield forecasts and special climatological data for Africa and Europe.

5.1.3 Description of how system/network/forum functions

Ears developed the Energy and Water Balance Monitoring System (EWBMS).
EARS is operating receiving facilities for Meteosat/Meteosat Second Generation (MSG) over Africa and the Indian Ocean and for FengYun-2c over Eastern Asia. Visual and Thermal Infrared Data are received and pre-processed hourly. The data are processed in two lines.

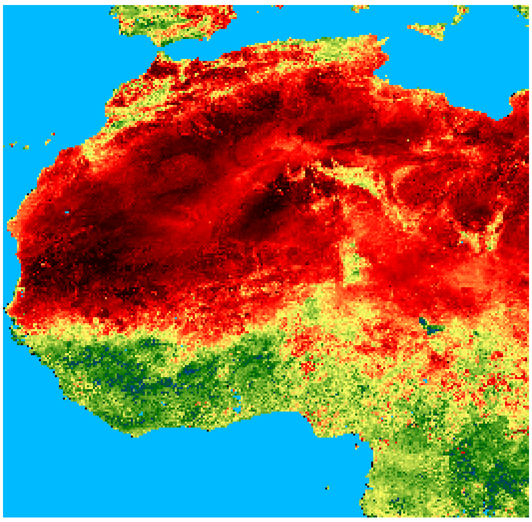
The first line generates cloud frequencies at several levels and precipitation data fields based thereon. The second line produces temperature, albedo, radiation, sensible heat and evapotranspiration data. These primary data products are thereafter used to generate user oriented products related to drought, crop yield and river flow.



5.1.4 Description of the Inputs to system/network/forum

The input to the EWBMS consists of Meteosat/MSG (METEOSAT Second Generation) product for Africa and WMO's Global Telecommunication System (GTS). This is defined as *"The co-ordinated global system of telecommunication facilities and arrangements for the rapid collection, exchange and distribution of observations and processed information within the framework of the World Weather Watch."*

As data is obtained from satellite imagery, monitoring is continuous (hourly intervals), at 3km spatial resolution. Hereunder is an example of the evapotranspiration output over West-Africa for 1 -10 June 2011.



The source of data is Meteosat/MSG (METEOSAT Second Generation).

5.1.5 Description of the methods/techniques/models and outputs

The following paragraphs describe how different indicators are obtained from the source data. This detailed description is publicly available at the EARS website.

- Precipitation

Using hourly thermal infrared images, cloud levels are classified based on their cloud top temperatures. A count of the different cloud classes during the period of interest (day, dekad) leads to cloud durations (CD). The CD is related to Rain gauge data from WMO-GTS Synops reports by means of local regression. This means that a regression equation is established for each rainfall station considered and its 11 surrounding rainfall stations:

$R = a + a_1.CD_1 + a_2.CD_2 + a_3.CD_3... + \text{residual}$

The regression coefficients (a) and the residual are assigned to the station. This procedure is repeated for every rainfall station. Hereafter the regression coefficients and residual are interpolated to each pixel by means of inverse distance weighing. Finally the rainfall is calculated for each pixel and the complete rainfall field is obtained.

- Evapotranspiration
- Pre-processing

Actual evapotranspiration is derived through the energy balance. Hourly thermal infrared and visual data are pre-processed to noon and midnight composites. Cloud information is collected during daylight hours and a weighed cloud indicator is determined, which is later used in the calculation of global radiation. Thermal and visual counts are converted to planetary temperature and albedo by means of calibration equations. For the TIR data the calibration information is attached to the raw images. For the VIS data a vicarious calibration method is applied.

- Surface temperature and albedo

Planetary temperature and albedo are converted to surface temperature (T) and surface albedo (A). For the temperature a technique based on the hottest land pixels for which evapotranspiration is zero are used. For the visual channel the technique is based on the darkest land pixels. The latter uses a two-flux model, extended from Kondratyev, and leads to the determination of the atmospheric optical depth.

- Air temperature

The boundary layer air temperature (T_a) is derived from the noon and midnight surface temperature using an analytic model of the daily temperature cycle. The temperature at observation height (1.5 m) is generated by weighing the surface and boundary layer air temperature.

- Global and net radiation

Daily global radiation (I_g) is calculated on the basis of the time of the year, longitude, latitude, atmospheric optical depth and cloudiness. It involves the earlier mentioned two-flux model for global radiation transmission. The net radiation (I_n) is then calculated with:

$I_n = (1\text{-}A).I_g+I_d-I_u$

Here the downward and upward long wave radiation fluxes (I_d, I_u) are calculated from the boundary layer and surface temperature, respectively.

- Sensible heat flux

The daily sensible heat flux (H) is found by multiplying the heat transfer coefficient with the difference between the average surface and boundary layer air temperature

$H = a.(T\text{-}T_a)$

The heat transfer coefficient a is a function of height, taken from a DEM. This is based on (a) decreasing specific mass and (b) increasing aerodynamic roughness with height.

- Evapotranspiration

The daily latent energy flux (LE) is found as the net radiation minus sensible heat flux, minus a correction for photosynthetic electron transport (E):

$$LE = In - H - E$$

The latent heat flux is converted into the actual evapotranspiration in mm/day. The potential evapo-transpiration may be determined from the net radiation using a Makkink type formula. Also the Thornthwaite estimation method has been implemented.

- Snow accumulation and melting

Given the precipitation and surface temperature data, snow accumulation may be mapped in a post-processing step. In spring snowmelt is simulated on the basis of the available latent energy after accounting for potential evaporation.

<u>Drought monitoring</u>

- Climatic drought

The EWBMS data products are useful to derive climatic and other drought products. They are particularly relevant in the framework of the United Nations Convention to Combat desertification (UNCCD). In 1958 the Russian scientist Budyko did already introduce the "dryness ratio" or "aridity index"

$AI = I_n/LR$

where I_n is the net radiation and LR the energy required to evaporate the rainfall. In 1994 the UNCCD defined -slightly different- the Climatic Moisture Index (CMI)

$$CMI = LR/LE_p$$

i.e. the ratio of rainfall and potential evapotranspiration. The CMI defines the climate types of desertification in the following way:

Climatic zone	*CMI range*
Extremely arid	0.00 - 0.05
Arid	0.05 - 0.20
Semi-arid	0.21 - 0.50
Dry sub-humid	0.51 - 0.65
Humid	> 0.65

Arid, semi-arid and dry sub-humid area's are understood to be subject to desertification. It is therefore very important to a government to know which parts of its national territory are classified as such. Mapping these climatic zones based on ground measurements is usually laborious or even impossible due to data insufficiency. The EWBMS system however, can deliver such maps easily and fast.

- Agricultural drought

Agricultural drought is often expressed in terms of soil moisture, e.g. "Plant Available Water". Collecting such data, to obtain nation wide distributed information on agricultural drought, is a huge, labour intensive and costly task. Satellite data changes this. The plant available water and the evapotranspiration drought index correspond very well and can both be considered good indicators of agricultural drought. Their approximate relation is:

PAW = 0.3*EDI

Satellite derived EDI data has as advantages that the effort for data collection is much smaller and is easily done for very large areas. Moreover, the EDI represents the crop water use, and the relative evapotranspiration is directly related to CO_2 assimilation and therefore to crop growth. This fact makes the EDI a more attractive agricultural drought indicator than soil moisture. During the growing season the EDI is also a measure of crop production.

- Food Assessment by Satellite Technology (FAST)

EARS developed the EARS Crop Growth Model (ECGM).This model simulates crop biomass development during the growing season. The ECGM is fed with the satellite derived global radiation and relative evapotranspiration data. It simulates crop biomass development on a daily basis. It takes into account dry matter production and respiration for maintenance based on Monteith (1977). According to Monteith crop biomass production is linearly related with light interception, independent of crop type. Daily dry matter production is thus expressed in terms of the daily average global radiation (I_g); Monteith's results are not always applicable. Light use efficiency and water limitation are therefore included.

- River runoff forecasting

Ears uses a Large Scale Hydrological Models (LSHM) developed by UNESCO-IHE to obtain river runoff forecasts. The model is forced by the satellite derived rainfall and evapotranspiration fields. It can assimilate weather forecast scenarios and measured flow data from river discharge stations. The LSHM computes a running water balance on every grid point in the terrain, the two-dimensional accumulation of water towards the river network, and the flow at all points of the river network. The system provides fully dynamic spatial information on the actual state of the river basin water resources. It can also run in forced boundary-flux mode, to provide river flows through part of the network. Thus it is possible to use the system for modeling a non-closed hydrological system. The latter operation mode is also used to provide short-range forecasts of river flows. The LSHM consists of two parts, a land surface flow component and a river flow routing component.

The land surface flow component takes the EWBMS rainfall and evaporation fields as input and accumulates the resulting surface and subsurface flows through the model area along a two-dimensional gradient, which is broadly related to the topography. The terrain is discretized into distinct grid cells, each of which have a storage potential that is dynamically modified depending on input and output fluxes. The running water balance of the grid cells are described by a two-dimensional continuity equation. The diffusivities are parameterized using a non-linear relationship between storage potential, water deficit and antecedent precipitation. This allows the model to respond more rapidly under increasing saturation conditions while the opposite holds for dry conditions, which is more or less similar to the flow mechanism applied in the TOPMODEL concept (Beven, 2001). The model equations are solved by means of a finite difference technique.

The one-dimensional river flow component is based on the Muskingum-Cunge routing method (Cunge 1969) with lateral inflow. This model routes the flow through a discrete channel network from upstream to downstream points over specified time intervals Dt. The coefficients of the model are a function of the Courant number and the Reynolds number and are parameterized following Ponce (1986). The exchange of water between the land and river components is solved through an iterative procedure. The main advantage of the scheme is that it can simulate diffusion wave dominated flow while requiring only a generalized description of cross-section geometry. As such, the scheme is particularly attractive in large-scale river basin modelling for which detailed geometry data are scarce or lacking. Information on water level may be derived from measured stage-discharge (rating curve) relationships.

Data is received and pre-processed hourly. Outputs are produced near real time and recalculated to daily and dekadal products.

5.1.6 Information available from the system/network/forum

Primary data products:

- surface albedo
- surface temperature
- air temperature at observation height
- boundary layer air temperature
- global radiation
- net radiation
- sensible heat flux
- actual evapotranspiration
- potential evapotranspiration
- precipitation
- snow height
- snow melt

Derived data products for *Drought and desertification:*

- climatic Moisture Index (CMI)
- Soil Moisture Index (SMI)
- Evapotranspiration Drought Index (EDI)

Water resources:

- effective precipitation
- cumulative effective precipitation
- river discharge
- *crop yield*
- relative yield
- difference yield

Users should contact ears for access to data products and for projects.

Crop yield forecast information can also be obtained through subscriptions. Subscriptions are available for: Europe, West-Africa, East-Africa and South-Africa. The crop forecasts for Africa cover Maize and/or Millet & Sorghum forecasts at 3 km resolution. The frequency of delivery is monthly to the end of the growing season. Costs are around 260 or 1250 euro ex VAT depending on the product.

Recent Climatological data for Africa and Europe can be obtained as ‘special data products’

The information is disseminated through the EARS website. Date products are delivered by e-mail.

5.1.7 Evaluation: Assessment of System/Network Capabilities

The system involves expertise in automated data handling. From obtaining data from the providers (METEOSAT) to the final product. This includes a thorough knowledge of how the available data (Visual and Thermal Infrared Data) can be converted to desired indicators.
EARS has been active in mapping rainfall, evapotranspiration using Meteosat since 1980. Therefore they have 30 years experience with mapping these aspects. The first mapping project was executed in 1986 and consisted of a rainfall mapping experiment for FAO. Projects often spanned multiple years.

The input data seems to be adequate for the techniques used. However it can be questioned whether a result at 3 km resolution is adequate for their intended purpose. Clearly this system is relevant for rather regional assessments, but not for very local assessments. Nonetheless, for regional assessments a resolution of 3 km is still quite good.

Evidence is given showing that the system reproduces river runoff quite well. Also the examples for drought seem to correspond quite well with maps based on ground data, although correlation is somewhat harder to establish. It is unclear what the reliability of the indicators is. The system is certainly under constant development. EARS focuses on broadening application of its products to new fields and developing new products-datasets.
Some points that are mentioned for improvement in the internship-information section are:

- Exploiting new spectral information on Meteosat Second Generation satellite
- Split window atmospheric correction of thermal channel
- MSG derived NDVI and its relation to evapotranspiration based yield estimates
- Estimation of surface emissivity
- Improving MSG based cloud classification and rainfall estimation
- Involving additional spectral channels
- Including evapotranspiration as pre-event and post-event indicators of rainfall
- Kriging techniques to minimize residual errors
- Estimating wind speed and direction from MSG sequences
- Using multi-temporal MSG data for low-resolution land-use classification

5.2 ID: DM EAC 02- FACTSHEET Nº 11: EUROPEAN DROUGHT OBSERVATORY

5.2.1 General information

In Europe, there is a need for consistent and timely information on droughts to support policy makers in the definition of adequate strategies for a sustainable use of water resources.
In this context, the DESERT Action of the European Commission Joint Research Centre (JRC) is developing the prototype of the European Drought Observatory (EDO). The

development of this prototype began in 2008, estimating that this will be completed in 2012. The EDO is a web-based platform for drought detection and monitoring, forecasting, and information exchange.

5.2.2 Who uses the system/network/forum?

This system is based on a multi-scale approach, integrating continental (EU), national (MS), regional, and river basin scale information.

The European level information (+ platform) is managed at JRC, having some partner organisations like ECMWF (European Centre for Medium-Range Weather Forecast), EUMETSAT (The European Organisation for the Exploitation of Meteorogical Satellites). The users are Commission services, MS (Member States) and regional bodies, public. The information, at a national/inter-national level, is managed at relevant and interest MS authorities, inter-national organisations namely DMCSEE (Drought Management Centre for Southeastern Europe), Ministry for Environment, National Meteo./ Hydro. Services). With respect to the regional information, river basin/regional environmental authorities process it.

It should be noted that there is a direct linking and exchange between different levels by common standards (allows for seamless up- and downscaling, comparison, analysis, and validation), and a regular feedback process between all levels for comparison and improvement.

5.2.3 Description of how system/network/forum functions

The EDO is a web-based platform for drought detection and monitoring, detection, and forecasting, presenting up-to-date drought relevant information for entire Europe to the public and to decision makers in policy and water resources management (existing an important information exchange). This system integrates data of different levels, from the European Continent (EU) to a river basin scale (based on a multi-scale approach). This system presents a commonly set of products that are produced routinely on all spatial scales, namely SPI, Q95, soil moisture anomaly. These indicators are produced from data from different sources, such as meteorology, hydrological modelling, and remote sensing, and displayed as maps on the EDO Mapserver.

This map server has a menu toolbar, which permits choosing the information that we want to see in the map. Some of this information is: soil moisture estimates, anomalies, one-week forecast, monthly SPI calculation for 1, 3, 6, 9, 12 months, meteorological forecast (14-day & monthly from ECMWF), vegetation response (e.g. Vegetation Water Content (NDWI), Vegetation Productivity, Vegetation Productivity Anomaly), drought related products (Fire Weather Index, FWI). It is also possible to generate graphs and time series. It should be noted that is possible to see some information of some systems developed by a few countries (namely Spain, in a national level, give drought information from SIA (Sistema Integrado de Información del Agua), and in a regional level, information of Ebro river basin). This information is still under development.

5.2.4 Assessment of spatial coverage

The EDO is a multi-scale on-line monitoring system, having as spatial coverage: the European Continent (EU), a country, a region, and a river basin.

5.2.5 Description of the Inputs to system/network/forum

Inputs of the system are meteorological information, hydrological parameters, and remote sensing data.

It is important to note that all weather and climate datasets are derived from real time series as provided since 1975 to the Joint Research Centre. Meteorological input information is derived from measured and spatially interpolated meteorological point data provided by the JRC Institute for Protection and Security of the Citizen. Due to the reception via the Global Telecommunication System of the World Meteorological Organization and further processing the data received is typically one to two days old.

5.2.6 Description of the methods/techniques/models and outputs

EDO provides European-wide data on drought relevant products such as precipitation, soil moisture, and photosynthetic activity of the vegetation cover. Continuous simulations within the European Flood Alert System (EFAS) produce daily soil moisture maps of Europe (along with their anomalies and seven days forecasts). This information provides an instantaneous image of the current modelled situation of the water content.

Information on soil moisture is presented in the form of soil suction (pF) values, describing the force, which plants must apply in order to extract water from the soil. Precipitation is presented, in the form the Standardised Precipitation Index. SPI in monthly step is calculated for the 1, 3, 6, 9 and 12 months averaging periods. Two satellite remote sensing drought indicators are produced: Normalized Difference Water Index (NDWI) and Fraction of Absorbed Photosynthetic Active Radiation (fAPAR) anomalies. NDWI 10-day composites are obtained daily from Moderate Resolution Imaging Spectroradiometer (MODIS) data, while fAPAR anomalies are calculated from 10-day composites delivered by the European Space Agency (ESA) and estimated from Medium Resolution Imaging Spectrometer Instrument (MERIS) data. All these drought indicators are made available online for visualization and querying by means of a map viewer.

6 DETAILED DESCRIPTIONS OF DROUGHT MONITORING AND FORECASTING SYSTEMS/ NETWORKS/ INSTITUTIONS IN EUROPE COVERING NORTHERN AFRICA

6.1 ID: DM ENA 01: FACTSHEET 12: XEROCHORE

6.1.1 General information

XEROCHORE is a Support Action founded by European Commission under the FP7 that started in 2008 and ended in 2010.XEROCHORE SA compiles a roadmap that comprises of: 1) a state-of-the-art review and identification of the research gaps in the natural system, in impact assessment, in policy-making and in integrated water resources management, and 2) an assessment of the possible impacts of droughts and guidance on appropriate responses for stakeholders.

An extended network of experts will gather inputs for the roadmap through focused workshops, round table discussions, which integrate the various aspects, and a concluding conference. A Core Group will guide and facilitate the discussion and synthesis process, and eventually write the integrated roadmap.

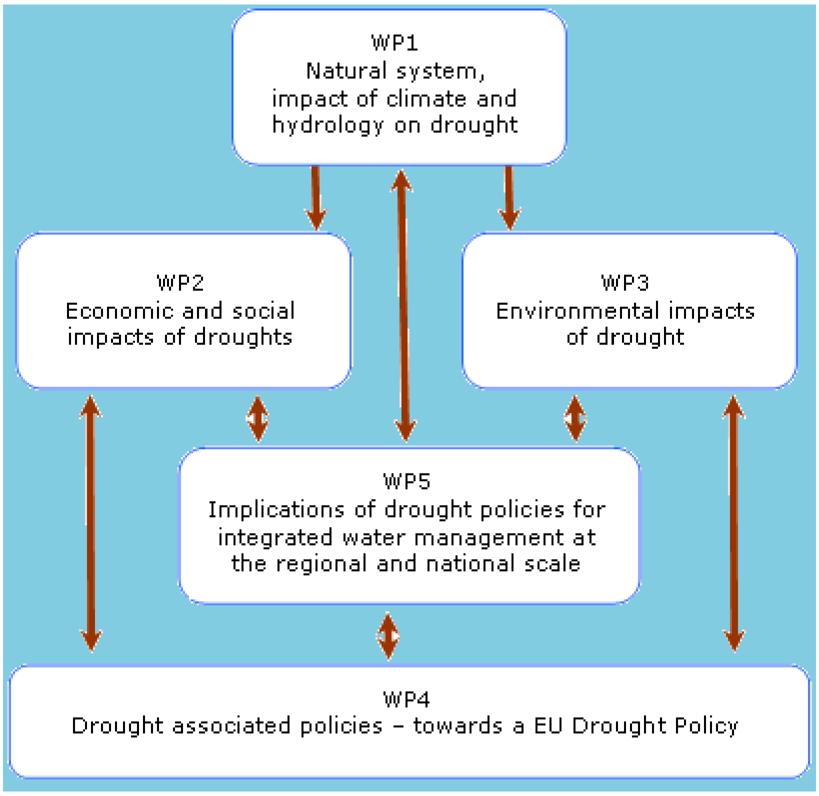
The project network consists of over 80 organizations including research institutes, universities, ministries, water management organizations, stakeholders, consultants, international organizations and programmes. It includes key members of the European Drought Centre and the WFD-CIS Working Group on Water Scarcity and Drought and representatives from overseas and neighbourhood countries, in particular around the Mediterranean Basin. The large number of organizations covering different aspects and geographic regions guarantee that all drought aspects will be covered. The drought network will be embedded in the already-existing European Drought Centre to reach the wider scientific and to provide research advice and policy support to the EC beyond the lifetime of this action. The following four African organizations are part of the ‘project network’:

- Water Resources Research Institute, El Kanater El-Khairiya, Egypt
- Université Sidi Mohamed Ben Abdellah, Faculty of Sciences and Technique (FST-Fez)Fez, Morocco
- Ministry of Agriculture and water resources (DG-ACTA), Tunis, Tunisia
- Agence Nationale des Ressources Hydrauliques, Departement des Eaux Superficielles Alger, Algeria

The Xerochore SA is based on the involvement of 11 Partners (Core Partners) and a wider group of already identified partners as Network Partners (contributing to the review and synthesis). Also being open to more experts on a voluntary basis, the area addressed benefits from broadening the information collection as much as possible, by keeping the effort for coordinating the synthesis development in reasonable limits.

Work package 1 (WP1) provides the review of knowledge about the climatic and hydrological systems and their interaction in controlling drought development. It also considers human influences, including climate change and its impact on the occurrence of droughts. In addition, the review on existing and still missing knowledge on drought characterization will help to get the boundary conditions for a systematic review of the other areas of work, WP2 (Economic and social impacts) as well as WP3 (Environmental impacts)(see figure). First it will collect existing information on impacts and then, by using first outcomes from WP1 and providing in particular the knowledge base on where research gaps would limit the development of a EU Drought Policy (WP4), but also where open research fields are limiting the planning of sustainable drought mitigation and adaptation plans in the sense of an Integrated water resources management (WP5).

The outcome of the WP's 1-3 provide then a possibility to integrate drought management both to its drivers (causes) and impacts as well as to possible consequences of drought management (WP5). The link of the drought management to WP4 (Drought policy) is dual, first to impose urgent fields of action in policy making, but considering at the same time constraints and restrictions as discussed under WP5.



The Xerochore library contains documents dealing with drought management and mitigation. The aim of this effort is to develop a wide knowledge base that could be used by project partners and other interested parties. The material is structured in five broad categories:
EU Documents, Scientific Papers, National / Regional Drought Plans, Reports
MSc/ PhD thesis. You can access the documents at
http://environ.chemeng.ntua.gr/xerochore/Default.aspx?t=162

6.1.2 Who uses the system/network/forum?

The outputs of the project are publicly available and used by organisations involved in the development of the European drought Policy in accordance with the Water Framework Directive.

6.1.3 Description of the methods/techniques/models and outputs

Xerochore produced four guidance documents on;
- Natural/Physical System; exploration of hydro climatic aspects of drought, propagation of meteorological droughts into hydrological droughts, integrated drought assessment framework (hydrology and climate), drought monitoring (incl. early warning) and forecasting
- Socio-economic Impacts; economic and social effects of droughts, Water demand- and supply management (WDM and WSD) for the key sectors: agriculture, energy production, residential water use, water-intensive manufacturing.

- Environmental Impacts; definition of environmental variables that can enhance understanding of:

1. how the effects of drought are influenced by ecosystem structure such as species composition
2. how drought alters key ecological functions for the preservation of water quality and habitat integrity
3. what flow conditions are required for reducing ecosystem sensitivity to drought

- Drought Management and Policies; overview of drought mitigation options, European and national policies and management efforts addressing drought, examples in the form of Case Studies, policy recommendations for drought management and processes for developing drought management plans (DMPs)within Water Framework Directive river basin management plans and minimum required content of DMPs.

Xerochore also produced five Science Policy Briefs available in English, French, Italian, Spanish on the link between drought and the EU Water Framework Directive all available through the website:

- Science Policy Brief #1: Characterization of water bodies and of the analysis of pressures and impacts (Article 5)
- Science Policy Brief #2: Monitoring of surface water and ground water status and of protected areas (Art. 8 - relevant also for Art. 1)
- Science Policy Brief #3: Recovery of costs for water services (Article 9)
- Science Policy Brief #4: Implementing a programme of measures (Art. 11, including Annex VI part b)
- Science Policy Brief #5: River basin management plans (Art. 13)

6.2 ID: DM ENA 02: FACTSHEET 13:DROUGHT PREPAREDNESS NETWORK FOR THE MEDITERRANEAN

6.2.1 General information

The purpose of the project (2003 – 2007) was to develop guidelines for Drought Preparedness Plans and to set up a Drought Preparedness Network for the Mediterranean countries. The Guidelines provide an integrated approach to face droughts from a risk management perspective and therefore minimizing the impacts of drought in the population and resources.

The following organizations participated in the project; Mediterranean Agronomic Institute of Zaragoza and Universidad Politécnica de Madrid (Spain), University of Cyprus, National

Technical University of Athens (Greece), University of Catania (Italy), Institut Agronomique et Vétérinaire Hasan II (Morocco), UPM (Universidad Politecnica de Madrid (Spain), Canal de Isabel II (Spain), Tagus River Basin Authority(Spain), Fundación Ecología y Desarrollo (Spain), The General Directorate of Dams and Large Hydraulic Works (Tunisia).

The following activities were carried out in the project:

- Collection and analysis of information on drought and drought mitigation
- Carry out Drought Identification, Risk Analysis, and Best Practices on six partner countries
- Develop guidelines for drought preparedness plans with the participation of institutional and civil stakeholders
- Verify and test Drought Guidelines on six different partner water basins
- Disseminate Guidelines as model to Mediterranean countries for formulating their own plans
- Set up the framework for a Drought Preparedness Network for the Mediterranean countries

The project was partially funded by the EuropeAid Co-operation Office-European Commission under the MEDAWATER Programme initiative.

It contributed to the MEDA Water programme through the following achievements:

1. Understanding of drought, its causes, its impacts on the economy, the environment, and society
2. Transfer of know-how, technology, and expertise
4. Strengthening institutional and public capabilities and raising awareness
5. Enhancing regional co-operation in the areas of sustainable and integrated management of water resources
6. Prevention and mitigation of the negative effects of drought and promotion of equitable management of water scarcity.

6.2.2 Who uses the system/network/forum?

The produced guidelines are publically available through the website http://www.iamz.ciheam.org/medroplan/. The MEDROPLAN Project Website has been developed with the purpose of communicating scientific information and establishing an effective network among project participants and collaborators.

6.2.3 Assessment of spatial coverage

The project focussed on the Mediterranean region. Six river basins were used as test cases; Cyprus, Greece, Morocco, Tunisia, Italy and Spain.

6.2.4 Description of the methods/techniques/models and outputs

The following Drought Management Guidelines output are available through the website in six languages (French, English, Arabic, Spanish, Italian, Greek)

a. - Drought management Guidelines. Paper, website and CD versions

b. -Tutorial of the Drought Management Guidelines. Website and CD

c.-Technical Annexes of the Drought Management Guidelines. Paper and pdf (downloadable from website and in CD) versions

These guidelines are structured in three products that are complementary but that can be used independently. (IAMZ, 2011)

The Guidelines are a “manual” that provide an effective and systematic approach to develop drought management plans based on the existing scientific and technical knowledge and adapted to the socio-economic, political and environmental conditions. The proposed approach can be applied in the Mediterranean region but also in other regions of the world suffering from drought. The Guidelines are not prescriptive and have to be taken as a reference, and the tools proposed have to be chosen and adapted to the planning reality.

The Guidelines have been developed starting from the premises of moving from a reactive to a proactive approach to fighting drought, placing emphasis on the institutional and legal framework and on stakeholder participation, and establishing a wide range of methodologies to cope with drought. They incorporate the scientific background and knowledge on droughts, the meteorological, agricultural and hydrological drought aspects, their onset and end, their frequency of occurrence, the water shortage observed and the impacts of water shortage caused by droughts in the six Partner countries of the Project (Cyprus, Greece, Italy, Morocco, Spain and Tunisia).

PRODUCT	FORMAT	STRUCTURE	CONTENTS	LANGUAGES	ADDRESSED TO
DROUGHT MANAGEMENT GUIDELINES and Examples of Application	2 Booklets Website CD	PART 1. DROUGHT MANAGEMENT GUIDELINES	Summary of the drought planning framework and methodology proposed by the MEDROPLAN project	Arabic, English, French, Greek, Italian, Spanish	Policy makers Professionals and experts of water and agricultural management General public
		PART 2. EXAMPLES OF APPLICATION	Summary of the application of the drought planning methodology in 6 countries (Cyprus, Greece, Italy, Morocco, Spain, Tunisia)	English and French	
TECHNICAL ANNEX	Journal Downloadable from the website CD	Issue of the CIHEAM journal Options Méditerranéennes (Series B, nº.58) containing 23 chapters	Compilation of technical and scientific results of the MEDROPLAN Project. In-depth development of the components of the Drought Management Guidelines and of the Examples of Application.	English	Professionals and experts of water and agricultural management
WEBSITE	Website CD		All the information contained in the Guidelines, the Examples of Application and the Technical Annex A tutorial to help the users of the Guidelines to understand and visualize the components of drought planning	English	Professionals and experts of water and agricultural management General public

6.2.5 Information available from the system/network/forum

The information is currently disseminated through the website. During the project several trainings and events were organised with the goal of integrating:

- Stakeholders' groups for understanding the potential uses and limitations of the Guidelines for Drought Preparedness Plans in their planning and decision-making activities.
- Regional policymakers and resource management planners for assisting the scientists to consider variables and time-windows that are actually useful and to define ways for presenting research results that can be effectively assimilated in the stakeholders' activities.
- Regional scientists for testing and extending the work agenda and methods of analysis.

6.3 ID: DM ENA 03: FACTSHEET 14: AQUASTRESS CASE BASED REASONING

6.3.1 General information

This experimental tool designed in the framework of the FP6 AquaStress project was set up in 2007. The purpose was to develop a methodology to address the concept of knowledge transfer from well monitored areas to unmonitored ones. A Case based Reasoning (CBR) tool was set up to enable the user to compare European areas on their water-related characteristics and to find analogues. The drainage sub basin was chosen as the smallest spatial entity at which scale comparison should be feasible. The water-related characteristics are described using two sets of indicators. The first describing the natural conditions related to water, the second describing the water stress present due to use of water for a specific sector (agricultural, industrial, domestic, tourism, environment). The third set describing the mitigation measure used to cope with the stress was not implemented.

This experimental tool was funded by the EC in the framework of the FP6 project and is not available anymore.

6.3.2 Who uses the system/network/forum?

This experimental tool was funded by the EC in the framework of the FP6 project and is not available anymore

6.3.3 Description of how system/network/forum functions

According to Aamodt and Plaza (1994) in case based reasoning the reasoner has to: identify the current problem situation, find a past case similar to the new one, use that case to suggest a solution to the current problem, evaluate the proposed solution, and update the memory by learning from the experience.

As case, the drainage sub basins of Europe were used. Pan-European datasets were used to describe each ‘case’ using predefined indicators. The user fills out a few criteria and runs the tool, which yields an ordered subset of the most resembling cases.

6.3.4 Description of the Inputs to system/network/forum

Data describing the natural conditions of a catchment available at Pan-European level (Precipitation, evapotranspiration, net precipitation, soil permeability, Hydrogeology permeability, mean slope, groundwater recharge potential, natural background quality (salinity, arsenic), presence of extraction sites, presence of active volcanoes, runoff, river density, open water bodies. The climate data, from the Climatic Research Unit, University of East Anglia, United Kingdom, are from the high resolution gridded dataset CRU CL 2.0, with a spatial resolution of 10’ and years ranging from 1961 to 1990. (New et al, 2002). From the global set only the part for Europe was selected with longitudes between 30º west and 60º east and latitudes between 30º and 85º North. The data are given as monthly figures over the period 1961-1990 and summed over the winter period (October-March), summer period (April-September) or the whole year. The output is then averaged, for every time period, over every drainage sub basin. The potential evapotranspiration is calculated with the Thornthwaite formula using the monthly average temperature (from CRU) and the calculated hours of daylight. The results are ArcInfo grids with 10 km cells for summer, winter and the whole year. The output is then averaged over every drainage sub basin.

Soil permeability was obtained from the FAO/Unesco Soil Map of the World 1:1000000. Three classes are distinguished, high, medium and low respectively coarse soils (clay < 18% and sands > 65%), medium soils (clay < 35% and sands < 65%) and fine soils (clay > 35%). The areal percentage of every soil permeability within a drainage-basin is then calculated.
Aquifer permeability was obtained from the Hydrogeological Map of Europe, IAH/UNESCO, UN Water Series 24/2, 1993. Four classes are used; very good, good, modest and poor permeability. Extra information on karstic areas is used to determine areas with very high permeabilities (identified as aquifers with very good permeability). The areal percentage of every soil permeability within a drainage-basin is then calculated. The slope data are from the Hydro1k_Europe dataset provided by the USGS/EROS Data Centre and are given in degrees. The output is then averaged over every drainage sub basin. Aquifer salinity is obtained from the Hydrogeological Map of Europe, IAH/UNESCO, UN Water Series 24/2, 1993. The areal percentage of aquifers with brackish groundwater within a drainage-basin is then calculated.

Average runoff was obtained from a TIFF-file supplied by the European Environment Agency. The file is converted to an ArcInfo grid and polygon coverage. The data are for the year 1997 (Rees et al., 1997). There are seven classes distinguished in the map. The centre value per class was used to determine the 'average' runoff in every drainage sub basins using a weighted average based on the areal percentage of a runoff class within the basin.
River density is calculated as stream length per km2 per basin. The river dataset has the same source as the GISCO basin database.

The percentage of open water bodies is obtained from the open water bodies database from GISCO, the same source as the basin database.

Data describing the water stress conditions of a catchment available at country levels (domestic water use per capita, percentage of population with formal access to water supply, irrigated versus total agricultural area, ratio of irrigated to irrigable land etc…) was collected from the EUROSTAT-portal and the national bureau of statistics for three case countries (Italy, Netherlands, Cyprus).

6.3.5 Description of the methods/techniques/models and outputs

The case based reasoning tool is like a database of cases described using the indicators mentioned above. The user chooses one sub basin using a set of criteria and runs the tool to find out what cases are most similar to their own case.

Procedures for developing and interpreting indicators

In the AquaStress, one work package dealt with the development of indicators describing water stress. The focus lied on driver indicators, as they characterize a water stress problem in terms of causes and origins, and enable to identify suitable mitigation options. In order to map a given water stress problem, the concept of the AquaStress Water Stress Index

(AWSI), described in Sullivan et al (2006), was adopted. One of its key components is the Integrated Sectoral Water Stress Index (**ISWSI**). The ISWSI showed the overall level of water stress and the type of stress associated. It is calculated from a matrix describing the water stress problem in terms of anthropogenic sectors and, within each sector, possible sources of stress. The sectors to be considered within water management decisions are: domestic, agricultural, industrial, tourism, and the environment.

Possible sources of stress have been identified and summarized in three categories: institutional capacity, infrastructure, social and economic equity. As a fourth source of stress, one could think of drivers that are more directly related to the water system, such as demands and loads. These can be categorized as quality and quantity issues. The main challenge though was to choose suitable indicators to fill each cell of the matrix with indicators for which data are available with the appropriate coverage's and on the appropriate scales.

6.3.6 Information available from the system/network/forum

The web-tool is not reachable anymore as the project leader removed the website for this tool at the end of the FP6 project.

6.3.7 Evaluation: Assessment of System/Network Capabilities

The experience gained in the AquaStress project, with respect to Case-Based Reasoning and its application to water stress assessment, is available at Deltares.

Regarding the indicators, as concluded in the project, these are often developed without verifying if the data to calculate them are available and accessible. Even if these indicators could theoretically be a good indication of the type and status of the water stress, it seems a pointless exercise when the basic information to calculate them is missing.

Currently the system can not be accessed anymore as the website was closed down at the end of the project.

6.4 ID: DM ENA 04 FACTSHEET 15: CLIMATE CHANGE AND IMPACT RESEARCH IN THE MEDITERRENIAN ENVIRONMENT -CIRCE

6.4.1 General information

CIRCE is an EU FP6 funded project projected to take place from April 2007 until June 2011 (4 years), with a budget of about 10 million Euro. 64 partners participate, from 61 research institutes and 17 countries including Egypt, Tunisia, Algeria and Syria. The work is divided over 13 research lines. (Cordis, 2011; CIRCE brochure, 2011)

CIRCE aims at developing an assessment of the climate change impacts in the Mediterranean area. The objectives of the project are:

- To predict and to quantify physical impacts of climate change in the Mediterranean area
- To evaluate the consequences of climate change for the society and the economy of the populations located in the Mediterranean area
- To develop an integrated approach to understand combined effects of climate change
- To identify adaptation and mitigation strategies in collaboration with regional stakeholders CIRCE wants to understand and to explain how climate will change in the Mediterranean area.

The project investigates how global and Mediterranean climates interact. Recent observed modifications in climate variables and detected trends are compared. The economic and social consequences of climate change are evaluated by analysing direct impacts on migration, tourism and energy markets together with indirect impacts on the economic system. CIRCE investigates the consequences on agriculture, forests and ecosystems, human health and air quality.

The variability of extreme events in future scenarios and their impacts are assessed. A rigorous common framework, including a set of quantitative indicators developed specifically for the Mediterranean environment are developed and used in collaboration with regional stakeholders.

The results are incorporated in a decision support system tool and disseminated to the relevant users. Possible adaptation and mitigation strategies are identified. The integrated results discussed by the project CIRCE will be presented in the first Regional Assessment of Climate Change in the Mediterranean area.

Circe results show a scenario in the Mediterranean basin that will be characterised by an increase of temperature of about 2°C (from 0.8 to 1.8°C on the sea surface), an according sea level rise of 6-12 centimetres (also due to salinity increase), a precipitation reduction from 5 to 10%, and an increase of extreme events (heat waves, floods, torrential rains, cyclones) rate.

Nevertheless, CIRCE models show that the Mediterranean region is characterised by wide unpredictability: even if CIRCE showed an increase of temperatures and climate extreme events during summer seasons, it is not possible to predict a clear trend in the winter.

6.4.2 Who uses the system/network/forum?

Circe office is located at INGV in Italy. Dr. Antonio Navarra (INGV) and Dr. Laurance Tubiana (IDDRI) Co-Chair the Executive Board. The 64 participating institutes and the Research Lines (RL) they coordinate are listed in the following tables. Circe has an Executive board, which is supported by an advisory board and the annual General Assembly. RL leaders and the board coordinator take care of contact with the RL, the project office and the European Commission (see figure x).

Coordinators of the 13 Research Lines (RL)

RL	Topic	Coordinators
RL 0	Coordination and Communication	Simona Masina (INGV), Elisabetta Tola (Zadig)
RL 1	Identification and attribution of present climate trends	Hans Von Storch (GKSS), Elena Xoplaki (UNIBERN)
RL 2	The Mediterranean Region and the Global Climate System	Laurent Li (CNRS/IPSL), Silvio Gualdi (INGV)
RL 3	Radiation, clouds, aerosols and climate change	Herve Le Treut (CNRS/IPSL), Jos Lelieveld (MPICH)
RL 4	Scale Interaction and Feedback processes	Millan Millan (CEAM), Christos Zerefos (NKUA)
RL 5	Water Cycle	Alpert Pinhas (TAU), Michele Vurro (IRSA-CNR)
RL 6	Extreme Events	Piero Lionello (UNILE), Ricardo Garcia (UCM)
RL 7	Impacts of Global Change on Ecosystems and the services they provide	Riccardo Valentini (UNITUSCIA), Holger Hoff (PIK)
RL 8	Air Quality and Climate	George Kallos (IASA), Zev Levin (TAU)
RL 9	Human Health	Bettina Menne (WHO-Europe), Bensalah Afif (IPT)
RL 10	Economic Impacts of Climate Change	Roberto Roson (FEEM), Mordechai Schechter (HU)
RL 11	Integrating case studies	Clare Goodess (UEA), Cristos Giannakopoulos (NOA)
Rl 12	Relevant Societal Strategies	Carlo Jaeger (PIK), Ana Iglesias, (UPM)
RL 13	Induced Policies	Hubert Kieken (IDDRI), Tom Downing (SEI-YO

Participating institutes (CORDIS, 2011)

institute	country
ASSOCIATION DE RECHERCHE SUR LE CLIMAT ET L'ENVIRONNEMENT	ALGERIA
UNIVERSITAET FUER BODENKULTUR WIEN	AUSTRIA
COMMISSION OF THE EUROPEAN COMMUNITIES - DIRECTORATE GENERAL JOINT RESEARCH CENTRE - JRC	BELGIUM
THE CYPRUS INSTITUTE	CYPRUS
WORLD HEALTH ORGANISATION REGIONAL OFFICE FOR EUROPE	DENMARK
DANMARKS METEOROLOGISKE INSTITUT.	DENMARK
CENTRE FOR ENVIRONMENT AND DEVELOPMENT FOR THE ARAB REGION AND EUROPE	EGYPT
FONDATION DE RECHERCHE POUR LE DEVELOPPEMENT DURABLE ET DES RELATIONS INTERNATIONALES	FRANCE
METEO-FRANCE	FRANCE
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)	FRANCE
CENTRE DE COOPERATION INTERNATIONALE EN RECHERCHE	FRANCE

AGRONOMIQUE POUR LE DEVELOPPEMENT	
MEDIAS FRANCE	FRANCE
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	GERMANY
EUROPEAN CLIMATE FORUM	GERMANY
FREIE UNIVERSITAET BERLIN	GERMANY
UNIVERSITAET HAMBURG.	GERMANY
POTSDAM INSTITUT FUER KLIMAFOLGENFORSCHUNG	GERMANY
GKSS-FORSCHUNGSZENTRUM GEESTHACHT GMBH	GERMANY
INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS	GREECE
PANEPISTIMIO AIGAIOU	GREECE
NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS	GREECE
NATIONAL OBSERVATORY OF ATHENS	GREECE
INSTITUTE OF ACCELERATING SYSTEMS AND APPLICATIONS	GREECE
UNIVERSITY OF CRETE.	GREECE
HELLENIC CENTRE FOR MARINE RESEARCH	GREECE
BEN GURION UNIVERSITY OF THE NEGEV.	ISRAEL
THE HEBREW UNIVERSITY OF JERUSALEM	ISRAEL
TEL AVIV UNIVERSITY	ISRAEL
UNIVERSITY OF HAIFA.	ISRAEL
AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE	ITALY
ZADIG SRL	ITALY
CENTRO EURO-MEDITERRANEO PER I CAMBIAMENTI CLIMATICI SCARL	ITALY
ALMA MATER STUDIORUM-UNIVERSITA DI BOLOGNA	ITALY
UNIVERSITA DEL SALENTO	ITALY
UNIVERSITA DEGLI STUDI DELL'AQUILA	ITALY
UNIVERSITA DEGLI STUDI DELLA TUSCIA	ITALY
AZIENDA UNITA SANITARIA LOCALE ROMA E	ITALY
CONSIGLIO NAZIONALE DELLE RICERCHE	ITALY
CLU SRL	ITALY
ISTITUTO NAZIONALE DI OCEANOGRAFIA E DI GEOFISICA SPERIMENTALE	ITALY
FONDAZIONE ENI ENRICO MATTEI	ITALY
VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	NETHERLANDS
INSTITUTO DE CIENCIA APLICADA E TECNOLOGIA DA FACULDADE DE CIENCIAS DA UNIVERSIDADE DE LISBOA.	PORTUGAL
UNIVERSIDAD DEL PAIS VASCO / EUSKAL HERRIKO UNIBERTSITATEA	SPAIN
UNIVERSIDADE DE SANTIAGO DE COMPOSTELA	SPAIN
UNIVERSITAT DE LES ILLES BALEARS	SPAIN
UNIVERSIDAD DE ALCALA DE HENARES	SPAIN
FUNDACIO PRIVADA PARC CIENTIFIC DE BARCELONA	SPAIN
UNIVERSIDAD POLITECNICA DE MADRID	SPAIN
UNIVERSIDAD COMPLUTENSE DE MADRID.	SPAIN
FUNDACION CENTRO DE ESTUDIOS AMBIENTALES DEL MEDITERRANEO	SPAIN
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	SPAIN
UNIVERSITAT POLITECNICA DE CATALUNYA	SPAIN
UNIVERSITAET BERN	SWITZERLAND
PAUL SCHERRER INSTITUT	SWITZERLAND
INTERNATIONAL CENTRE FOR AGRICULTURAL RESEARCH IN THE	SYRIA

DRY AREAS	
INSTITUT PASTEUR DE TUNIS	TUNISIA
INSTITUT NATIONAL DES SCIENCES ET TECHNOLOGIES DE LA MER	TUNISIA
SEI OXFORD OFFICE LIMITED	UNITED KINGDOM
UNIVERSITY OF SOUTHAMPTON	UNITED KINGDOM
THE UNIVERSITY OF BIRMINGHAM	UNITED KINGDOM
UNIVERSITY OF YORK.	UNITED KINGDOM
MET OFFICE	UNITED KINGDOM
NATURAL ENVIRONMENT RESEARCH COUNCIL	UNITED KINGDOM
UNIVERSITY OF EAST ANGLIA	UNITED KINGDOM

6.4.3 Description of how system/network/forum functions

Stakeholder involvement forms an important part of CIRCE (RL0). At the beginning of the project a stakeholder meeting was held. Products are aimed to be useful for the stakeholders, including the Final Report – Regional Assessment of Climate Change in the Mediterranean (RACCM) and produced decision support tools. Outreach is done through scientific publications and conferences, the website, videos, and through MUSEA and collaboration with the WWF.

CIRCE is a very broad research project, which assesses both environmental aspects (especially climatic ones) and Socio-economic aspects, as is explained in the research contract (CIRCE 2007). Research Lines (RL) 1 to 5 focus on data collection, homogenization, downscaling and analysing. This results in a better documentation and understanding of climatic trends (RL1), climate evolution scenarios for the 21st century (RL2), radiation changes (RL3) and Future changes in the water cycle (RL5). Subsequently the Mediterranean system can be assessed, again both from an environmental and socio-economic perspective, to determine feedback processes and scale interactions (RL4).
RL6 to 10 subsequently assess more socio-economic aspects: a better understanding of extreme events is of immediate importance to policy makers (RL6) as well as an understanding of the impact of agriculture and ecosystems (RL7), air quality (RL8), health (RL9) and the economy (RL10).

CIRCE's findings are integrated and applied in a series of case studies (RL11) which are driven by stakeholder questions, geography, and temporal scale. This should finally result in an assessment of relevant societal strategies interacting with the climate drivers to determine impacts (RL12) and derived induced policies (RL13).

6.4.4 Description of the Inputs to system/network/forum

The work done under CIRCE ranges from pure environmental research to societal and economic assessments. CIRCE did not produce a single system, rather different assessments result in a better understanding of different processes driving climate and society in the Mediterranean. Each assessment uses its own specialized models, most appropriate to answer the question at hand. The input for these models however does often rely on work performed in earlier RL's (see the following table) (CIRCE, 2007). A few data sources, models and methods are presented in this section:

RL1: Identification and attribution of present climate trends:

- Homogenization of data using standard methodologies (monthly) or improved methods (daily temperature data). For Precipitation monthly adjustments are used.
- Variable oceanic and atmospheric states are described in suitable space-time statistics.
- Using: ARPEGE-Climate model with anthropogenic and natural forcings (solar + volcanic) over the 20th century.

RL2: The Mediterranean Region and the Global Climate System

- Three regional models of the Mediterranean region, comprehensive of atmospheric, oceanic and land-vegetation components will be assembled dynamical downscaling methods will be developed to allow a resolution around 20 km

RL3: Radiation, clouds, aerosols and climate change

- Needed datasets: Clouds: (International Satellite Cloud Climatology Project; AQUA-train - Parasol - ; Meteosat second generation; in situ); Aerosols (Aeronet, MODIS, MISR, SeaWiFS), Radiation (GEBA, BSRN, ERBE, CERES); new satellite instruments: MSG, Aqua-train instruments (CLOUDSAT, CALIPSO, PARASOL) ; a long record of consistent cloud observations (ISCCP) and weather reanalysis (NCEP, ERA40); Global aerosol maps from satellite instruments (e.g. MODIS, MISR, SeaWiFS); Water vapor and ozone profiles as well as column amounts are derived from radio sound measurements and satellite observations; The GEBA database contains data of several sites in the Mediterranean region to quantify local surface fluxes
- emission scenarios, including species such as SO_2, NO_x, NH_3, OC, BC, will be made available through the EDGAR database on a 0.5°x0.5° global grid
- emission scenarios will be applied in time slice simulations with a chemistry-general circulation model for the years 2000, 2010, 2025 and 2050

RL4: Scale interactions and feedback processes

- needed: atmospheric moisture, precipitation and evaporation from ERA 40; fog capture, rainfall, Sea surface temperature (SST) evolution, water vapor changes and water vapor recharge are acquired from satellite measurement. Further land use and land use change and vegetation and vegetation change
- assessed: the evaporation-precipitation balance is assessed
- using: a coupled regional Earth System modeling framework will be created based on regional atmospheric models such MM-5 and RAMS and advanced land surface schemes that include a carbon cycle and O3 effects, such as ORCHIDEE and Sib-2. The model will enable the simulation of 1) vegetation, carbon cycle and surface hydrology, 2) regional mesoscale meteorology, and 3) regional transport and production of pollutants, and their interactions

RL5: Water Cycle

- needed: inter-annual rainfall variability,
- Assessed: floods and droughts, water stress sensitive areas.
- Using: SVAT (Soil Vegetation Atmosphere Transfer) models and a coupled surface energy and water balance/ hydrological model.
- Time-interval: monthly and inter-annual analysis for 2020 – 2040 and 2080 – 2100

RL6: extreme events

- Needed: daily RCM and ERA-40 data; in situ, satellite and model reconstructed wave data. And data obtained from partners: Temperature (UEA), Precipitation (UNIBERN), Hydrological cycle (ICAT-UL), Cyclones (UBERLIN), Sea level and wave heights (UNILE, NERC-NOCS), Upper Troposphere (UCM), Processes of heavy rainfall in climate scenarios (DMI)
- Using: Regional Climate Model data at 44 km resolution and 25 km resolution over the period 1961 – 1990
- Assessed: fires, landslides, Saharan dust transport and other impacts.

RL7: Impacts of Global Change on Ecosystems and the services they provide

- Assessed: crop yield (wheat, Maize, sunflower, etc.); ecosystem services, ecosystem vulnerability, climate impact and biogeochemical cycles.

RL8: Air Quality and Climate

- Assessed: Impacts of particulate matter and mineral dust on the water budget
- Needed: historical emissions (1990 – 2005) on 0.1 x 0.1 degrees (Emission Database for Global Atmospheric Research); Biogenic emissions (CEPEMPS); satellite products of tropospheric interest (NO_2, SO_2, formaldehyde, CO and water vapor data); EARLINET data and EARLINET-ASOS

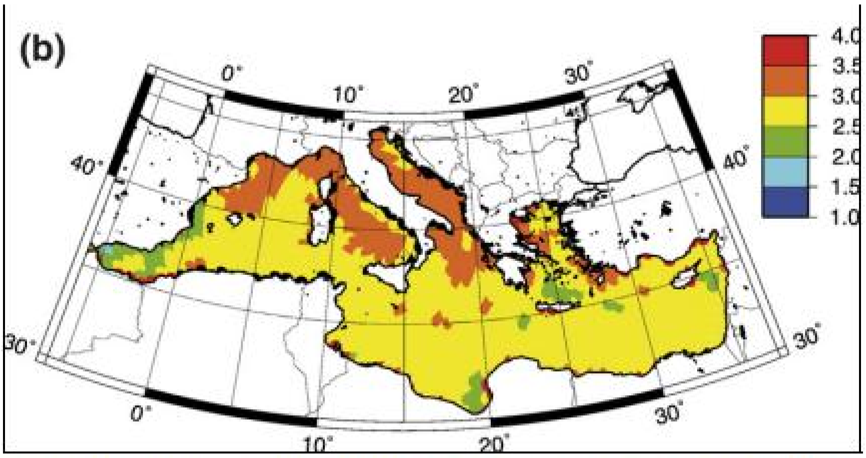
- Using: TM5 model at 1x1 and possibly 0.5 x 0.5 degree resolution. Existing atmospheric modeling systems RAMS and SKIRON/Eta with the dust cycle capabilities and the photochemical models CAMx and CMAQ.

RL9: Human health

- Assessed: health impacts of climate sensitive infectious diseases

RL10: Economic Impacts of Climate Change

- Assessed: Tourism, migration, extreme weather and tensions on water sue, Sea Level Rise, valuation of ecosystems
- Using: Nexus-agri and Nexus-elec; a computable General equilibrium model of the world economy (e.g. GTAP)



Foreseeable changes in sea surface temperature in winter (a) and summer (b) from 2070 to 2099 compared to 1961 to 1990 (Source: Somot *et al.*, 2007)

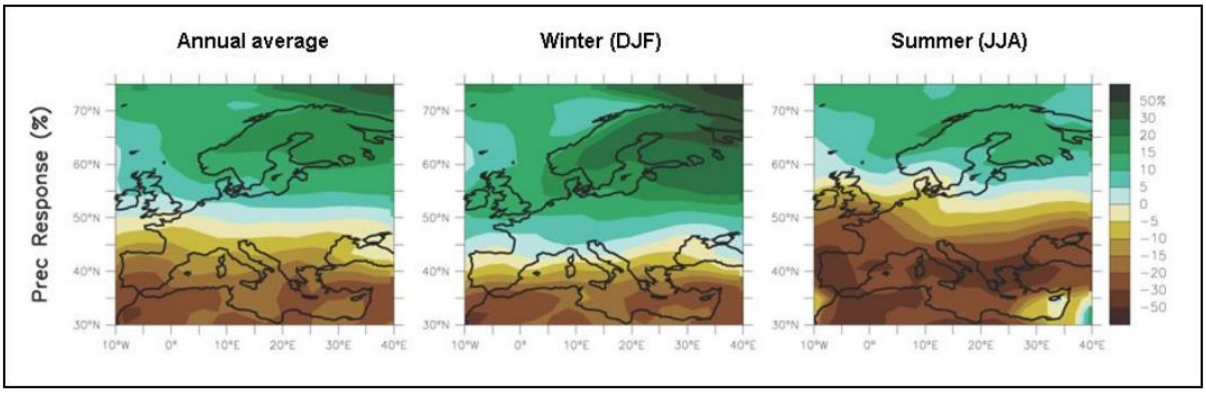


Figure 4. Evolution of precipitation in the Mediterranean and in Europe for 2080 to 2099, compared to the period of 1980 to 1999, according to the emissions scenario A1B (Source: IPCC, 2007b)

Example images from IDDRI (2009)

6.4.5 Evaluation: Assessment of System/Network Capabilities

Considerable expertise exists in the CIRCE network.

All individual models and systems are no doubt of high quality. Their resolutions differ, with the coarser resolutions (0.1 to 0.5 degrees) of course being less useful than the more fine grained resolutions.

7 DETAILED DESCRIPTIONS OF DROUGHT MONITORING AND FORECASTING SYSTEMS/NETWORKS/ INSTITUTIONS AFRICA CONTINENTAL

7.1 ID: DM AC 01: FACTSHEET16: TIGER

7.1.1 General information

In 2002, the Johannesburg World Summit on Sustainable Development stressed the need for action in Africa with respect to water resources for the continent's development.
In response, the European Space Agency (ESA), within the context of the Committee of Earth Observation Satellites (CEOS), launched the TIGER initiative. The overall objective of the initiative is to assist African countries to overcome problems faced in the collection, analysis and use of water related geo-information by exploiting the advantages of Earth Observation (EO) technology.Since 2005 TIGER has supported African partners with access to space-borne data and products, by offering specific training on EO applications for water management, by funding North-South collaborative projects aimed at developing tailored EO-based water information systems, and by favouring take-off, operationalization and technology transfer of those demonstrated systems to African water authorities.

From 2005 – 2007 more than 150 African institutions (water authorities, universities, technical centres) were involved in TIGER projects and training activities. The success of the first phase lead to the request for a second phase. TIGER II takes place from 2009 to 2012 and focuses on two components: 1) water management and 2) research.

A major component of this new phase is devoted to support African scientists to develop the scientific skills and the technical capacity to make the best use of Earth Observation technology to better understand, assess and monitor the status of the water resources in Africa as well as the potential impacts of climate change. This should allow development of effective adaptation or mitigation measures at political level in the continent.

In the ESA call for proposals of 2009, TIGER mentions that it does not provide any additional financial support on top of training and capacity building supporting activities. Projects were therefore required to demonstrate access to sufficient resources to perform the proposed work.

Tiger follows the implementation logic that a scientific component leads to a development and demonstration component which subsequently transitions to an operational system (the final component).

The service development component supports water authorities at national and basin scale to set up prototype information systems and services to improve integrated water resources management. An initial service portfolio has been developed and demonstrated through 16 projects funded by ESA and CSA with more than 6 million Euros in collaboration with more than 30 African users during TIGER I.

Projects (funded under DUE) followed a Develop-Demonstrate-Transfer (DDT) approach aimed at empowering African users to take the lead in managing the transition towards an operational phase and ensuring sustainability in the long term.

TIGER II has not yet started with the third component. This TIGER Development and Demonstration Component will support African water authorities to develop and demonstrate at pre-operational level tailored information systems and services responding to user needs and preparing the basis to advance towards operational information services. Activities will be carried out under the leadership of African institutions and in partnership with donors (e.g., African Development Bank). For this activity ESA will issue an invitation to tender (1.5 Million Euro) in 2011.

7.1.2 Who uses the system/network/forum?

The TIGER office is located at ESA, the European space Agency. A selection of TIGER projects receives support from a Capacity Building Facility. In TIGER I this facility was coordinated by the Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, the Netherlands;

During TIGER II the coordinator (ITC) is aided by a consortium of four partners:

Technical University Delft (TUD) the Netherlands;

Flemish Institute for Technological Research, VITO, Belgium and

Institute for Statistics and Geo-Information, Universidade Nova de Lisboa,ISEGI-UNL, Portugal.

Furthermore, three Regional Offices are established for the time span of 2009-2012:

AGRHYMET Regional Centre in Niger;

Regional Centre for Mapping of Resources for Development, RCMRD in Kenya and

Water Research Commission, WRC in South Africa.

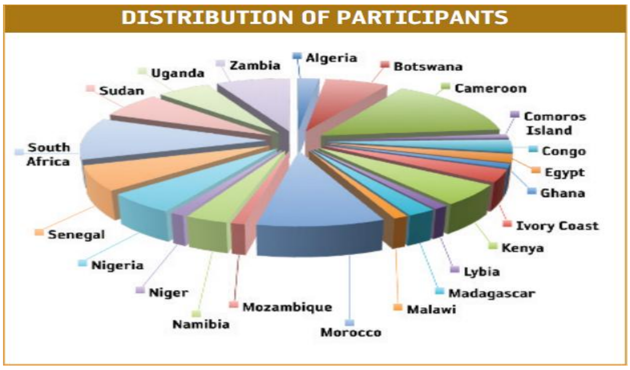
TIGER operates under the guidance of the African Ministerial Council on Water (AMCOW), with contributions from CEOS (e.g., ESA, the Canadian Space Agency), UNESCO and the African Development Bank and in collaboration with the Economic Commission for Africa (UN-ECA) and several other African and international organizations (e.g. CSIR, CRTM, Ramsar-Africa, South African Department of Water Affairs)

TIGER I involved 150 scientists. 15 research projects were supported through the CBF

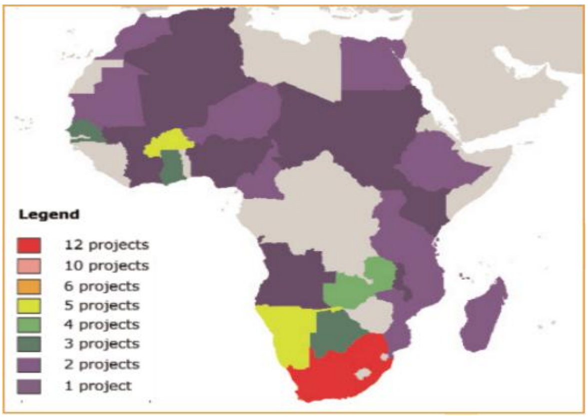
TIGER II spans 13 African countries that work on subjects like sustainable water use, flooding patterns, groundwater resource assessment, hydrological and environmental aspects of wetlands and climate change impacts among others.

During TIGER II 20 projects receive explicit support although it seems that more projects are being executed. It should be noted that the projects only receive support in capacity building and had to find other funds for executing the proposed work.

TIGER does provide: free access to EO data, software tools and scientific advice from international experts as well as dedicated training and research stages in expert laboratories, support for participation in postgraduate courses and publishing scientific results.



Distribution of participants to TIGER I

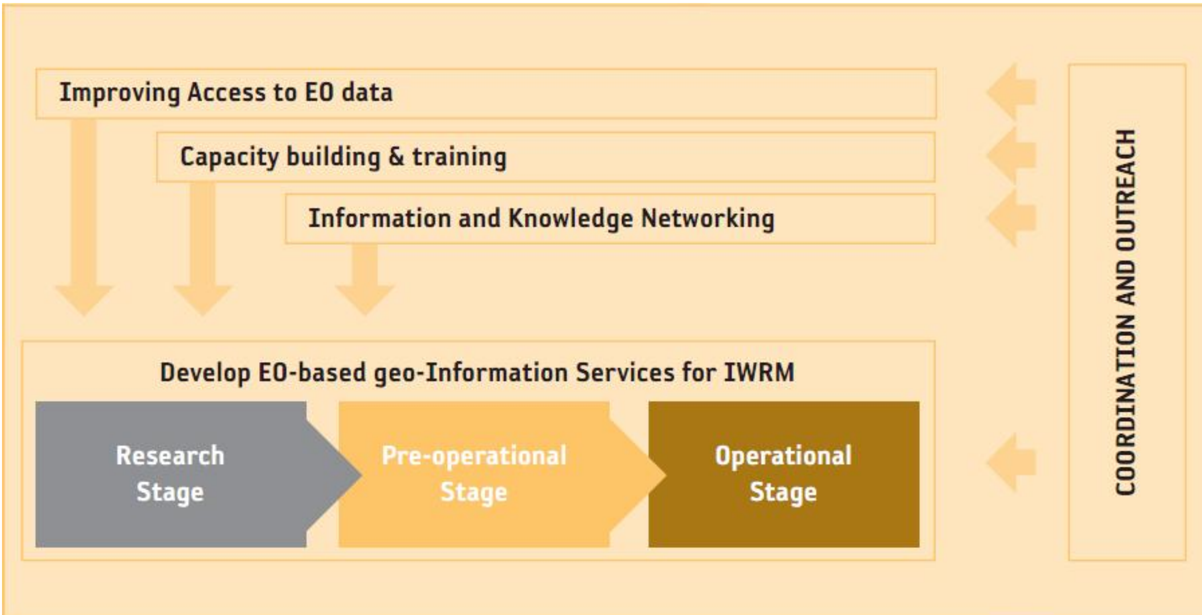


Distribution of research projects in TIGER

I

Locations of the 20 projects selected for TIGER II.

7.1.3 Description of how system/network/forum functions



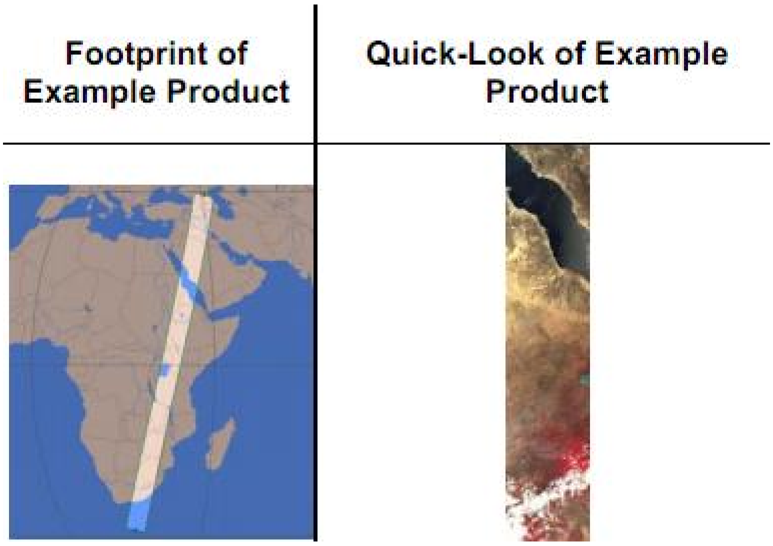
TIGER CBF and regional offices provide coordination and outreach so that the projects can have improved access to EO data, obtain training and work on capacity building and finally improve their information and knowledge networks. This aids the projects to develop EO-based geo-Information Services for IWRM while transitioning from a research stage to the pre-operational stage and finally the operational stage.

7.1.4 Description of the Inputs to system/network/forum

EO data is made available by the participating partners for the projects. The available data was described for the call for proposals and included:

- ENVISAT AATSR (1 km x 1 km resolution)
- ENVISAT MERIS (260 m x 300 m)

- ALOS AVNIR2 (10 m)
- SPOT-2 – 4 (20m x 20m)
- ALOS PRISM (2.5m)
- KOMPSAT-2 MSC (1m, 4m)
- PROBA CHRIS (17/34 m)
- ENVISAT ASAR (30 x 30m)
- ERS SAR (30m)
- ALOSPALSAR (10m)



To give an example: the footprint and a preview of ENVISAT AATSR (1 km x 1 km resolution)

7.1.5 Description of the methods/techniques/models and outputs

Some relevant TIGER I and II projects:

Soil Moisture measurement by remote sensing to enable and improve: Flood Forecasting, Hydrological Modelling, Drought Assessment, Agricultural and Catchment Management in Southern Africa by Geoffrey GS Pegram from Civil Engineering Programme, University of KwaZulu-Natal.Application des Images Satellitaires a L'évaluation et au Suivi des Ressources en Eau dans un Contexte de Variabilité Climatique dans le Bassin Transfrontalier du Bassin du Bani au Mali By Adama Mariko from Ecole Nationale d'Ingénieurs Abderhamane Baba Touré - http://www.eni-abt.com/ad/ad.htm

Intégration des Données Géo-Spatiales pour le Développement d'un Système d'observation des Ressources en Eau dans le Bassin Hydraulique du Sebou : Contribution a une Gestion Adaptée aux Variations Climatiques by Ludovic A. R. TAPSOBA from Centre Royal de Télédétection Spatiale

Some relevant Phase I results

Soil moisture

- Soil moisture composite (1km) for entire SADC (Southern African Development Community) from November 2007
- Mean surface soil moisture anomaly over East Africa derived from ASCAT in May 2008 and May 2009

Water balance, precipitation

- Basin wide water balance map over SAI (Système d'Aquifères d'Iullemeden) for 2005
- Basin wide annual actual evapotranspiration map over SAI (Système d'Aquifères d'Iullemeden) for 2005

Project example: Aquifer Information System: AQUIFER
Develop and demonstrate products and services based on EO technology to support the management of trans-boundary aquifers in Africa (SASS and Iullemeden areas)
Budget: 1,000,000 Euro (Funded by the African Water Facility, AWF)
Carried out by an international consortium led by the German company GAF;
Users: Ministries in Algeria, Libya, Mali, Niger, Nigeria, Tunisia;
User coordinator: OSS;
Local providers: AGRHYMET, Remote sensing centers in Tunisia, Libya and Algeria

7.1.6 Information available from the system/network/forum

The TIGER CBF supports the research projects with tailored capacity building activities. The major objective is to develop human, technical and institutional capacity to use Earth Observation technology within the water management process.Two advanced training courses were held focusing on the main needs of the selected projects. The first course was held at the University of Western Cape, in Cape Town, South Africa at the end of November 2006. A second course was held in November 2007 at the Regional Centre for Mapping of Resources for Development (RCMRD), Nairobi, Kenya.Complementary to the advanced training courses a tailor-made training programme was implemented that consisted of three components:

Enrolment of project staff on core level remote sensing and GIS e-learning courses;Participation of project staff in applied short course modules according to their research topics and needs, both through face-to-face training in ITC and e-learning via World Wide Web; supporting project research in the form of on-the-job training, focusing on the execution of the research projects by personal tutoring and supervision.The programme also foresaw initiatives for MSc/PhD research and training, but additional funds were needed for the complete realization. The available resources permitted the inclusion of participants in

the first phase from 15 projects. However, from the very beginning, ITC promoted and encouraged the other TIGER research projects to participate in the activities of the Facility.
The TCBF included also communication and promotion with activities such as a web site with on-line resources and education material, fresh news, the preparation of a special issue on TIGER in an international scientific journal, press releases, and contributions to the TIGER brochure.

Through the mobilization of additional resources by preparing proposals in collaboration with the partners to suitable donors, the core activities like training sessions and tailored capacity building actions were reinforced.

7.1.7 Evaluation: Assessment of System/Network Capabilities

Considerable expertise must have been developed in TIGER network. Many scientists from the African continent have participated in the project and had the opportunity to improve their knowledge, understanding and capabilities with respect to EO data. The tiger website includes a list of about 60 results of phase one. Many of these results include a project website, but these do not always work any longer. However, project outlines, project presentations and an image of the result is available online. The results include primarily very useful GIS-based maps. Most of these are not directly concerned with drought, but clearly capabilities have been developed which are relevant to DEWFORA.
The results also include Geographic Information Systems and training and outreach materials. Entire courses in EO and RS are available online.

As TIGER I started in 2005, 6 years of expertise is now available with the participating scientists and research centres.
In this time, none of the participants seems to have created an operational (online) information system, but a tender will be held in 2011 aimed development of such systems.

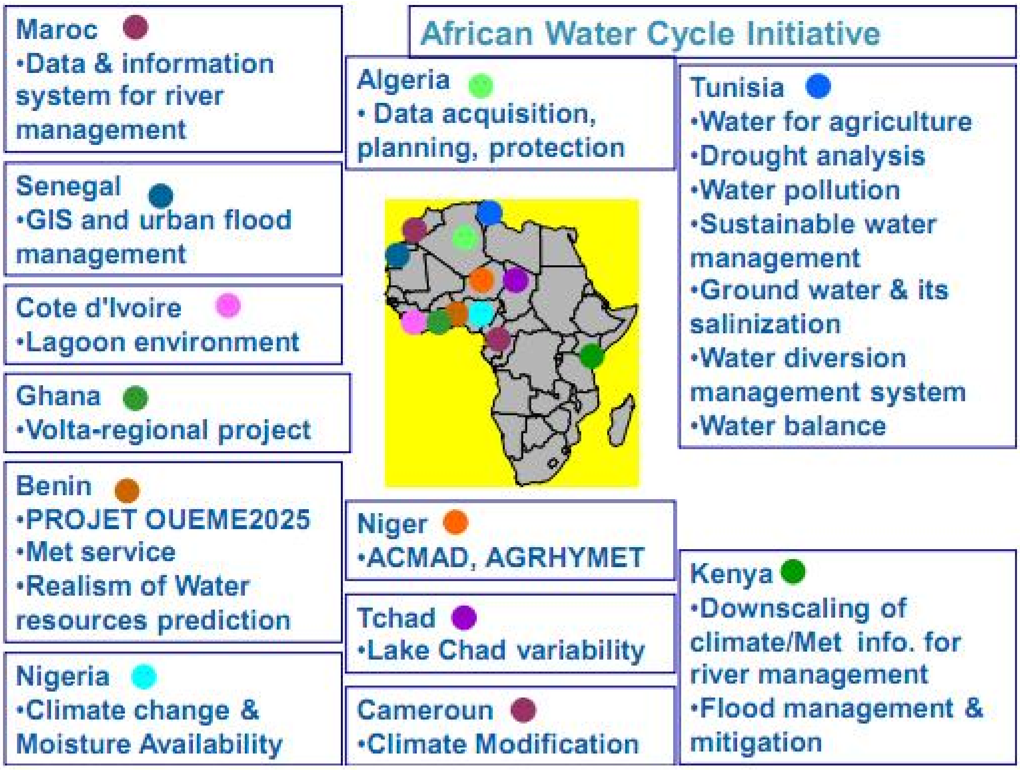
The success of TIGER I was recognized during the First African Water Week organized in Tunis on 25 – 29 March 2008. Here it was recommended to proceed with a second phase, resulting in TIGER II.

7.2 ID: DM AC 02:FACTSHEET17: AFICAN WATER CYCLE COORDINATION INITIATIVE

7.2.1 General information

The African Water Cycle Coordination Initiative (AfWCCI) was launched in Tunisia in January 2009. It develops synergies and cooperation between the various water cycle projects that cover Africa, assists African countries to overcome problems faced in the collection, analysis and dissemination of water-related geo-information, and exploits the advantages of Earth Observations (EO) to build the basis for an independent African capacity and establish sustainable water observation systems. In addition, these activities build on the extension of the Central American SERVIR (visualization and monitoring using Earth science data) for hydrologic applications (e.g., flood warning) to East Africa and possibly other parts of Africa. AfWCCI's efforts contribute to GEOSS, the Global Earth Observation System of Systems which is being built under the coordination of the Group on Earth Observations (GEO).

The first AfWCCI symposium concluded that although the "quantity and quality of available freshwater is crucial for the planning and efficient and sustainable water resources development and management in Africa, the status of the hydrological network is generally inadequate to satisfy the minimum needs for information. To address these problems, The AfWCCI is developing a programme of capacity building initiatives that will build upon the successful results of the CEOS TIGER and the NASA SERVIR initiatives in Africa.



During the first water cycle symposium in Tunis it was agreed that a task team be formed for:

- Assessing water-related issues in Africa
- Making an inventory of observations, modeling and information systems
- Assessing the data policy

- Drafting an implementation plan

The task team met for the first time in in Geneva in 2009 and since then has been actively networking through monthly teleconferences.
In February 2011 the second GEOSS African Water Cycle symposium was held in Addis Ababa, Ethiopia. During this symposium a plan was developed for the AfWCCI. More than 70 participants from 21 African nations and River Basin authorities as well as North America, Asia and Europe attended the meeting.
The Symposium participants identified the key challenges facing African in the water sector. Subsequently, using the white paper on "GEO Capacity Building and water Resource in Africa", three breakout groups were convened along the following thematic lines:

The conclusion from the second AfWCCI symposium (February. 2011, Ethiopia) is that the the AfWCCI will launch two studies in Transboundary African River Basins to explore how the application of GEO principles could benefit the management of River Basins where there is usually limited access to data and information services. The basins are the Nile river basin and the Great Lakes region.
The second AfWCCI also resulted in the "*White Paper on GEO Capacity Building and Water Resources in Africa"*

The timeline for elaboration of the AfWCCI implementation plan consists of:

- March 2011: preliminary draft of 2nd GEOSS African Water Cycle Symposium report (This has been delayed by the recent earthquake in Japan).
- April 2011: reorganization of AfWCCI Task Team into steering committee for 3rd GEOSS African Water Cycle Symposium.
- June 2011: submission of 2nd GEOSS African Water Cycle Symposium report to Preliminary African Caucus consultation in preparation for RIO+20.
- August/September 2011: workshop to select two candidate River Basins for AfWCCI implementation.
- November 2011: AfWCCI submission to Broad African caucus consultation in preparation for Rio+20, organized by UNECA.
- December 2011/January 2012: 3rd GEOSS African Water Cycle Symposium.
- March 2012: present AfWCCI at World Water Forum during side-event on Africa; solicit AMCOW/African caucus support to introduce into Ministerial Declaration.
- June 2010: submission of AfWCCI to Rio+20.
- August 2012: announce AfWCCI at World Water Week.

7.2.2 Information available from the system/network/forum

http://www.watercycleforum.com/pdf/igwco_brochure_2010.pdf - introduction to the IGWCO community of practice

http://www.euwi.net/africa/document/environment/eu-delegation-speaking-points-2nd-geoss-african-water-cycle-symposium - delegate's speech

http://www.earthobservations.org/documents/meetings/201102_2nd_awcs/20110223_25_2nd_awcs_cb_white_paper.pdf - white paper on geo capacity building and water resources in Africa (AfWCCI 2011)

7.2.3 Evaluation: Assessment of System/Network Capabilities

Considerable expertise is available in the network although this expertise predates the AfWCCI. Rather the experts are now coming together, networking and working towards cooperation in the AfWCCI and GEOSS framework.

The African Water Cycle Symposia have played important roles in the establishment of the network and the call for better collaboration and sharing of information.

7.3 ID: DM AC 03: FACTSHEET 18: PRINCETON UNIVERSITY LAND AND SURFACE HYDROLOGY GROUP EXPERIMENTAL SYSTEM

7.3.1 General information

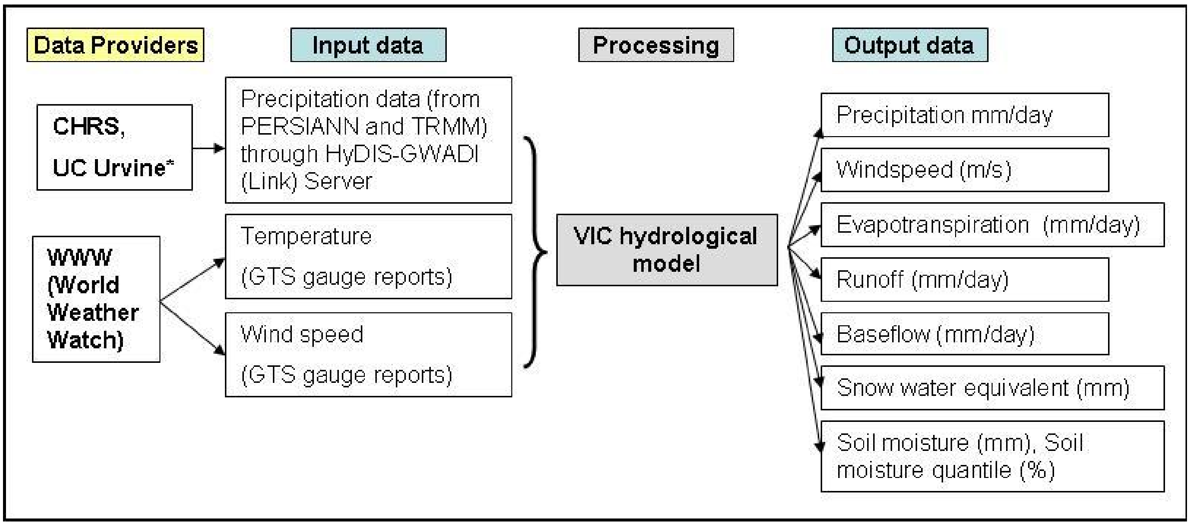
The experimental system was set up by the land and Surface Hydrology Group at Princeton University in 2008 with support of UNESCO-International Hydrology Program.The purpose was to make products available through a dedicated webpage for evaluation by UNESCO-IHP's partners in Africa and other African based groups. The base of these systems is a macro scale hydrological model (VIC) which is forced by a combined model/observation dataset.

7.3.2 Who uses the system/network/forum?

The system is managed by the land and Surface hydrology Group at the Princeton University. The current contact person is Justin Sheffield. The users of the system are first of all the organization who is evaluating the products; UNESCO-IHP's partners in Africa and other African based groups.

7.3.3 Description of how system/network/forum functions

The system works as described in the figure below. Pre-processed precipitation, temperature and wind speed data supplied trough respectively the CHRS (Centre for Hydrometeorology and Remote Sensing, UC Urvine) and WWW (World Weather Watch) is used as input to the VIC (variable infiltration model) land surface model. This VIC model (Gao et al., 2010) is a grid-based large-scale, semi-distributed hydrologic model. Land-atmosphere fluxes, and the water and energy balances at the land surface, are simulated at a daily or sub-daily time step. This model is run and provides near real-time terrestrial hydrology output data for Africa. More specifically the 'Experimental African Drought Monitor' will provide near real-time fields of soil moisture and other hydrologic variables across the African domain for the period of the study using observation forced simulations of the terrestrial hydrologic cycle. It will also provide derived drought orientated products that quantify the current state of drought in the context of the climatology of the region. Based on analysis of historical climatology, it will establish a set of severity-area-duration thresholds for screening evolving droughts. Finally it will monitor where drought thresholds are crossed for soil moisture, and continue to track drought evolution in time until the newscasts indicate that the drought has dissipated.



7.3.4 Assessment of spatial coverage

The system covers the whole continent of Africa at a scale of 1 degree (about 100 km cell size).

7.3.5 Description of the Inputs to system/network/forum

The following parameters are used an input to the system;

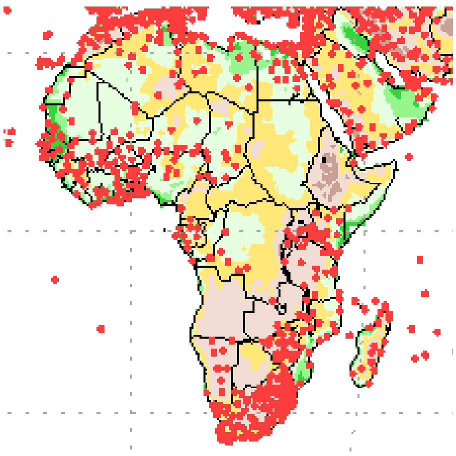
- Precipitation data from PERSIANN and TRMM datasets.
- Temperature and wind speed data from GTS (Global Telecommunications System) gauge reports.

Both remote sensing and in-situ data are used as forcing variables for the model.

Precipitation data are provided by the PERSIANN (Precipitation Estimation from Remote Sensing Information using Artificial Neural Network) and TRMM (Tropical Rainfall Measuring Mission) datasets. The current operational PERSIANN system uses neural network function classification/approximation procedures to compute an estimate of rainfall rate at each 0.25°

x 0.25° pixel of the infrared brightness temperature image provided by geostationary satellites (CHRS, 2011). The Tropical Rainfall Measuring Mission (TRMM) is a joint mission between NASA and the Japan Aerospace Exploration Agency (JAXA) designed to monitor and study tropical rainfall. TRMM, during its mission and broad sampling footprint between 35°N and 35°S, is providing detailed and comprehensive dataset on the four dimensional distribution of rainfall and latent heating over vastly under sampled oceanic and tropical continental regimes. (NASA, 2011)

Temperature and wind speed are in-situ datasets and are provided by the GTS gauge reports. These station reports are exchanged routinely among the World Meteorological Organization (WMO) member countries through the GTS network. WMO's Global Telecommunication System (GTS) is the communications and data management component that allows the World Weather Watch (WWW) to operate through the collection and distribution of information critical to its processes. It is implemented and operated by National Meteorological Services of WMO Members and International Organizations, such as ECMWF and EUMETSAT. (WMO, 2011)



GTS gauge locations for July 1, 2005, plotted on the background of elevation (Climate Prediction Centre, NOAA, 2005)

7.3.6 Description of the methods/techniques/models and outputs

To provide the background climatology for drought assessment, long-term (1950-2000) simulations of terrestrial hydrology are used using the VIC land surface model. The simulation is driven with a hybrid meteorological forcing dataset that combines reanalysis with a suite of observational datasets (Sheffield et al., 2006). The final bias corrected and downscaled forcings are applied at 1.0degree resolution and the resulting hydrologic fields

have been validated against a number of observations including point soil moisture networks, remotely sensed/modeled snow datasets and large basin stream flow.
Such observation-forced simulations offer a way of analyzing historical soil moisture over large time and space scales in the absence of direct observations. An index of drought is calculated from the soil moisture fields and stream flow relative to their seasonal climatology. (Princeton University, 2011)

This system is updated daily with at 2 days behind real-time.
Outputs available through the website are; Precipitation (mm/day), Temperature (degrees Celsius), Wind speed (m/s), Evapotranspiration (mm/day), Runoff (mm/day), Base flow (mm/day), Snow water equivalent (mm) and Soil moisture (mm) and soil moisture quantile (%)
Additionally historic records are available for 6 periods as time series (last 30 days, 3 months, 6 months, last year, last 5 years and last 10 years) for the following variables; precipitation ,evapotranspiration, runoff, base flow and soil moisture.

7.3.7 Information available from the system/network/forum

The output of this system is accessible through the drought monitoring webpage; http://hydrology.princeton.edu/~justin/research/project_global_monitor/index.html
Beside the outputs variables

Additional information can be obtained by contacting the Land Surface Hydrology Group of the Princeton University.

7.3.8 Evaluation: Assessment of System/Network Capabilities

The system is an experimental system. Products are supposed to be evaluated by UNESCO-IHP's partners in Africa.

8 DETAILED DESCRIPTIONS OF REGIONAL DROUGHT MONITORING AND FORECASTING SYSTEMS/NETWORKS/ INSTITUTIONS: NORTHERN AFRICA

8.1 ID: DM R 01: FACTSHEET 19: SAHARA AND SAHEL OBSERVATORY (OSS) / (MAGHREBIAN DROUGHT EARLY WARNING SYSTEM (SMAS)

8.1.1 General information

OSS was created in the aftermath of the 15th G7 Summit, also known as the Summit of the Arche, which was held in Paris from 14 to 16 July 1989. The Summit had recommended the creation of an Observatory that would ensure effective monitoring and protection of the Sahara, which was already considered as a fragile, arid area undergoing an ever-exacerbating natural resource degradation. Hence, **OSS** was founded in 1992as an independent international association at UNESCO, in Paris. In 1997, the general assemble decided to adopt the status of international organization and to transfer its seat to Tunis, Tunisia, which was ratified in 2000.

The main objective has been to give impetus to the combat against desertification and the mitigation of drought by providing member countries and organizations with a forum where they can share experiences and harmonise the ways in which data is collected and processed to feed into decision-support tools. Today, the OSS community includes 22 member countries. It is a North-South-South partnership platform. The funding is in the form of voluntary contributions, subsidies and donations by member countries and organizations, as well as partners (The 4th article of the OSS statute).

OSS coordinated **SMAS project** aiming to establish a Maghreb-wide system for early warning to drought (Système maghrébin d'alerte précoce à la sécheresse, SMAS),. It was implemented in Algeria, Morocco and Tunisia. SMAS project was approved on July, 2005 and launched on March, 2006 in the framework of LIFE-Pays-Tiers Program, which is financed by the European Union.

The main objective of SMAS is to put in place a Maghreb-wide system for drought early warning, to prevent by this way the environmental degradation caused by drought and to improve the response capacity of the concerned countries. The key institutions were implied in each country, so that high-risk zones vulnerable to climate variability can be identified for detection and reaction.

8.1.2 Who uses the system/network/forum?

The statutory bodies of OSS are:

-The General Assembly meets every four years, bringing together all members and partners, to review past activities and to define the programme of activities for the coming four years.
-The Executive Board meets once a year. It adopts the budget and monitors the functioning of the organisation and of the programme of activities.
-The Executive Secretariat ensures the implementation of decisions taken by the Executive Board and General Assembly, and of the programme of activities.

-***The Strategic Orientation Committee*** is a consultative body that provides strategic guidance to the Executive Secretariat.

The partners of the OSS are:

1. Countries

Algeria (AMU)	Kenya (IGAD)
Burkina Faso (CILSS)	Libya (AMU
Canada	Mali (CILSS)
Cape-verde (CILSS)	Mauritania (CILSS / AMU)
Chad (CILSS)	Morocco (AMU)
Côte d'Ivoire	Niger (CILSS)
Djibouti (IGAD)	Senegal (CILSS)
Egypt	Somalia (IGAD)
Eritrea(IGAD)	Sudan (IGAD)
Ethiopia (IGAD)	Switzerland
France	TheGambia (CILSS)
Germany	Tunisia (AMU)
Guinea Bissau (CILSS)	Uganda (IGAD)
Italy	

2. Sub-regional African organizations Arab Maghreb Union (AMU) Inter-Governmental Authority on Development (IGAD)Permanent Interstate Committee for Drought Control in the Sahel (CILSS) Community of Sahel-Saharan States (CEN-SAD)
3. Regional and international organizations
African Centre of Meteorological Applications for Development (ACMAD)African Organization of Cartography and Remote Sensing (AOCRS)Food and Agriculture Organization of the United Nations (FAO)United Nations Convention to Combat Desertification (UNCCD)United Nations Educational, Scientific and Cultural Organization (UNESCO)United Nations Organization General Secretariat (UN-GS)

4. Civil society
Environmental Development Action in the Third World (Enda-TM)
The partners (national) of SMAS are:

- **Remote sensing:** Centre Royal de Télédétection Spatiale in Morocco, Agence Spatiale Algérienne In Algeria and Centre National de Télédétection in Tunisia (CRTS, ASAL, and CNT);

- ***Meteorology***: Direction de la Météorologie Nationale in Morocco, Office National de Météorologie in Algeria and Institut National de la Météorologie en Tunisie (DMN, ONM, and INM);

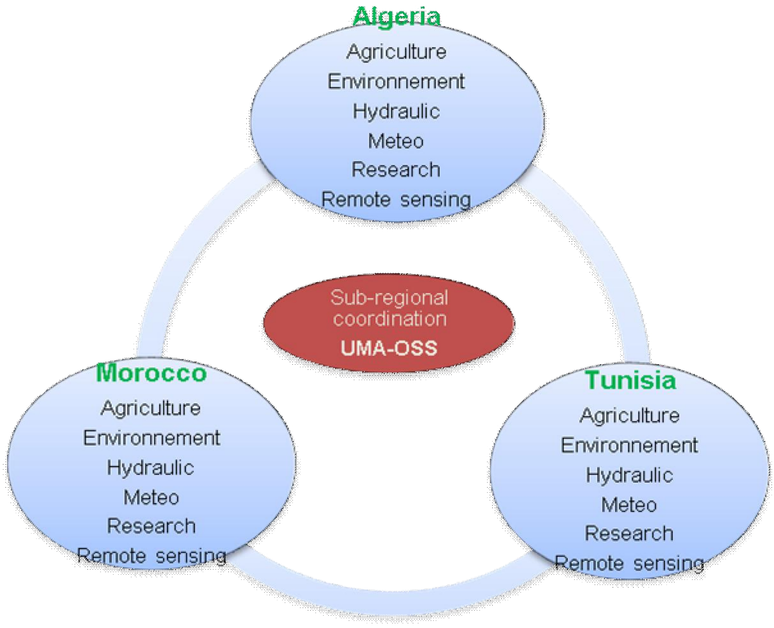
- ***Agro-Ecology***:
  Morocco: Direction de la Production Végétale in Ministère de l'Agriculture and Haut-commissariat pour les Eaux et Forêts (DPV, HCEFLCD).
  Algeria : Direction Générale des Forêts and Centre de Recherche Scientifique et Technique des Régions Arides (DGF, CRSTRA)
  Tunisia, Institut des Régions Arides en Tunisie (IRA)

All these institutions are public and support financially the project. In each country, there is a leader partner (DGF in Algeria, CRTS in Morocco and CNT in Tunisia).

8.1.3 Description of how system/network/forum functions

OSS works in Africa's arid, semi-arid and dry sub-humid regions, in line with the sub-regional, regional and international organizations listed above. OSS assists the member countries and organizations in generating, managing and disseminating information that can be used to ensure sustainable natural resources management.

Concerning SMAS project, a multi-disciplinary approach was used. In order to put early warning systems in place in the countries concerned, the project built on existing achievements in the field of studying and monitoring desertification, and more specifically, drought. The final objective was a work with all the partners towards devising a common early warning strategy for the whole sub-region, namely the Arab Maghreb Union, AMU.



Information flux between partners

8.1.4 Assessment of spatial coverage

The OSS covers countries of Sahel and Sahara, which are listed above. The SMAS project is limited to North Africa: Morocco, Algeria and Tunisia.

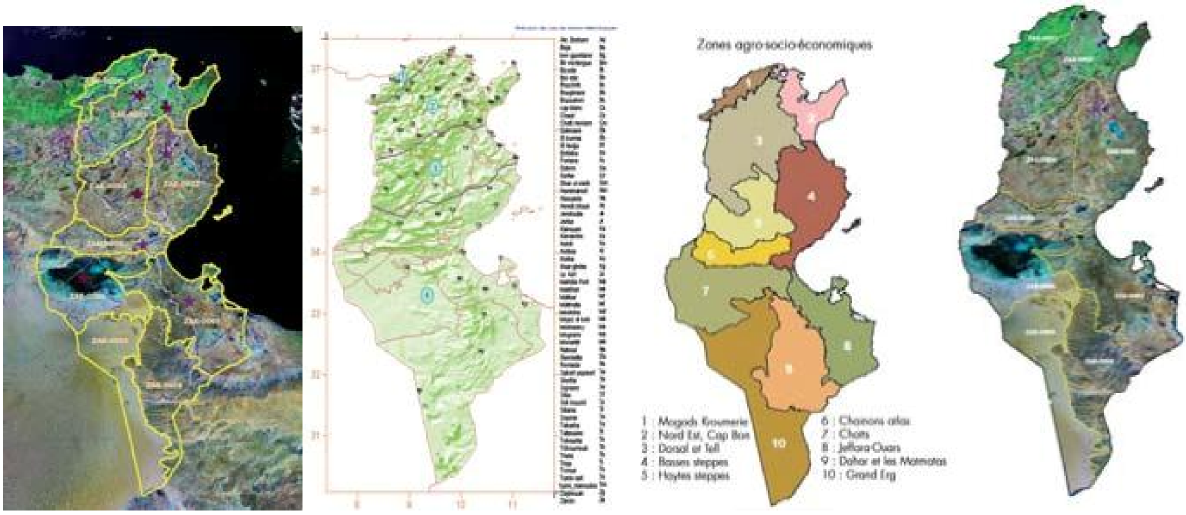
8.1.5 Description of the Inputs to system/network/forum

To assess drought SMAS project used the following parameters:

- Meteorological data
- Remote sensing data
- Agro-ecological data
- Biophysics
- Water resources availability
- Yield production
- Socio-economic data:
- Natural vulnerability

8.1.6 Description of the methods/techniques/models and outputs

The first stage of work was a zoning in each country: Homogeneous agro-ecological areas are determined according to meteorological, agronomical, hydrological and socio-economic criteria as shown by the figure bellow for the Tunisian example.



Spatial data **Climate-Meteorological data** **Agro-socio-economic data** **Agro-ecological data**

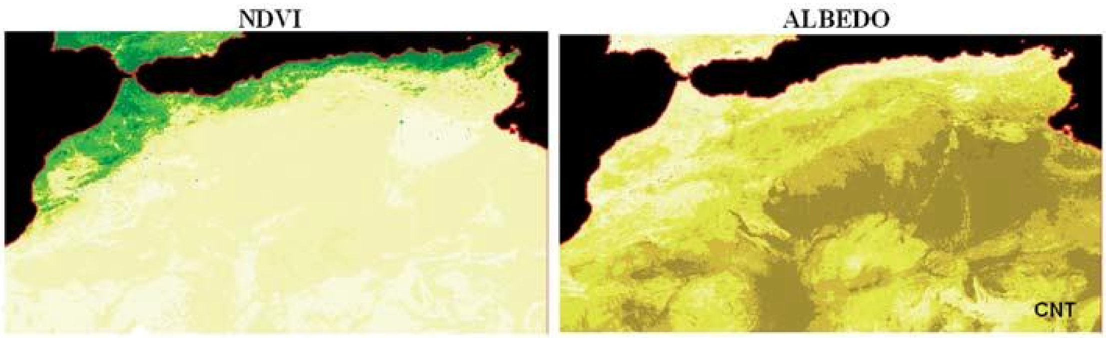
Zoning in Tunisia

The final zoning fixed by SMAS in dialogue with all partners splits Tunisia in 9 homogeneous agro-ecological zones for the early warning drought, characterized by various attributes and descriptors such as the altitude, the rainfall average, the thermal amplitude, the bioclimatic type, and socio-economic criteria.

According to this zoning, several potential indications were tested in order to choose the most adapted to the Maghreb conditions. So, the retained ones by SMAS are:

- Meteorological indicators: SPI, RA (Precipitation deviation/normal);
- Agricultural and forest indicators: Actual water stress, VCI, TCI (using remote sensing);
- Hydrological indicators: SWSI, SWI
- Socio-economic indicators: seed prices, commodity prices, quantity sold and price of livestock food and straw, rural migration.

SMAS partners agreed to fix the frequency of collecting these different data monthly, and to publish each 2 weeks an information bulletin.



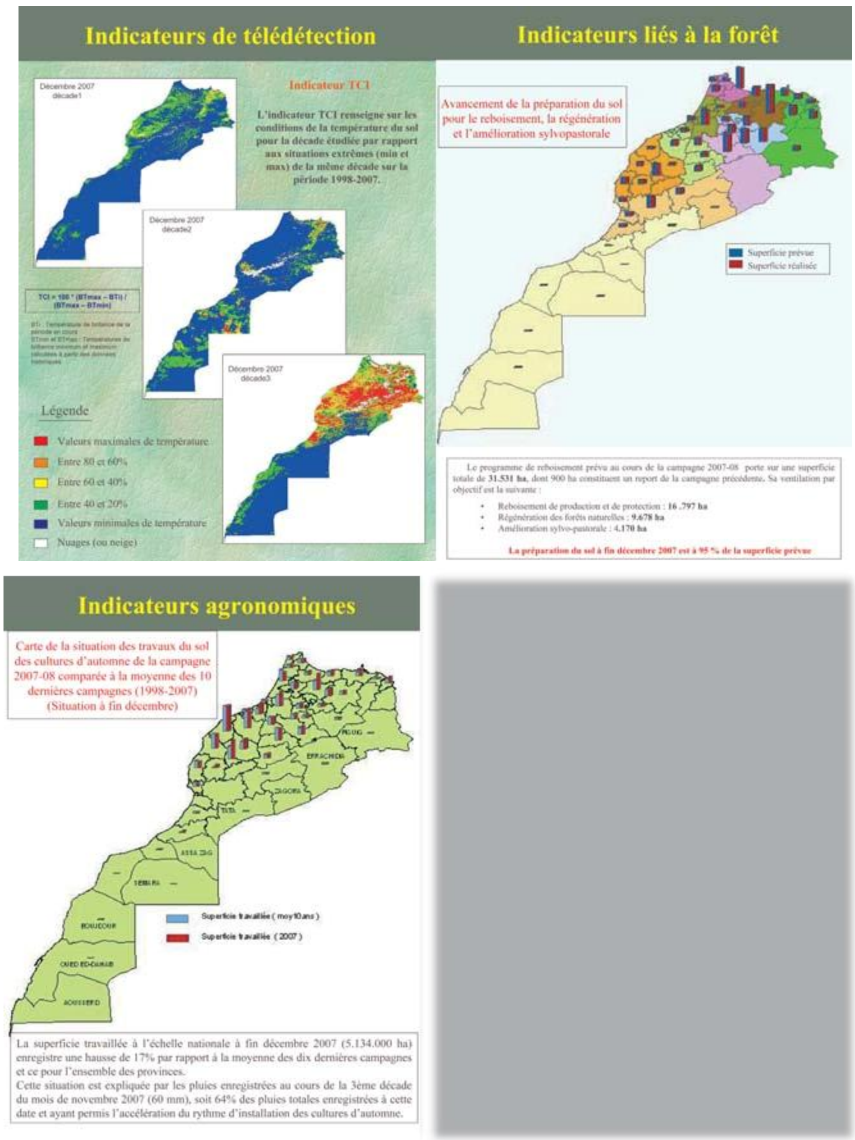
NDVI and Albedo in the Maghreb region

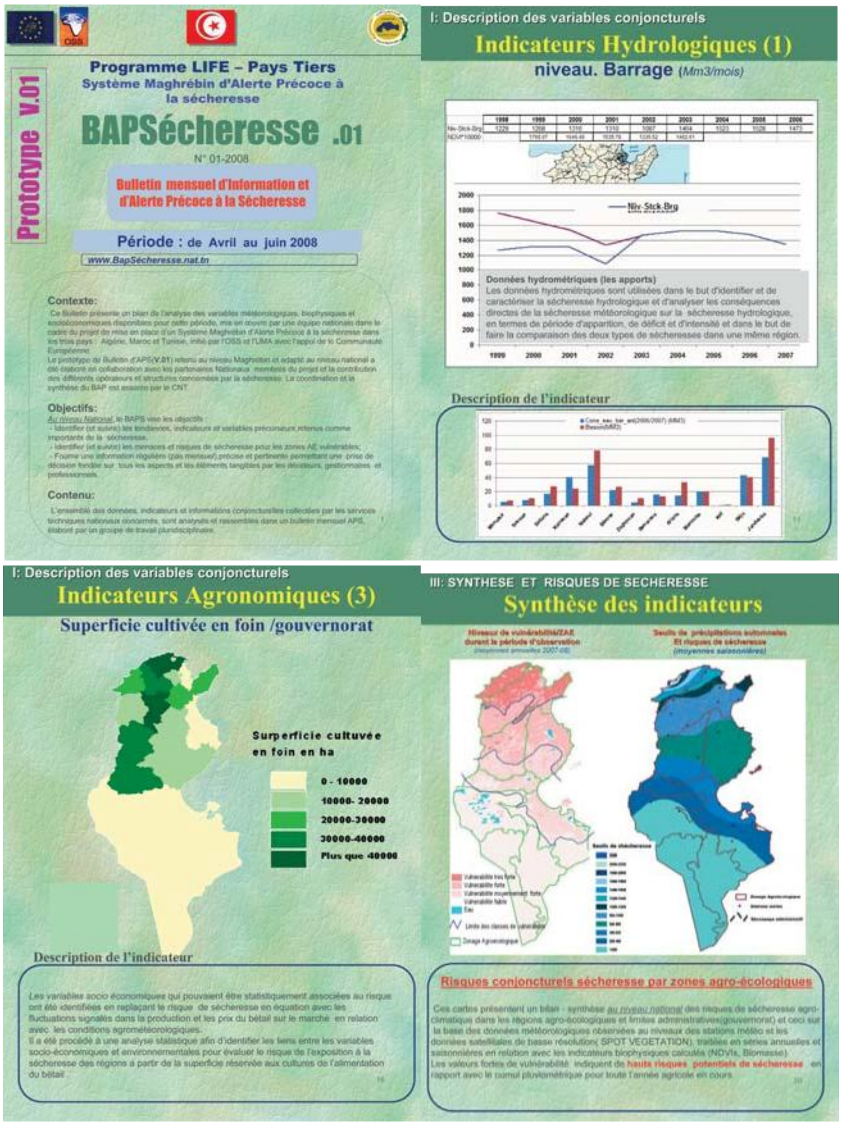
8.1.7 Procedures for developing and interpreting indicators

Refer to sections that follow.

8.1.8 Information available from the system/network/forum

The OSS bulletin: RESONANCE : A monthly newsletter. In the framework of SMAS project, Moroccan and Tunisian partners has already published bulletins between 2007 and 2008.





Published bulletins (SMAS)

9 DETAILED DESCRIPTIONS OF REGIONAL DROUGHT MONITORING AND FORECASTING SYSTEMS/NETWORKS/ INSTITUTIONS:EASTERN AFRICA

9.1 ID: DM R 03: FACTSHEET 21: ICPAC

9.1.1 General information

The Greater Horn of Africa (GHA) was established in 1989 is prone to extreme climate events such as droughts and floods. These extreme events have severe negative impacts on key socio-economic sectors of all the countries in the sub-region.
In 1989, twenty four countries in Eastern and Southern Africa established a Drought Monitoring Centre with its headquarters in Nairobi (the DMCN) and a sub centre in Harare (Drought Monitoring Centre Harare – DMCH) in response to the devastating weather related disasters. In October 2003, the Heads of State and Governments of the Intergovernmental Authority on Development (IGAD) held their 10th Summit in Kampala, Uganda, where DMCN was adopted as a specialized IGAD institution. The name of the institution was at the same time changed to IGAD Climate Prediction and Applications Centre (ICPAC) in order to better reflect all its mandates, mission and objectives within the IGAD system. A Protocol integrating the institution fully into IGAD was however signed on 13 April 2007. The centre is responsible for seven member countries namely: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda as well as Burundi, Rwanda and Tanzania

ICAPC convenes a regional workshop where the NMHs send their climate scientists with their national meteorological data for analysis and development of the forecast. A standard methodology is used by countries to produce the regional forecast. A consensus forecast is then developed in collaboration with the Advanced World Climate Centres for the region. The member states then downscale this forecast for their countries.
ICPAC is a specialized institute of IGAD and gets funding for its operations from IGAD. However, the forums are funded through different donors

9.1.2 Who uses the system/network/forum?

The ten Greater Horn of Africa countries including Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda; World Meteorological Organizations, the Global Producing Centres – participate in the development of the forecasts, Government ministries, humanitarian agencies, development NGOs, e.t.c

9.1.3 Description of how system/network/forum functions

ICAPC convenes a regional workshop where the NMHs send their climate scientists with their national meteorological data for analysis and development of the forecast. A standard methodology is used by countries to produce the regional forecast. A consensus forecast is then developed in collaboration with the Advanced World Climate Centres for the region. The member states then downscale this forecast for their countries.

9.1.4 Assessment of spatial coverage

GHA partner countries

9.1.5 Description of the inputs to system/network/forum

Parameters and data used are rainfall, ssts, qbo, soi, e.t.c and their source is mainly: satellite, in situ, reanalysis. Observations are done on a daily basis.

9.1.6 Description of the methods/techniques/models and outputs

Multivariate regression analysis, dynamical modelling, time series, trend and extreme value analyses are used to input data into the system and drought indicators that are produced are: rainfall anomalies, standardized precipitation indices (spi), drought frequency, magnitudes and duration. The frequency of delivering the outputs is dekadal, monthly and seasonal.

9.1.7 Procedures for developing and interpreting indicators

Multivariate regression analysis, dynamical modelling, time series, trend and extreme value analyses.

9.1.8 Information available from the system/network/forum

Probability of and spatial extent of rainfall and temperature and the system is accesses through ministries of agriculture, print and electronic media, brochures and posters and the information is disseminated thorough electronic and print media, brochures and posters, extension officers (where available), climate outlook forums, email lists, websites.

9.1.9 Evaluation: Assessment of system/network/forum capabilities

This is a network of meteorological services with several climate scientists involved. the problem has been the regular rotation of personnel and the number of in situ stations is not adequate. Techniques are currently adequate but are always undergoing review. The predictors are also reviewed constantly.

The product is in terms of probability and may not be very adequate at local levels.

Most of the indicators currently used are reliable. However, they are sometimes far removed actual requirements and are mainly relevant for capture the large scale systems. Local scale systems are therefore not properly modelled.

The scale of output is not very good for subsistence farmers, highly variable parameter (option) – network of stations, skill limited for wide area.
Lesson learnt is that climate information is useful at local level adaptation, need to have the information in language and terms understandable to the direct users.
Challenges that are experienced by Institutions are:

- Quality of data
- Sparse station network
- Frequent turnover of forecast personnel
- Timeliness of the warning – what lead times do the forecasts have?
- Financial resources

9.2 ID: DM R 04: FACTSHEET 22 : CLIMATE PREDICTION AND APPLICATION CENTRE (IGAD)

9.2.1 General information

In 1989, 24 countries in Eastern and Southern Africa established a Drought Monitoring Centre with its headquarters in Nairobi (the DMCN) and a sub centre in Harare (Drought Monitoring Centre Harare – DMCH) in response to the devastating weather related disasters. In October 2003, the Heads of State and Governments of the Intergovernmental Authority on Development (IGAD) held their 10th Summit in Kampala, Uganda, where DMCN was adopted as a specialized IGAD institution. The name of the institution was at the same time changed to IGAD Climate Prediction and Applications Centre (ICPAC) in order to better reflect all its mandates, mission and objectives within the IGAD system. A Protocol integrating the institution fully into IGAD was however signed on 13 April 2007.

The objectives of the Centre are:

1. To provide timely climate early warning information and support specific sector applications for the mitigation of the impacts of climate variability and change for poverty alleviation, management of environment and sustainable development;
2. To improve the technical capacity of producers and users of climatic information, in order to enhance the use of climate monitoring and forecasting products in climate risk management and environment management;
3. To develop an improved, proactive, timely, broad-based system of information/product dissemination and feedback, at both sub-regional and national scales through national partners;

4. To expand climate knowledge base and applications within the sub-region in order to facilitate informed decision making on climate risk related issues; and
5. To maintain quality controlled databases and information systems required for risk/vulnerability assessment, mapping and general support to the national/ regional climate risk reduction strategies.

ICPAC member counties were to contribute to its annual budget of US$500,000, with each of the ten countries involved contributing US$50,000 each year to its basic operational budget.

The Famine Early Warning Systems Network (FEWS NET) is a USAID-funded activity that collaborates with international, regional and national partners to provide timely and rigorous early warning and vulnerability information on emerging and evolving food security issues. FEWS NET professionals in the Africa, Central America, Haiti, Afghanistan and the United States monitor and analyze relevant data and information in terms of its impacts on livelihoods and markets to identify potential threats to food security.

9.2.2 Who uses the system/network/forum?

The ICPAC system is managed by a secretariat, which draws from regional and international data and human resource. The FEWS NET network is managed by the USGS.

Key partners for the two institutions covering Kenya include;

PARTNER	ROLE
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID)	ACCESS TO INFORMATION AND PRODUCT DISSEMINATION
NASA/GODDARD SPACE FLIGHT CENTER (GSFC)	WEATHER DATA
NOAA/CLIMATE PREDICTION CENTER (CPC)	WEATHER DATA
UN FOOD AND AGRICULTURE ORGANIZATION (FAO/Rome)	SOIL MOISTURE AND LAND USE DATA
DROUGHT MONITORING CENTER, NAIROBI (DMCN) (Kenya)	SOFTWARE HARDWARE INFRASTRUCTURE
REGIONAL CENTRE FOR MAPPING OF RESOURCES FOR DEVELOPMENT (RCMRD) (Nairobi, Kenya)	REMOTE SENSED DATA INFRASTRUCTURE
KENYA METEOROLOGICAL DEPARTMENT (KMD), Nairobi	WEATHER DATA

Among the key users (Fig. 20), of ICPAC of the ICPAC and FEWS NET systems products in Kenya include;

- Ministry of Agriculture
- Ministry of Livestock Development
- Ministry of Special Programmes

- The Kenya Red Cross
- The energy sector
- The Tourism and wildlife sector
- The Water sector, and
- The Health sector

9.2.3 Description of how system/network/forum functions

Once sector issues are identified, both ICPAC and FEWS NET use suites of communications and decision support products to help decision makers' act to mitigate drought, livelihoods and food insecurity. These products include ten day, monthly weather and food security updates for 25 countries, regular food security outlooks, and alerts, as well as briefings and support to contingency and response planning efforts. More in-depth studies in areas such as livelihoods and markets provide additional information to support analysis as well as program and policy development. Both ICPAC and FEWS NET systems also focus efforts on strengthening early warning and food security networks. Activities in this area include developing capacity, building and strengthening networks, developing policy-useful information, and building consensus around food security problems and solutions.

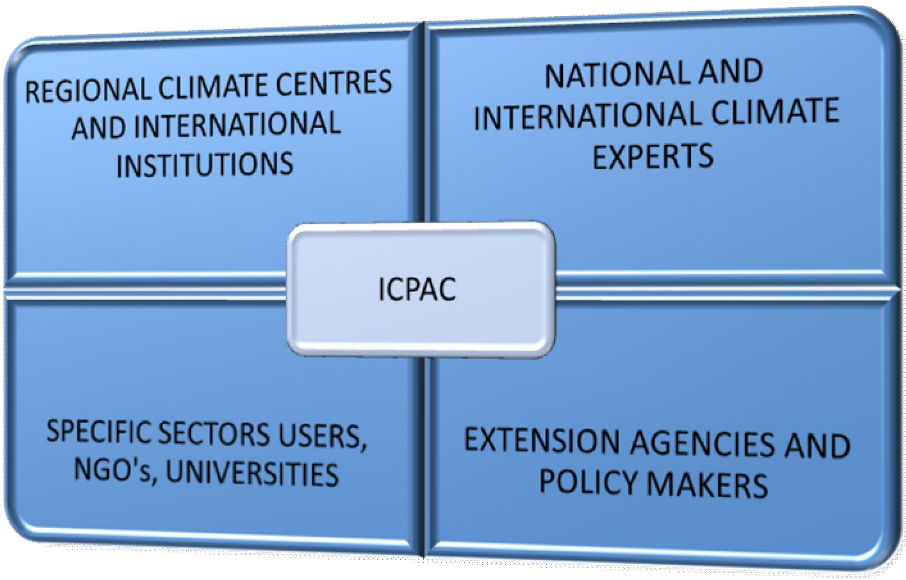


Fig. 20 ICPAC Beneficiaries

10 DETAILED DESCRIPTIONS OF REGIONAL DROUGHT MONITORING AND FORECASTING SYSTEMS/ NETWORKS/ INSTITUTIONS: SOUTHERN AFRICA REGION

10.1 ID: DM R 06:FACTSHEET 24: SARCOF

10.1.1 Background

The Southern African Regional Climate Outlook Forum (SARCOF) is a regional seasonal weather outlook prediction and application process adopted by the fourteen countries comprising the Southern African Development Community (SADC) Member States in conjunction with other partners.

The process facilitates and information exchange as well as interaction among forecasters, decision-makers and climate information users. Its main objective is to promote technical and scientific capacity building in the region in producing, disseminating and applying climate forecast information in weather sensitive sectors of the region's economic activities.

10.1.2 Description of how the system/network/forum functions

The SARCOF process has two layers of involvement. There is meteorological component that focuses on the techniques and other meteorological aspects. Participants that are involved in the SARCOF process at this level include weather forecasters from National Meteorological Services of the region. On the other hand there is application component of SARCOF. On this part participants are policy-makers and stakeholders involved in various weather-sensitive sectors of the region's economies.

User attendance of seasonal forecast meetings is in two parts i.e. at; the regional consensus meeting, and the subsequent national forums. A number of regional users have been sponsored to attend the SARCOF meetings. In terms of understanding the process and the limitations of the final products, regional users have expressed interest in attending the SARCOF meetings.

For both the regional and national seasonal forecasting forums, user specific fora should be encouraged to give user sectors the opportunity to understand at first hand the implications of the particular forecast to the sector. Collaboration is required here for the climate experts and users to jointly produce appropriate guidance for each sector. In terms of the sustainability of this activity, users could be asked to sponsor and finance such an activity on an annual basis.

10.1.3 Capacity building activities and their links with SARCOF end- users

Capacity building forms an integral part of the SARCOF process. The pre-SARCOF training workshops are crucial in providing technical skills to weather forecasters in the region. The workshops normally cover a period of two to six weeks. The main objectives of the workshops are:

- To enhance the capacity of the SADC national meteorological Services in data processing, diagnosis, seasonal climate prediction.
- To develop empirical/statistical prediction models for each country and to down-scale global circulation models (GCMs) products to national level.
- To generate national seasonal climate forecasts for subsequent input into SARCOF meeting.
- To promote application of climate information and prediction by various end users for the socio-economic development of the region.

Since the start of the SARCOF process a total of three training events have been implemented. The training has benefited forecasters from the region who have acquired various techniques in operational seasonal forecasting. Beneficiaries of the training have also been the user community who have had an opportunity to learn the applicability of the outlooks in their respective sectors. The interaction between forecasters and users at various fora has also facilitated close cooperation between National Meteorological Services and user community including user agencies.

11 DETAILED DESCRIPTIONS OF REGIONAL DROUGHT MONITORING AND FORECASTING SYSTEMS/ NETWORKS/ INSTITUTIONS: WESTERN AFRICA REGION

11.1 ID: DM R 02 FACTSHEET 20: ROSELT

11.1.1 General information

The network was established in 1995and the launch in West African Bamako in June 2000. The first phase of ROSELT(environmental monitoring and not monitoring the drought) started in 1995 and ended in 2005. The current phase (2006-2012) is to work on the observatory in the area during the previous period (Mali, Niger, Tunisia and Senegal), some activities are held in Kenya, Algeria and Morocco.

The ROSELT provides regularly a summary of the environmental situation, in a format that allows for a comparison at the sub-regional and regional scales. The Observatories Network for Long-Term Ecological Monitoring(ROSELT)of the OSS (Sahara and Sahel) is a tool that was designed as a bridge between countries where desertification is a major concern requiring the mobilization of potential synergistic scientific and technical and know-how to try to stop, slow down or at least better control mechanisms of this phenomenon.

The financing is ensured by financial partners of the North: Switzerland, French Fund for Global Environment Facility, GTZ, Italian Cooperation. In-kind contribution by the recipient countries was obviously necessary for the proper functioning of the project.
Globally between 300 000 and 400 000 € /year.

11.1.2 Who uses the ROSELT?

The ROSELT is coordinated at the Sahara and Sahel Observatory. However, ROSELT units are at the country level(implementation partners).

- African Center for Meteorological Applications for Development (ACMAD)
- Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD)
- Integrated Development Authority of the Region of Gourma-Liptako
- African Development Bank (AFBD)
- Economic Commission for Africa
- International Fund for Agricultural Development (IFAD)
- United Nations Institute for Training and Research (UNITAR)
- League of Arab States (LEA)

- o African Organization of Cartography and Remote Sensing (OACT)
- o World Meteorological Organization
- o United Nations Program for Environment

The users are agents of development in countries that use the results of ROSELT to empower the various national programs (Climate change, desertification…).ROSELT reports are sent at the focal point of ROSELT of each country. Other users have access to reports on the website of ROSELT.

11.1.3 Description of how system/network/forum functions

Each ROSELT / OSS report provides regularly a summary of the local environmental situation, in a format that allows for comparisons at the sub-regional and regional levels. The data collected are made available to regional institutions and used to produce indicators and integrated environmental monitoring tools.

These indicators and tools, and sub-regional synthesis will then be integrated into the monitoring and evaluation systems set up by the Arab Maghreb Union(AMU) and the Inter-State Committee to Fight against Drought in the Sahel(CILSS) as part of their of sub regional program action and feed their information systems on the environment.

The role ROSELT network in this process is to assist countries to organize all the data, information and metadata available and to produce indicators of environmental change and regional overviews of the state of the environment

From its inception, the ROSELT/ OSS network has been applied to:

- o refine the concept of environmental monitoring at the local level and develop techniques and methodologies for collecting and processing data;
- o Test the working hypothesis, based on knowledge of desertification processes, to produce at lower costs, tools for decision support. Tools should be reliable and reproducible in maps format, indicators or information systems;
- o Develop and validate standardized methodologies for collecting and processing of biophysical and socio-economic data. The latter should be used to develop a set of synchronic and diachronic indicators and allow comparisons between different observatories;
- o Create a model to simulate the impact of the use of natural resources. This model will provide a spatial assessment of available resources in relation to their use (agriculture, livestock, fuel wood). It will also generate scenarios and maps of risk index to desertification.

11.1.4 Assessment of spatial coverage

The ROSELT covers the Circum-Sahara, namely Mali, Senegal, Niger, Tunisia, with some activities to Algeria, Morocco and Kenya.

11.1.5 Description of the inputs to ROSELT

Series of bio-physical data:

- Climate: Precipitation (amount and spatial and temporal distribution), meteorological data;

- Soil and water: Quality and spatial distribution (surface soil, soil, surface hydrology and hydrogeology);
- Vegetation: production, structure, quality, spatial distribution and floristic biodiversity;
- Fauna: Structure and spatial distribution of domestic livestock and wildlife;

Series of socio-economic data:

- Population : Census and localization
- Households micro-economics

Series of interface data:

- Rules of access to land resources**;**
- Characterization of uses / activities: Farming systems/exploitation;
- Production and harvesting (agriculture, pastoral and forestry).
- Satellite and aerial imagery**:** based on extrapolation and spatial data field; to refine existing maps of the environment and follow the dynamics of the land use and vegetation.

LANDSAT satellite data are used in the ROSELT as well as network and other data are from their representative in each country.

The data are mainly data collected in the field(measured and/or observed, not developed), supplemented where possible(accessibility, cost, suitable resolution) with remote sensing data in the frame of long term monitoring. They are the basis for the production of ROSELT / OSS by translating the basic information most directly related to the phenomenon observed or measured. They are also inputs and parameters embedded in the tools of information processing, in models of spatial processes studied, to develop the ROSELT/ OSS decision support products. The outputs are usually provided annually(after the campaigns of data collection).

11.1.6 Description of the methods/techniques/models and outputs

The method/ technique/ model applied to the input data is the introduction of harmonized system of sampling and data collection. The sampling is based on the following principles. It must be established as soon as possible in anticipation of:

The integration of data from the management system and information processing(SIEL);

The development of spatial models of the processes studied from samples (a model, with its own parameters and its own rules, must be developed at each level of organization);
The application of models to a sample of the entire country observed (generalization);
The extrapolation to the region represented.

Indicators are:
Biophysics indicators, socio-economic indicators of desertification, indicators of the prospects. The outputs are usually provided annually(after the campaigns of data collection)

Procedures for developing and interpreting indicators:
The project focused primarily to enhance the coherence of multidisciplinary teams of national observatories and secondly the valuation of data collected in the field. Historical data available in the national observatories were combined and used to establish an environmental condition that would serve as a reference for diachronic environmental studies. Interpretation of the results provides an overview on the evolution of the environment and products ranging from thematic maps to scientific papers:
a wide range of thematic maps such as maps of land tenure, maps related to physical characteristics, maps of risk index to desertification; Satellite and aerial photographs have sometimes been used to refine these maps;

- information system on the local environment (SIEL) ;
- the basis of metadata that allows are al sharing of data across the network;
- indicators kit at local and regional;
- the scientific and technical collection ROSELT/ OSS which includes, among others, methodological guides and national scientific and technical reports;
- synthesis sub-regional and regional environmental change and socio-economic

11.1.7 Information available from the ROSELT

The integration of data from the management system and information processing (SIEL); the development of spatial models of the processes studied from samples(a model, with its own parameters and its own rules, must be developed at each level of organization). The application of models of the sample to the entire country observed (generalization). The extrapolation to the region represented.

COUNTRY	LOCATION	AREA	CLIMATE	TYPE OF SYSTEM	ACTIVITY
CAP VERT	Ribeira Seca	22 000 ha	Tropical, semi-arid and arid coastal ocean variation in monomodal	Agroforestry systems	Rainfed, irrigated

MALI	Cercle de Bourem: zone-test de Bamba	50 000 ha	Tropical, arid monomodal	Savanna ecosystems and agro systems Sahelian	Pastoral systems, flood-recession farming, irrigated farming, fishing
MAURITANIA	Nouakchott	40 000 ha	Tropical, arid and arid coastal ocean variation in monomodal	Peri-urban ecosystems degraded coastal Ecosystems	Pastoral systems
NIGER	Torodi – Tondikandia – Dandiantou Keita	69 800 ha 40 000 ha 486 000 ha	Tropical, semi-arid monomodal	Savanna ecosystems and agro systems Sahelian	Rainfed, irrigated crops, grazing systems
SENEGAL	Grappe du Ferlo, 3 sites : Souilène, Widou, Linguère	2 600 000 ha	Tropical, semi-arid monomodal	Savanna ecosystems and agro systems Sahelian	Rainfed, irrigated crops, grazing systems

Internet, publication, booklets, posters,
They give the evolution of the environment and products ranging from thematic maps to scientific papers.

<u>Expertise involved in the network</u>

- Sahara and Sahel Observatory;
- International Geosphere-Biosphere Programme;
- Programme of the UNESCO on Man and Biosphere ;
- Long Term Ecological Research;
- French Ministry of Ecology and Sustainable;
- National Centre for Space Techniques ;
- Arab Maghreb Union;
- Inter-State Committee to Fight against Drought in the Sahel (CILSS).

Network Observatory for Long-Term Ecological Monitoring (ROSELT) was set up by the Sahara and Sahel Observatory (OSS).

The data input are adequate to the methods, because the production of quality results is related to it. These depend on both the sampling, processing and interpretation of these data. The approach ROSELT provides an harmonization of techniques for collecting data for at least the ability to set a baseline or reference for comparison of results
Techniques are adequate for their purposes.

The system provides information and publications on their website. It also produces brochures, scientific publications, booklets, posters, etc. The accuracy of the indicators are at the height of hope, but the network meets some difficulties on the interpretation of certain parameters:

1. Areal difficulty is encountered in the use of old data for their integration as a basis for evaluating existing resources(e.g. assessing the suitability of soils for Menzel Habib, either approach "diachronic" which compares the instantaneous descriptions to evaluate changes during the period between these descriptions).
2. Designs and different definitions are assigned to the same object, concept or process by different authors or schools. It is thus necessary to unify the senses or at least to be clear in the confrontation of several results.
3. The covered area is highly variable from one observatory to another.
4. The spatial scale is appropriate for decision making.

Highlights of Roselt through observations and measurements are: the mass of data collected, the development and integration of old data, the effort in the analysis and interpretation of data reflects the results in an interdisciplinary frame. What has been already achieved through the network is a challenge given:

- the previously scattered work state and the teams isolation involved in the study of arid ecosystems and desertification in the Sahara territory;
- the difficult harmonization of approaches in a diverse set of situations, experiences and problems already engaged in research projects in progress;
- the insufficient level of knowledge on the dynamics of dry land ecosystems in general because of the complexity of dynamic interactions between the dynamic systems, scales and levels of action/feedback.
- The nature of university teams, which traditionally required some scientific originality incompatible with the routine mode of long-term monitoring;

The ROSELT / OSS has already succeeded in creating a climate of collaboration between teams often which did not know before and now are existing and established “living network."

11.1.8 Challenges that the system/network/forum is experiencing

The long-term monitoring in general and in particular ROSELT uses approaches that are not common in traditional research. This is continuously monitored by techniques and devices requiring a work type 'routine', which is not consistent with traditional approaches to university and academic. This feature explains a number of difficulties experienced and future:

The organization of environmental monitoring network requires both coordination and sustainability of observatories to meet their long-term dimension. Observatories should be integrated into national schemes by enrolling in an institutional approach for ensuring the sustainability of resources and activities. This must lead to the appropriation of the approach by the relevant institutions in different countries (some examples exist already) but must also overcome the difficulties of institutional fragmentation often in force.

It is an environmental approach to large-scale theme that supports and mobilizes all the information and historical data, recent or ongoing, to establish the basis of validated knowledge through interdisciplinary fields and appropriate to the development of the decision support products. Yet often, the academic tradition and structuring have promoted specialization and reduction is enemy of interdisciplinary and systemic approaches to which the trend is still insufficient and slow. The study of the effect of a disturbance must take into account all the synergies that can be identified only through cooperation between the disciplines, in order to identify and evaluate all factors, both biophysical and socio-economic implemented by the disturbance.

The long-term monitoring is based on simple variables providing data that, in "quiet" times, do little interest because of variables giving low dispersion(or variation) relevant the statistical analysis. In arid climates, that is the case during dry periods. Remember that many observatories began their monitoring activity during a very dry period, which is often regarded as a phase that does not require observation " you do not measure the vegetation when a plant does not grow". When, for example, in an observatory, plant biomass and vegetation cover is not measured due to drought, it is missing data that cannot be validly replaced by zero unless an effective measure provides this value;

At the equipment of permanent stations, it seems important to note that due to the necessary continuity of observations, it is imperative to search for the most resistant devices can withstand a harsh environment and over time. In this context, it is recommended to have an alternative in case of malfunction or breakdown. For example, an automated and sophisticated recording rain gauge must be accompanied by a simple rain gauge counter but more "rustic" used as a rain backup.

12 DETAILED DESCRIPTIONS OF NATIONAL DROUGHT MONITORING AND FORECASTING SYSTEMS/NETWORKS/ INSTITUTIONS:NORTHERN AFRICA

12.1 ID: DM NNA 01: FACTSHEET 27: NATIONAL OFFICE OF METEOROLOGY (ONM)

12.1.1 General information

The National Office of Meteorology, created in 1975 is a public institution with an industrial, commercial, scientific and technical character since 1998. It is based in Algiers, attached to the Ministry of Transport and its main mission is to implement the national policy in terms of Meteorology through the gathering, treatment, exploitation and diffusion of national and international meteorological data. The ONM is composed of a general direction, central functional and operational departments, and six regional meteorological departments (West, East, Centre, South, South-east and South-West).

At the central level, the ONM has two main technical departments:

- The National Centre of Meteorological Forecasts (C.N.P.M) which:
  - Contributes to the design and set-up of information systems for the management and dissemination of climatological data through automatic acquisition of meteorological data observations, quality control, dissemination, analyses, and adequate storage of climatological data
  - Develops research/studies on climate and its impacts at a national and regional scale: Contribution to the knowledge of the climate processes, collaboration in coordinated research with national and international institutions with the aim to monitor permanently the climate variability and change in Algeria and around the Mediterranean basin, and promotion of the application of climate information and services for to the benefit of appropriate socio-economic systems.
- The National Climatologic Centre (CNN) which is charge of:
  - The management of the meteorological data base
  - The assistance to users, climatologic studies and seasonal forecast bulletins
  - The Climatic watch

At the regional level, the 6 regional departments are decentralized structures composed of:

- A climatic division in charge of data collection and control
- A division of exploitation in charge of regional forecasts
- A maintenance division in charge of the maintenance of the meteorological equipments
- Commercial and communication sections

12.1.2 Who uses the system/network/forum?

The National Office of Meteorology is attached to the Ministry of Transport and managed by a General Direction based at Algiers.
Its main national partners are:

- All the departments of the Ministry of Water resources and in particular the National Agency for Hydrological Resources, the Hydraulic Basin Agencies, the Directions of Hydraulics of the Wilayas
- The Ministry of Agriculture
- The Scientific and Technical Research Centre on Arid regions (CRSTRA)

- The Algerian Spatial Agency

Besides these national partners, the National Office of Meteorology has international partners:

- The Sahel and Sahara Observatory
- The African Center of climatology ACMAD
- France-Meteo, INM Tunisia, DMN Morocco, Mali-Meteo, Mauretania-Meteo
- The Aladin Consortium

The National Office of Meteorology offers climatic assistance and meteorological services to different socio-economic users such as:

- Coastal enterprises
- Agriculture
- Industry and Energy
- Marine and Aviation

12.1.3 Description of how system/network/forum functions

The meteorological stations represent a functional network that ensures a national meteorological watch. The Regional Meteorological centers of the Wilayas coordinate all the meteorological activities at the Wilaya scale and feed the national level or a specific user sector. The national office of Meteorology has a data base of all the climatic parameters at different time scale (hourly, daily monthly, annually) and produce also short, medium, and seasonal meteorological forecasts (rainfall and temperatures) . Thanks to this data base, the ONM produce and diffuse periodical bulletins and publications and provide climatic support services to different socio-economic sectors.

12.1.4 Assessment of spatial coverage

The National office of Meteorology has a national and local coverage but provide also information about the international weather.

12.1.5 Description of the Inputs to system/network/forum

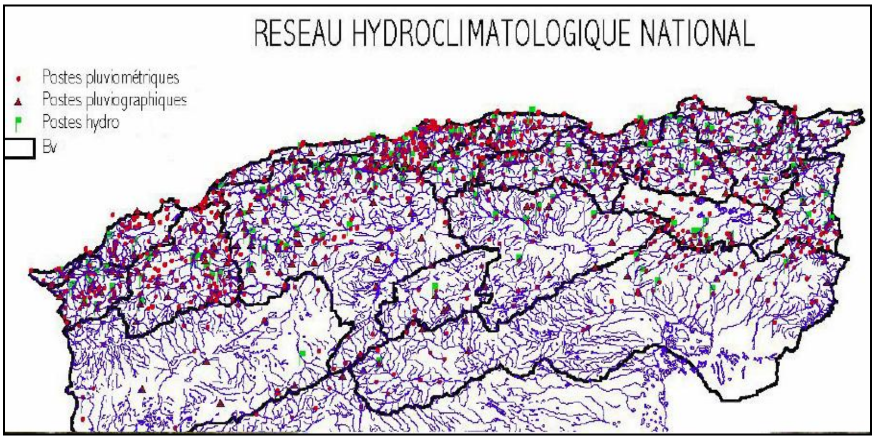
The national Office of Meteorology monitors:

- Temperatures
- Precipitations
- Wind direction and speed
- Insulation, evaporation, air moisture

These parameters are recorded thanks to a network of monitoring stations spread across the country and composed of:

- 1000 pluviometric stations
- 400 climatic stations (117 synoptic stations)
- 5 meteorological radars

The following map shows the active monitoring points of the northern part of the country. Currently, the distance between stations is about 30 Km but the ONM wishes to increase the number of climatic stations and reduce that distance to 9 Km in order to increase the precision of climate watch.



Pluviometric stations network of Northern Algeria

12.1.6 Description of the methods/techniques/models and outputs

The ONM produce several indicators with the raw parameters monitored by the rainfall and climatic stations:

- The deviation from the mean: which is the difference between the annual total of precipitations (Pi) and the annual average precipitations (Pm): Em = Pi – Pm. This difference is positive when the year is humid and negative when the year is dry.

- The ratio to the mean (rainfall index): which is the ratio of the annual total of precipitations (Pi) to the annual average precipitations (Pm): Ip = (Pi/Pm). The year is humid if this ratio is superior to 1 and dry if it is inferior to 1. In order to compare several years within a long serial of annual rainfall data, we can use the proportional deviation to the mean: Ipm = Ip – 1. The cumulating of indices for several years reveals the global tendency towards humidity or drought.
- Drought intensity: which is defined as the ratio of the deficit (Pi – Pm) to the mean Pm. For drought events longer than one year, intensity is the summation of the annual intensities
- The length of the dry period: which is the number of months over the last 5 years during which rainfall >20% lower than the 30yr average for the month (data accumulated over all referenced climate stations / # stations)
- The length of the wet period: which is the number of the months over the last 5 years during which rainfall >20% higher than the 30yr average for the month (data accumulated over all reference climate stations / #stations
- Global Radiation calculated with the length of insulation
- The maximum Evapotranspiration calculated with the method of Penman
- Water Balance, Moisture index
- Seasonal long term forecasts (Al Mafissa program)

12.1.7 Procedures for developing and interpreting indicators

In Algeria, there is no public entity especially devoted to drought monitoring and mitigation. ONM plays a key role by collecting, analysing and diffusing meteorological information and drought situation through periodical bulletins. An operational national centre of assistance to decision (CNAD), attached to the Ministry of Interior is in charge of collecting, interpreting, and diffusing in real time all the information given by all early warning systems, from any kind. This centre evaluates crises situations and issues warning towards public powers. It is also in charge of identifying reaction measures to be undertaken with the concerned sectors.

12.1.8 Information available from the system/network/forum

The ONM provide information about meteorological drought monitoring and seasonal long term forecast. This information are disseminated through the institution website, periodical climatic bulletins (decadal, monthly, annual) and a periodic meteorological information letter. The decadal bulletin compiles several raw and derived climatologic parameters, graphs (precipitation and temperatures) and a decadal climatologic analysis. The monthly and annual bulletins present several data, graphs, maps and analysis of the meteorological situations that prevailed during the previous month or year.
In the frame of its activities of formation and information organized for its different partners and users, the National Center of Climatology organizes on a regular base national information days covering several themes such as:

- Climatic and Meteorologic extreme phenomena (drought and floods) risks
- Seasonal forecasts as decision support tool

12.2 ID: DM NNA 02: FACTSHEET28: NATIONAL AGENCY FOR WATER RESOURCES (ANRH)

12.2.1 General information

The National Agency for Water Resources (ANRH) is an administrative public institution of scientific and technical vocation endowed with the moral personality and the financial autonomy. It was created by the decree n° 81-167 of the 25th July 1981. It is placed under the Ministry of Hydraulics supervision, and its head office is based in Algiers. Its main missions are to:

- Prospect and evaluate water and soil resources of the country
- Follow up periodically resources at the quantitative and qualitative levels
- Preserve and protect the resources against any form of deterioration

In order to fulfill these missions, the institution relies on a certain number of technical and scientific tools linked to the following themes:

- Hydro geological and hydro climatic studies
- Prospection by surveys and drilling
- Map-making of ground water and rainfall
- Remote detection applied to resource knowledge
- Inventory of polluting agents and map- making

In the ground waters field, the agency is assigned:

- To do the inventory of the ground water resources of the country;
- To conceive, to install and to manage the controlling networks of the ground waters;
- To draw up the hydro geological maps and those of ground resources;
- To keep the balance of ground water resources and their use in continuity;
- To look after the ground water resources preservation in terms of quality and quantity;

In the surface waters field, the agency is assigned:

- To conceive, to install and to manage the national hydroclimatic network, intended for the elaboration of the national water balance;

- To entertain, to make out, to archive and to distribute the hydroclimatical data;
- To carry out the general methodological studies on the hydroclimatic regimes for the inventory of the surface water resources;
- To study the hydrological phenomenon on the experimental basins such as: the erosion, the water streaming, the water seepage and evapotranspiration;
- To place and to manage the networks of preventive floods.

In the irrigation and drainage field, the agency is assigned:
- To achieve an inventory of soil resources, intended for being evaluated by irrigation and drainage;
- To determine and to draw up maps of the hydro-dynamic characteristics of irrigable soils, in collaboration with the National Institute of Cartography (INC);
- To study the needs for water of cultures as well as areas of irrigation and drainage, intended for the elaboration of country planning, irrigation and drainage projects;
- To study the evolution of the saltiness of soils and surface waters in the irrigated zones and to provide with the relative elements for their protection and safeguard.

12.2.2 Who uses the system/network/forum?

The Hydraulics Resources National Agency is attached to the Ministry of Water Resources. In order to achieve its missions, the ANRH developed links with:
- The Ministry of agriculture
- All the other departments, agencies and institutions attached to the Ministry of Water Resources: (ANBT, ONID, ADE,ONA, OPI,DHW, DEW, ABH)
- The National Meteorology Office (ONM)
- The National Institute of Cartography (INC)
- The National Spatial Agency
- The Ministry of Research and Higher Education
- The international services of Cooperation (IRD, GTZ….)
- The Sahara and Sahel Observatory (OSS)

Since the 5 Hydraulic Basin agencies (ABH) are involved in water management at river basin scale, they represent a privileged partner of the ANRH. Indeed, the ABH elaborate and update the hydraulic cadastre and the hydraulic balance of the hydrographical basin. They collect for that objective, all statistical data, documents and information on water resources, samplings and water consumptions and complete the action of the ANRH.

- Hydrographical Basin Agency of the Sahara: www.abhs.dz
- Hydrographical Basin Agency Oranie- Chott- Chergui: http://www.abhoranie.dz
- Hydrographical Basin Agency Chéliff – Zahrez: http://www.abh-cz
- hydrographical Basin Agency Algérois- Hodna- Soummam: http://www.abhahs.org
- HydrographicalBasin Agency Constantinois-Seybousse-ellegue: http://www.abhcsm.dz

12.2.3 Description of how system/network/forum functions

The ANRH comprises 6 divisions, 5 of which are of technical character and one administrative one, and 6 regional branches radiating with the multidisciplinary activities on the whole national territory. In the face of the evolution of techniques in the field of water and soil, the agency is endowed with a research department to improve knowledge and provide methodological tools to technicians and the study of the extreme hydrological phenomena like droughts and floods figures among the main research themes

12.2.4 Assessment of spatial coverage

Through its central and regional directions, the ANRH have a local and national coverage and produce national and local maps.

12.2.5 Description of the Inputs to system/network/forum

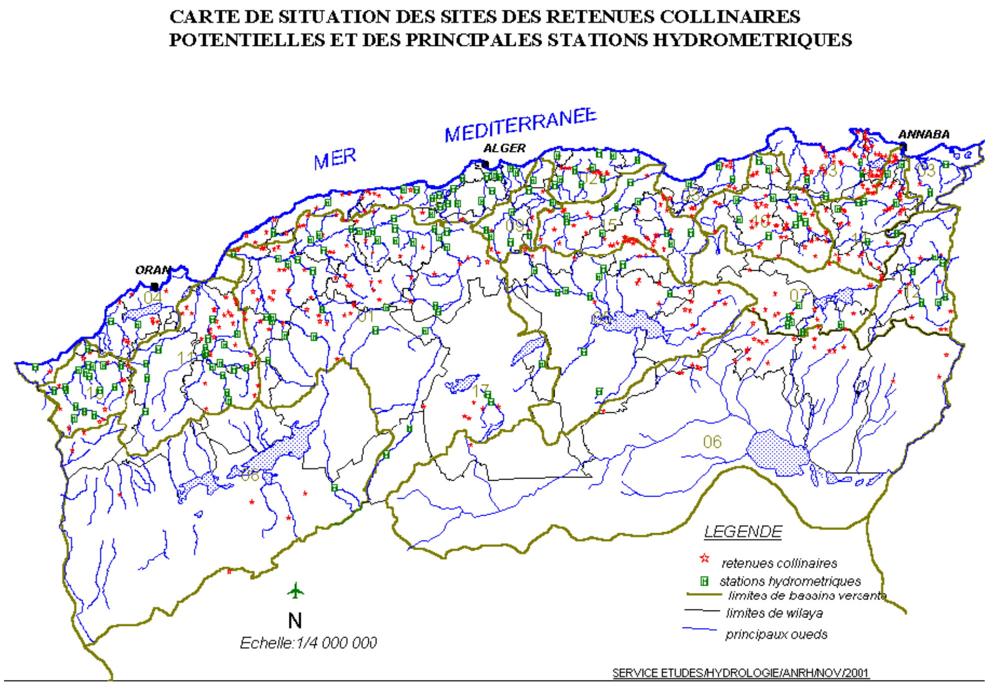
In the field of surface water resources, the ANRH manages a network of monitoring hydro-climatic stations spread all over the country. It is composed of:

- 220 hydrometric stations
- 860 rainfall stations
- 36 pluviographs
- 56 synoptic climatic stations

The collected data are controlled, treated and implemented in a data base. The following hydro climatologic parameters are monitored:

- Climatology : temperature, air moisture, wind speed, atmospheric pressure, evaporation, sunstroke

- Rainfall : daily, monthly and annual rainfall, rainfall intensity
- Hydrometry : water height; daily, monthly and annual flows, solids transport and salinity



Main hydrometric stations in Algeria (from ANRH)

In the field of ground water resources, the ANRH monitors:

- the update of the inventory of water points
- groundwater quantities and quality
- the piezometric evolution of aquifers
- the water balance of aquifers

The ABH monitor superficial water resources and ground water resources level at the hydraulic basin level (reservoir levels, groundwater tables).

12.2.6 Description of the methods/techniques/models and outputs

With the different hydroclimatic and groundwater parameters monitored across the country, the ANRH produce:

- Daily rainfall data
- Rainfall bulletins (monthly) which include the total and average rainfall of the month, the cumuling of rainfall from September to April
- Evapotranspiration and rainfall distribution maps
- Piezometric maps
- Ground water resources vulnerability maps

The ABH produce information on reservoir and aquifers levels.
A regional data server on water *banq-eau* is operational at: www.abhcsm.dz/banqeau/ (Hydrographical basin agency Constantinois- Seybousse- Mellegue) since june 2001, where alphanumeric and cartographic data on water are available

12.2.7 Procedures for developing and interpreting indicators

The water levels in dams, rivers and aquifers, the rain With regard to groundwater and surface water sustainability and using the results of the water balance tools described above, indicator maps have been developed, that give an overview of the resource situation, from national to regional level. These maps allow figuring out zones of elevated risk or lack of sustainability, in order to be able to focus any measures taken to improve long-term sustainability of water availability.

12.2.8 Information available from the system/network/forum

The ANRH and ABH provide information about the state (quantities and quality) of surface water and ground water resources at the national and hydrological basin scales. Most of these data are available at each of these institutions web site. Other data are published in Atlas and indexes, information letters, documentaries and brochures.

12.3 ID: DM NNA 03: FACTSHEET 29- NILE FORECASTING SYSTEMS

12.3.1 General information

The Nile Forecast System was established in 1990, the financial support is Governmental budget in addition to some support and training from foreign donors and Nile basin Initiative. (NFS) has developed models for short and medium term forecasting of inflows to HAD, and long-term simulation models for investigations of reservoir operations.

It has facilities to receive satellite data, including half-hourly CCC information and imagery from Meteosat. It also receives meteorological observations and weather forecasts from the ECMWF, which provides, inter alia, recent rainfall observations from five or six synoptic stations in the Ethiopian highlands. The Center is therefore able to make near real-time estimates of rainfall in the upper Blue Nile basin from CCC data using established techniques that have been calibrated to the ground observations available.

The general aim of the centre is to provide tools and information for water planning and management. To this end the Nile Forecast Center and its NFS system will provide to planners and decision-makers in Egypt with:

- Timely forecasts of the Nile River inflows into the High Aswan Dam reservoir;
- Real-time information about hydrological and meteorological processes occurring in the whole Nile Basin; and
- Rules to simulate the flow regime of the Nile and assess the possible consequences of changes, man-induced or natural, in the Basin.

Two main approaches are used to simulate river runoff by mathematical models. They are lumped parameter models and distributed parameter models. The lumped parameter models are simple, flexible and easily adjustable but they require input and output information for a long period to calibrate parameters for every basin (usually with a watershed area not much more than 5-10 thousand sq. Km). Distributed parameter models are more physical and include more understandable physical parameters but they require much more geographical information to utilize them.

12.3.2 Description of the Inputs to system/network/forum

Data from selected river gauging stations upstream of HAD (in Sudan and Uganda) are also transmitted to the Forecasting Center. A variety of techniques are also used to make seasonal stream flow estimates of inflows to Lake Nasser, and these are refined every 10 days as data from observation stations become available. The USGS flood forecasting model associated with FEWS-NET is used for short-term and medium term stream flow forecasting, starting with the calibrated CCC estimates of rainfall at a current resolution of 5 km x 5 km pixels, soil moisture accounting rainfall-runoff simulation for each cell, then kinematic wave routing between model cells and Muskingum-style routing along main river channels. Forecasts are refined as updated data becomes available from ground observation stations and satellite imagery. The main inputs to this model are rainfall and potential evapotranspiration

12.3.3 A conceptual description of how the system/network/forum functions

The core of the NFS is a conceptual distributed hydrological model of the Nile system including soil moisture accounting, hill slope and river routing, lakes, wetlands, and man-made reservoirs within the basin. According to the definition of Vörösmarty et al. (1993a), the hydrological component of the NFS can be considered an MHM. The main inputs to this model are the rainfall and potential evapotranspiration. From the outset of NFS development, it was decided to utilize satellite remote sensing technology in estimating rainfall over the basin. This was motivated by the scarcity and discontinuity of rainfall records within the basin in addition to the lack of direct monitoring control over rain gauges, as all basin rainfall occurs outside the borders of Egypt where the system is hosted. Therefore, the system grid was designed to match that of the satellite rainfall. In addition, the system includes a large database of rain gauge data, as part of the NBHIS which also holds flow records at all key river gauges.

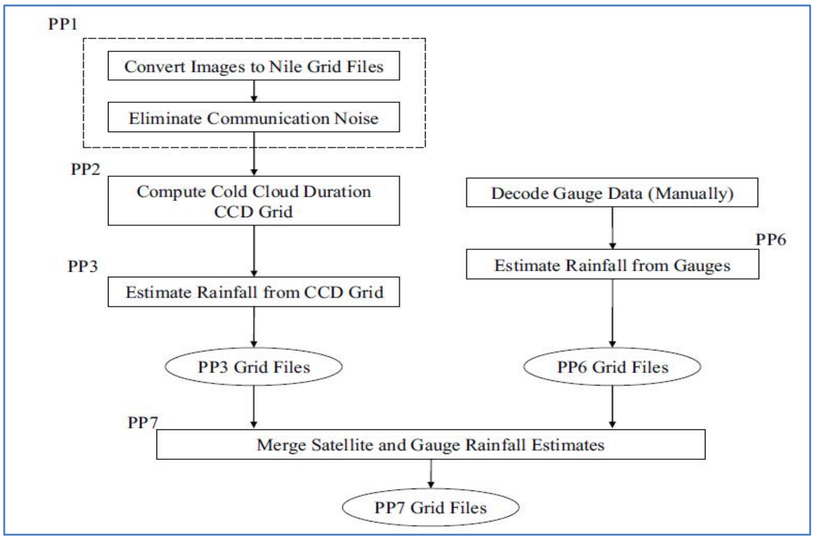
12.3.4 Description of the methods/techniques/models and outputs

When used for forecasting, a short NFS simulation (a few weeks) is performed using observed rainfall to define the model status (soil moisture storage, reach storage) on the current date. Subsequently, an ensemble of 60 series of historical rainfall for the 3 months following the current date is applied to the model to simulate 60 possible inflow series to Lake Nasser, called extended stream flow predictions (ESP). Once a week observed flows at some key points (e.g. Diem) are assimilated to update the model state. It implies that the rainfall estimates are adjusted for the last 4 weeks to minimize the difference between the simulated and the observed flows. When input data are missing or felt unreliable the deterministic model can be replaced by a first order Markov model for three locations (Malakal, Roseires and Khartoum), using a Wakeby distribution transformation (Koren, 1993). This model produces possible monthly runoff traces, which are subsequently disaggregated to daily data. The stochastic model is often applied to replace the deterministic forecast for the White Nile at Malakal, as the quality of the latter is considered less reliable. The system relies on a GIS database to represent the connectivity of the different pixels as well the different streams, rivers, and sub-basins associated with the designated forecast points. See fig 26-28 below.

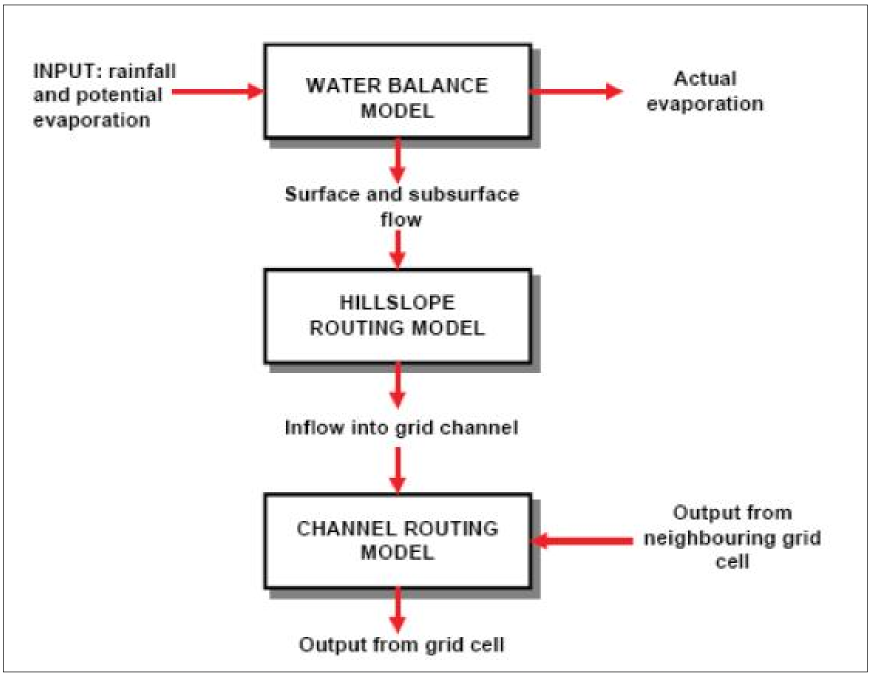
The NFS has the following main components:

- Real-time capture of raw satellite Infra-red, Visible and Water vapour images through Primary Data User System (PDUS) as well as reception of observed
- Raw meteorological data and weather analysis/forecast charts through
- Meteorological Data Distribution (MDD) system.
- Hydro climatic and GIS Data Base Component.

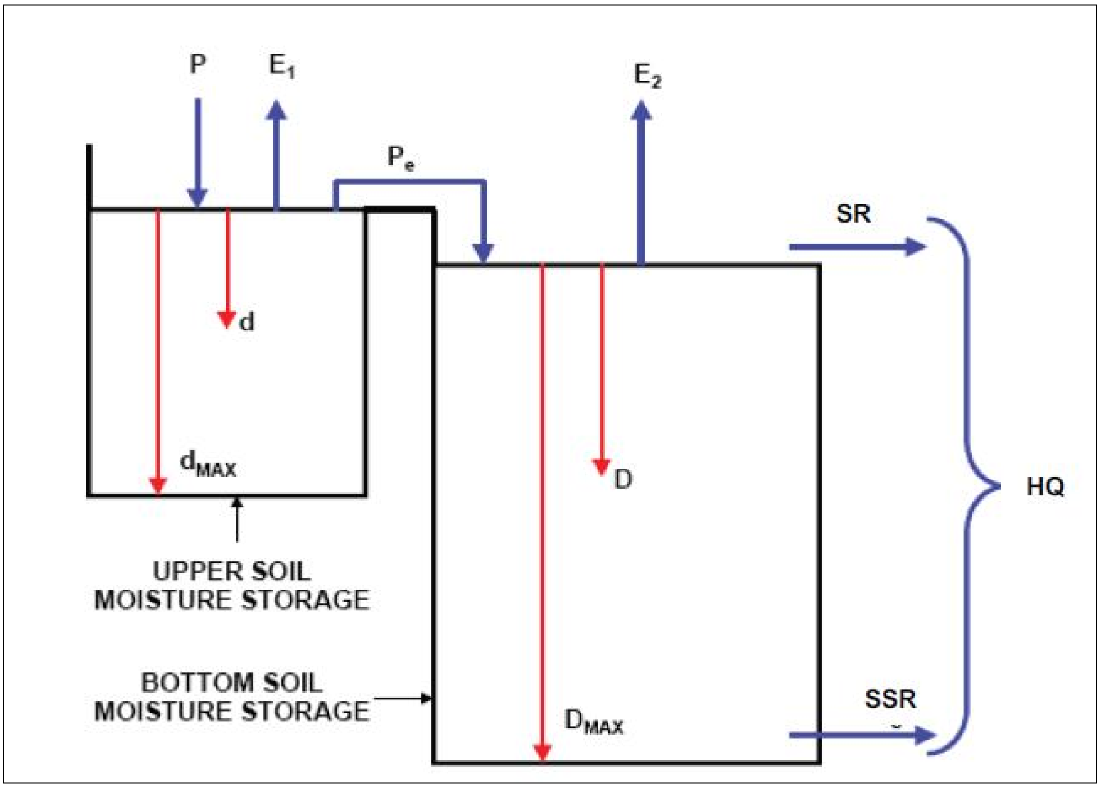
- Rainfall Estimation Component based on different spectral bands of satellite images.
- Simulation and Forecast Component for Blue Nile, White Nile, Atbara and, Main Nile.
- Extended Stream flow Prediction (ESP) Component.
- Data Assimilation/System Updating Component.
- Data and System Archiving Component.
- User Interface.
- Publishing unit.



Rainfall estimation sequence within the NFS



Hydrological model at the pixel scale



Schematic of the water balance model

12.3.5 Who uses the system/network/forum?

The system is managed and operated by the Planning Sector of the Ministry of Water Resources and Irrigation (MWRI), 6th Floor of MWRI Building, Korniche El-Nile, Embaba, Giza 12666, Egypt.

12.4 ID: DM NNA 04: FACTSHEET 30: EGYPT NATIONAL POLICY TO COMBAT CESRTIFICATION

12.4.1 General information

Egypt as located almost entirely in the arid zone is subjected to the desertification phenomena including the physical biological, socio-economical and political processes. This situation leads to negative impacts on socio-economic studies and the livelihood in the country. **As the UNCCD provides a platform for addressing desertification issues at national, regional and global levels, Egypt early ratified the UNCCD in July 1995.** As per agreement, the parties are committed to prepare and implement their national action program to combat desertification and to mitigate the effect of drought as well as reporting to the secretariat and COP's on measures which have been taken in this context.

Since significant variations in the environmental characteristics are apparent in each agro-ecological zone, the active factors and processes of desertification and their impacts are necessarily variable. Accordingly, it is not appropriate to formulate a unified plan to combat desertification in such zones. To address and focus on the varied natural attributes, priorities of actions and specific processes of desertification, sub-components of the action plan are figured out to facilitate investigation and identification of appropriate techniques, suitable indicators, for monitoring, capacity building, awareness needs, participating stakeholders, required legislation, economic tools, incentives, finance, institutional setups, responsible parties, on-going and projected future desertification processes as well as social implications, geared and tailored for the needs of each agro-ecological zone to ensure success and achievement of the Convention objectives.

A common set of benchmarks and applicable impact indicators are figured out and well defined. Vulnerability mapping of risk/sensitiveness to desertification and drought is initiated for some hot spots, particularly in the Nile Delta and northern coastal areas.

An inventory of relevant data for desertification assessment and monitoring is carried out and preparation of standard database for the most relevant agro-ecological zones in progress.
Facilitate four projects to respond to specific issues for combating desertification in the four agro-ecological zones, these will be further extended in the form of sub-projects dealing mainly with the urgent hot spots.

This work program describes activities undertaken in the dedicated set of measures, in the framework of the specific program of combating desertification. They will all take into account fundamental cross-cutting issues such as environmental, economic sustainability and social equity. Appropriate institutions and processes are actively encouraged with a view to ensure the highest positive impact possible in developing. Social dimensions such as gender roles, ethics and social equity must be adequately addressed as a matter of ensuring such impact.

12.4.2 A conceptual description of how the system/network/forum functions

Methodology:

To lend a support, in the scientific and technological field to the implementation of the community's development and to strengthen, develop and consolidate our partners research systems as measures of reinforcing synergies with the developmental policies, several methodologies are applied. Research contributed to the solution of specific problems faced in through partnerships, diversified objectives and approaches are warranted to accommodate the specific nature, problems and needs of different agro-ecological zones concerned by these specific measures in support of national cooperation. Rational and sustainable use of natural resources and associated vulnerable ecosystems (hyper arid, arid and semi -arid) under the specific climatic and socio-economic conditions. To implement the proposed NAP in a proper manner, the methodologies that will be undertaken should take into consideration the following issues.

Dynamics of such ecosystems under varying degrees of human pressure to lead to more sustainable use of renewable natural resources, identification of policy options and /or management strategies for harnessing judicious use of such resources focused on integrated approach and analysis of natural and agro-resource use systems at local and national levels (sustainable water management, reclamation, … etc.). Reconciling multiple demands of the limited resources in the coastal agro-ecological zone, mitigation, degradation and finding equitable, innovative solutions appropriate to the social, economic, institutional and environmental contexts of development topics are:

(a) Creation of a conceptual framework for integrated interpretation of information on coastal zone structure and acquisition dynamics supported by data and knowledge from past research, traditional practices and indigenous knowledge.
(b) Understanding of coastal ecosystem which supports income and livelihoods for communities relying on aquatic resources.
(c) Policy analysis and development to help implementing of the UNCCD convention through e.g. protected areas.
(d) Valuation of coastal ecosystem products and services in support of policies for equitable resource allocation.

Dynamics of arid and semi-arid ecosystems under varying degrees of human activity pressure to lead to more sustainable use of renewable natural resources in rural and peri-urban areas. Identifying policy options and/or management strategies for harnessing judicious use of such resources with focus on identifying management strategies for enhanced economic, agriculture and livestock productivity without deteriorating natural resource base in the long term; sustainable water management, forest ecosystem restoration and reclamation techniques.

Thematic issues:

- Development of desirable traits focused on tolerance to drought and salinity stress condition, heat.
- Development of sustainable management practices taking into account the traditional practices and indigenous knowledge, on conservation resources, use of genetic resources, multi-cropping, agro-forestry techniques, integrated pest and disease management , soil conservation, enrichment and higher productivity.
- Integrated management of limited water resources.

Water Resources:

Available water resources largely limit the conditions for sustainable development, for increased quality of life. The overall thematic issue addresses integrated management of limited water resources in some agro-ecological zones. This includes mix of such consideration as natural conditions (e.g. aridity and climate impaction on ecosystems) variety and efficiency of uses (irrigation, municipal uses , water quality, effluent control, … etc.), sources of supply (surface, groundwater and mixed); technological considerations (cost-effective waste water treatment and reuse, desalination, use of renewable energy, plant breeding for efficient use of water and nutrient use,…etc.), socio-economic conditions and institutional evaluation (competing demands from different societal uses, economics of different choices, including virtual water, socially acceptable choice, value of different uses), and socio-demographic conditions (such as population growth, rapid urbanization, industrialization, tourism, stakeholders demands, etc.).

Networking involves simultaneously scientists, economists, water professionals, economic and policy decision makers and water uses on the appropriately integrated management of limited water resources.

These issues take into consideration the costs, incentives, support and promotion of institutional and legal mechanisms for water purification and reuse.

Environmental protection:

Management of environmental risks associated with man-made changes, industrial and agricultural issues, including risks to soils, water, air, food-chain, infrastructure and possible remediation. Water-related risks during crisis and rehabilitation, including floods, drought and accidental pollution were among the concerns. Tools and methods suited to national management of water-related risks includes selection of relevant alarm, early warning and monitoring systems and assistance in identifying and examining the potential sources of pollution.

Budget during the first five years is 15 million, 5 million US$ for establishing the nation-wide network, 10 million US$ for running the system at 2 million US$/year. All the proposed intervention projects will be financed either by the central government (annual budget) as well as the concerned regional, international institutes, developed countries, donors, GEF, IFAD and World Bank. In this respect, it is important to devote special effort to set-up an effective mechanism to mobilize financial resource and technical support for successful implementation of proposed intervention.

Egypt with its land extending over one million Km2 fall under arid and hyper-arid climatic conditions. It is endowed with varied agro-ecological zones with specific attributes of resources base, terrain, land use pattern and socio-economic implementations. Such zones could be identified as follow:

1- North coastal belt, including North Western Coastal area and North coastal of Sinai.
2- The Nile Valley, encompassing the fertile lands of upper Egypt and the Delta and their fringes.
3- The inland Sinai and Eastern desert.
4- The western desert, including Oases and Southern Remote areas.

Although many efforts have been geared to the desertification control in those agro-ecological zones through different national and international organizations and authorities. However, much has still to be done for environmental improvement and desertification control.

Therefore, some proposed projects were formulated to meet the requirements of desertification control in these zones. The proposed projects are outlined in the following:

Project No. 1: Minimizing urban encroachment on productive lands. This project will set up in the agro-ecological zone of Nile delta, Nile Valley and their fringes.
Project No. 2: Combating water and land pollution. The performance of this project as priorities will set up in the following agro-ecological zones:
- Nile delta and Nile Valley.
- Siwa Oasis.
Project No. 3: Water logging, salinization and sodification control. The performance of this project as priorities will set up in the following agro-ecological zones:
- North Coast of Nile Delta.
- Oasis of the Western desert.
- Inland Sinai and Eastern desert.
Project No. 4: Movement of sand dunes and blown sands control. The performance of this project as priorities will set up in the following agro-ecological zones:
- The Oases and Southern Remote areas of the Western desert.
- The North Coast of Egypt.
Project No. 5: Management of rangelands. The performance of this project as priorities will set up in the following agro-ecological zone.
- North Western Coast.
- North Eastern Coast (North Sinai).
- South Eastern Portion of Egypt (Eastern desert).
Project No 6: Management of water resources (surface water and ground water). The performance of this project as priorities will set up in the following agro-ecological zones:
- Nile Delta and Nile Valley.
- The Oases and Southern Remote areas in the Western desert.
- North Coast of Egypt.
- Inland Sinai and Eastern desert.

Project No .7: Wind and water erosion control. The performance of this project as priorities will set up in the following agro-ecological zones:
- North Western Coast.
- Inland Sinai and Eastern desert.
- North coast of Nile delta.

Project No. 8: Improvement agronomic management practices. The performance of this project as priorities will set up in the following agro-ecological zones.
- Nile Delta and Nile Valley.
- Oases and Southern Remote areas in the western desert.
- Western and Eastern Coasts of Egypt.

The overall objectives of these projects aim to determine and assess the causes, status and impacts of desertification. These objectives are given hereafter:

1. Detecting and identifying the type and degree of desertification and assess its severity.
2. Identifying and evaluating the causative (pressure indicators) directly and indirectly involved in land degradation.
3. Identifying the hot and bright spots to be investigated as priority areas.
4. Finding out the most remedial measures and management practices to combat and prevent desertification for environmental improvement.
5. Achievement monitoring and early warning system of desertification hazards.
6. Achievement the participation development and capacity building (development of support communication program and capacity building program).
7. Establishment of a GIS based information system to act as support system for decision makings.
8. Developing economically and environmentally viable and social acceptable practices, guidelines and systems for controlling desertification factors.
9. Introducing some income generating activities to improve the quality of the woman and inhabitants life in the project areas.
10. Upgrading the skills of local inhabitants and extension staff for various techniques verified by the project activities through effective training and extension programs.

The overall activities of the proposed projects are given hereafter:

- Compiling and processing the relevant information, knowledge and data pertinent of the project areas.
- Establishment a GIS – based information system to project analyses and apply modality to compile data to act as a support system for decision making, monitoring and planning of actions to combat and mitigate desertification process in the project areas.
- Assessing the impacts of land use activities on desertification processes using indicators and modelling appropriate of the environmental conditions for each project area.
- Investigating the direct and indirect causes of desertification through analysis of pressure factors and impacts (environmental, economic and social) together with their important means.
- Identifying hot and bright spots and set priorities for preventive and remedial action through quantitative monitoring schemes of land, specific satellite point indicators and socio-economic statistics. Criticality and vulnerability will be discussed among the stakeholders and workshops to seek a consensus of priorities.

- Offering appropriate training and capacity building relevant to the project activities.
- Performing an extension service program for preventive and remedial action to combat desertification.
- Securing the participatory role of all relevant stakeholders in the various process of planning and implementation of the project activities.
- Exchanging experiences (nation-wide, regional and international).
- Encouraging the partnership of the private sector, NGOs and local communities.
- Preparing decision maps for each discipline related to desertification on the national level.
- Implementing the suitable measures to combat desertification in each ecological zone
- Periodical reporting every six months on the implemented activities

12.4.3 Who uses the system/network/forum?

List of partner stakeholders who benefit from the programme:

- 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).
- Local authorities and Concerned NGO's.
-

12.4.4 Procedures for developing and interpreting indicators

Desertification assessment is conducted at three levels: local (annual), Provincial (5 years; desertification dynamics) and national (5 years; to track and analyse the dynamics of desertification).

Classes of desertification:

• **Desertification types (natural, manmade, etc.)**

1. Land degradation.
2. Decline in soil fertility and damage of soil structure.
3. Decline in availability and quality of water resources.
4. Loss of vegetation cover and changes of its composition.
5. Loss of wildlife and biological diversity.

• **Degrees of desertification (ranked on basis of quantified and measured indicators)**

1. Non decertified.
2. Slightly decertified.
3. Fairly decertified.
4. Seriously decertified.
5. Very seriously decertified.
6. Extremely decertified.

• **Prominent causes of desertification:**

1. Soil salinity and land deterioration.
2. Harsh climatic factors leading to wind or water erosion, drastic aridity, sand dunes encroachment, etc.

3. Population density and migration.
4. Inappropriate agricultural practices (soil tillage may accelerate rates of erosion, use of low quality water, poor drainage, over irrigation, less fertilization and manuring, etc.).
5. Overgrazing uprooting and cutting of trees and shrubs for fuel and other civil constructions.
6. Land tenure and conflicts.
7. Cultivation of marginal fragile
8. Socio-economic problems, especially poverty.
9. Lack of labors and experience.
10. Urban and tourist development.

Impact monitoring

Evaluate the impacts through dissemination of information concerning climatic, physical, hydrological, biological, land use indicators , anthropogenic measures, socio-economic, biophysical, institutional and behavioral changes resulting from the application of action programs to combat desertification at various spatial levels and determine whether they are goal-oriented or not. Monitoring input during NAP implementation together with time lag between case and effect should also be considered in the impact monitoring.

In this regard, remote sensing technique has been successfully practiced for monitoring, follow up and evaluation of desertification indicators as follows:

- Mapping of surface water resources.
- Delineation and mapping of wastelands.
- Mapping of land degradation.
- Mapping of saline and alkali soils (salt-affected soils).
- Mapping of water-logged areas.
- Mapping of vegetation cover and land use.
- Mapping of hydro-geomorphology and ground water aquifers.
- Mapping of active and stabilized sand dunes.

Continuous monitoring by remote sensing, satellite imageries and ground truth are therefore efficient tools for identifying the principal desertification indicators such as vegetation cover, sand encroachment, surface water resources and distribution, salinity and drought problems. Accordingly, they can be used for early risk warning of desertification. Moreover, the implementation of remote sensing , satellite images ground truth and geographic information system can provide a sound national plan to combat desertification through monitoring of land degradation, wind and water erosion of soils, sand dunes fixation, rain water harvesting and conservation,… etc.

Data base of land use, vegetation cover, soils, surface and ground water resources, geomorphology and population could be prepared and integrated with socio-economic aspects to figure out an efficient national plan to combat desertification for sustainable development geared to the long term. Identification indicators, criteria and the frequency interval at which monitoring is carried out should be carefully selected. Nevertheless, the selection of indicators is sometimes opposed by constraints such as availability of technology and infrastructure for collection, measurement and implementation of data essential for certain indicator.

It is also important to define the area that will be considered for monitoring and implementation and prepare thematic or spatial or non-spatial data base design that fulfil the target of monitoring and assessment. In this respect, unifying data base in regard to scale, projection system, accuracy, minimum mapable unit, etc. is a must to evaluate desertification hazards and consequently select the proper means to combat desertification.

In brief, the most important indicators for drought and desertification impacts are:

• Changes in vegetation cover and its succession and cropping area,
• Changes in cropping area and crop performance.
• Changes in surface water bodies,
• Changes in degraded and waste lands.

Climatic indicators
From the meteorological stations reports on : rainfall changes, dust storms, minimum and maximum temperature, air humidity, wind velocity direction and albedo , aridity index, evapotranspiration and potential evapotranspiration are computed and mapped by GIS technique.
Hydrology indicators
Monitoring of groundwater hydrology through the geological study of sedimentary aquifers, measuring depth to water level, water salinity, wells depth, fluctuation of piezometric pressure, safe yield, chemical development, suitability of water for irrigation, human and urban use in the monitoring wells in the concerned area for desertification monitoring and evaluation. Monitoring of number and distribution of surface water bodies together with their turbidity, salinity, pH, Sodium Adsorption Ratio (SAR) and residual sodium carbonate, (RSC) changes with time using aerial photo interpretation or remote sensing techniques.
Physical indicators
They include salinity /alkalinity, sand creeping, water logging, soil compaction and sealing as well as wind and water eroded land (physical detachment, transportation and deposition) due to overgrazing and uprooting of shrubs.
Biological indicators
Climax sp as percentage of natural vegetation and composition. Where distribution and intensity of climax sp. reflect the overgrazing in certain area, evaluation of this indicator is appended.
Land use indicators
- Land tenure and changes in land use pattern.
- Cropping pattern, rotation and productivity.
- Types and number of livestock and animal pressure (carrying capacity)
Socio-economic indicators
• Population No. and growth
• Migration (seasonable and annual)
• Income (source and per capita)
• Unemployment
• Prices of foodstuff
• Marketing in relation to land acreage, livestock return or benefit.
• Unseasonable disappearance of essential foodstuff from market.
• Literacy and education level.
• Health condition of population.
• Mortality of livestock.

• Energy availability and prices.
• Awareness and capacity building
• Communication actions.
• Identifying national priorities.
• Training
• Stakeholders participation in NAP implementation.

Based on the foregoing indicators the depression costs of desertification and costs to combat desertification can be evaluated. Moreover, predicting the environmental changes pertinent to desertification can also be made. However, this needs international and financial support.

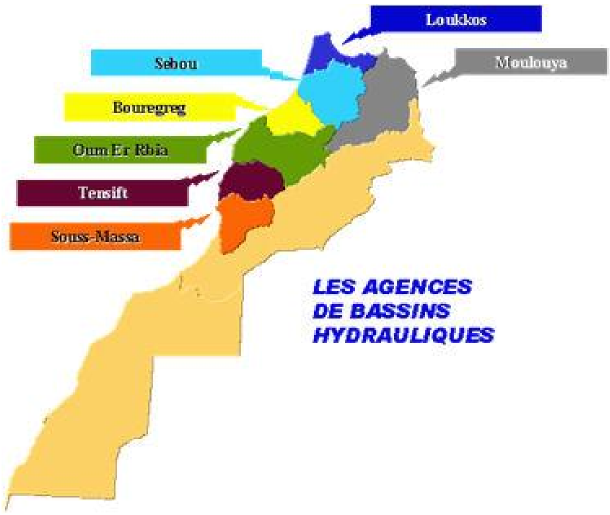
12.4.5 Information available from the system/network/forum

- Creating desertification information system at national level based on geo-referenced data and information.
- Creation digital base maps for different applications together with thematic maps for various disciplines of desertification.
- Obtaining data flow on desertification phenomenon through website and data network.
- Developing monitoring corrective action programme.
- Providing necessary information about desertification phenomenon for the policy makers and the executive leaderships in all managerial support.
- Strengthening the national bodies concerned with desertification assessment and monitoring.
- Local people will be involved in the monitoring of the desertification impact through the role of NGO's and mass media.

12.5 ID: DM NNA 05 -FACTSHEET 31: DIRECTORATE GENERAL OF HYDRAULICS (DGH) AND HYDRAULIC BASIN AGENCIES (ABH)

12.5.1 General information

In the early 1990s, the Government of Morocco, decided to reform its water sector and in 1995 it passed a comprehensive water law (Law 10-95) that laid the groundwork. This law decentralized water management to the basin level, leading to the creation of the Hydraulic Basin agencies in addition to the Directorate general of Hydraulics (DGH).The first HBA to be created was the HBA of Oum er Rbia in 1999 and the country count now 7 major agencies: HBA Sebou, HBA Tensift, HBA Souss-Mass, HBA Bouregreg-Chaouia, HBA Moulouya, and HBA Loukkos



Hydraulic Basin agencies in Morocco

The DGH is in charge of policy formulation and implementation in planning, mobilizing, managing and protecting quality of water resources at national level. It is also responsible for all the large infrastructure projects, in terms of implementation, management and maintenance at the national level. The Hydraulic Basin Agencies (HBA) manage the water resources and monitor quantity and quality of surface and underground water at the basin level. They also contribute to the management of drought and adjust water allocation according to the resource available. Thus, the GDH compiles data from the HBA and these two institutions, which are both attached to the State Secretary for Water and Environment form a system in terms of hydrological drought monitoring.

The DGH is organised in two main departments:

- The Direction of the Water Research and Planning (DRPE)

  This direction is in charge of water resources planning and development. Its activities are governed by the 10-95 Water Law. In this framework, the DRPE conducts studies that deal with ground water and surface water assessment, sets up and runs monitoring systems for surface and ground water units and systems, conducts ground water investigations, conducts river basin studies and prepares water legal framework.

- The Direction of Hydraulic installations

  This Direction looks after the mobilization of the water for the irrigation sector of the big Hydraulics. It builds and maintains the big hydraulic works such as dams and fluvial deviations.

  The HBA are public institutions with financial autonomy. Their policy and programs of activities are set up periodically through a board of directors composed of national and regional members: In the board of the River Basin Agencies, a third is composed from the administration; a quarter from public enterprises and the rest (42 %) represents users. The financial resources of these agencies are built up by loans, subsidies, donations and collected fees from the water user, according to the "user-payer" and the "polluter-payer" principles. Every basin agency has mainly as mission to:

  - Elaborate the master plan for an integrated management of the water resources coming under its actions zone and overlooks its application
  - Monitors the quantity and quality of water resources
  - Manages and controls the use of mobilized water resources.

12.5.2 Who uses the system/network/forum?

The DGH and the ABH are under the supervision of the Secretariat of State in charge of Water and Environment. They have links with the main institutional stakeholders in the water sector which are represented by the key ministerial departments including agriculture, water and environment, local collectivities (Ministry of interior), health, energy and mines, and finance departments, Service provision (regies, ONEP, concessions)
NGO's such as water user associations, and natural resources / environment protection associations are also actively operating in the country in response to civil society's needs.

The current institutional setting does not clearly define the scope of intervention of each ministerial department. However, it addresses the issue of coordination through consultative institutions at the national, regional river basin and local levels, and through the executive central administration authorities. The overall coordination is the role of the Directorate General of Hydraulics (DGH, State Secretary for Water) with a strong involvement of the Water and Ag-Engineering Administration (AGR, Ministry of Agriculture). Decisions related to water resources management are implemented by the Public Offices and Agencies which operate under the supervision of their respective ministries: ONEP for drinking water, ORMVA for irrigation and ONE for hydropower. The general model for water management in terms of decision making, coordination and implementation at the national, regional and local levels includes advisory bodies and the executive authorities at the different levels

12.5.3 Description of how system/network/forum functions

The General Directorate of Hydraulics developed a database system for water resource management called Water resources database for the 21st century (BADRE21). This database has been constructed since 1995. The system was developed by the State Secretary for Water and Environment (SEEE) to be a centralized system where all data is entered in the centre at SEEE office in Rabat. The system operation was then decentralized and the system software was replicated in the 7 basin agencies (HBA). Structured in five parts (data base settings, site reports, reports on measurements, data transfer and editing), it is fed textual and raw numerical data. DRH feeds information to ABH and the worked-out data can take the opposite direction. The five parts that make up this system concern dams, hydrometric stations, boreholes, wells, streams, water quality and rainfall/climatology.

12.5.4 Assessment of spatial coverage

The output information from the DGH/ABH system is provided at the national, sub-basin and basin scales.

12.5.5 Description of the Inputs to system/network/forum

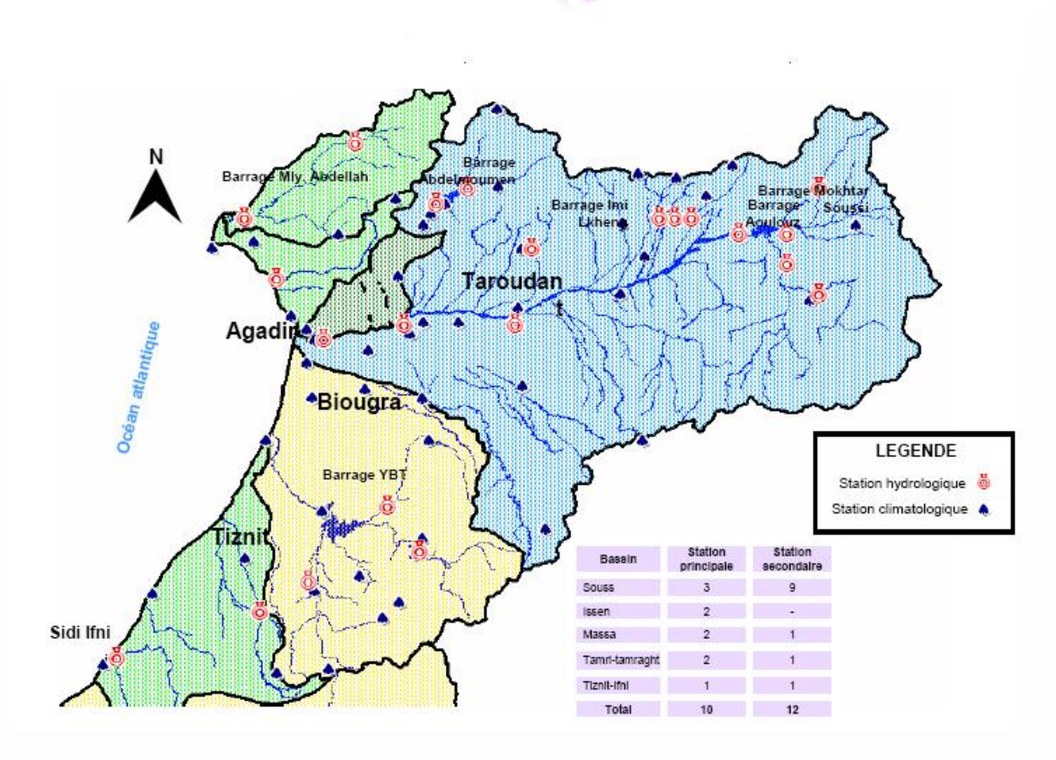
Data managed by BADRE21 are related to.

- **Hydrology:** Data about batteries, scale tables, calibration curves, water depth, calibrations, tilted scales and flow.
- **Solid transportation:** Data about solid transportation
- **Management of dam water storage:** Data related to dams, reservoirs, restitution works, downstream water facilities and any other data concerning the dams.
- **Rainfall and climatology**: data about rainfall, windspeed, evapotranspiration, temperature, snowpack.

Data managed by BADRE21 are collected by each Hydraulic Basin Agency through its hydrologic and climatologic stations network.

- **ABH Souss-Mass**:

The ABH of Souss-Massa has a network of 22 hydrologic stations spread across the river basin.



Bassin	Station principale	Station secondaire
Souss	3	9
Issen	2	-
Massa	2	1
Tamri-tamraght	2	1
Tiznit-Ifni	1	1
Total	10	12

Density of climatologic and hydrologic stations in the Souss-Massa basin

- **ABH Tensift:**

The ABH of Tensift has a network of 35 hydrologic stations spread across the river basin.

- **ABH Sebou**:

The HBA of Sebou has a network of 57 hydrologic stations and 56 meteorological station spread across the river basin.

- **ABH Moulouya:**

The HBA Moulouya has about 30 hydrological stations

- **ABH Bouregreg-Chaouia:**

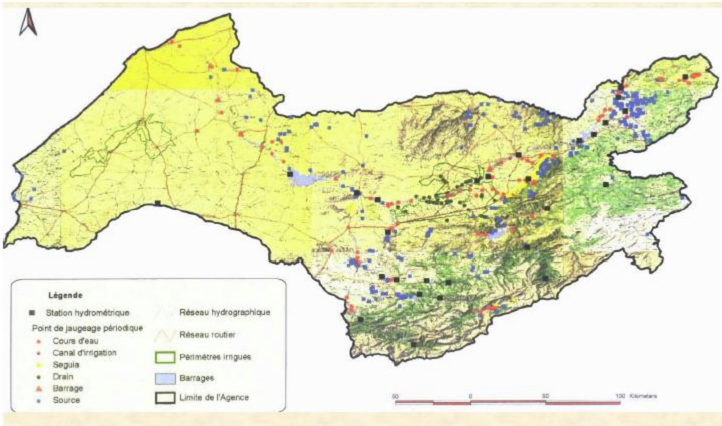
The ABH of Bouregreg-Chaouia has:

- 19 hydrologic stations;

- 132 piezometric points

- **ABH Oum er Rbia**

The hydro meteorological network of the Oum er Rbia basin has 25 pluviometric stations of, 22 hydrological stations, 149 points of runoff measures, 13 meteorological stations (precipitation, temperature, evaporation…)



Density of hydrologic stations in the Oum Er Rbia basin

12.5.6 Description of the methods/techniques/models and outputs

The data set managed by BADRE 21 is used for the calculation of:

- Sudden flows, daily flows and monthly statistics
- Water resource balance sheet.
- Level of the watertable, variations and velocity, the water potential for extraction
- Rainfall and climatology statistics, average rainfall deficit

At the river scale basin different hydrological models are used to simulate the water balance. Among them figure:

- Ribasim Model
- Swat model
- Ihacres model
- HEC model
- Modflow model (simulation of water table hydrodynamics)

12.5.7 Procedures for developing and interpreting indicators

The General Hydraulic Directorate has the responsibility of surface and underground water resources mobilization, water storage in the dams, and evaluates with the relevant structures of agricultural sector (mainly the Administration du Genie Rural) and other users the water needs throughout the drought period. The evaluation is regularly made in joint meetings on the basis of indicators concerning the average rainfall deficit across the country, the amount of water stored in dams and the situation of the main groundwater tables.

12.5.8 Information available from the system/network/forum

The outcome from these services is a number of scenarios for water allocation by sectors (irrigation water, domestic, industrial). For each scenario, estimates are proposed to activate the water supply programme including: drinkable water supply of the urban and rural zones mostly affected by drought; mobilization of water resources from groundwater by creation of additional water sources; water supply for livestock in rural areas; and water economy package including public awareness campaigns to adopt hygienic and water saving measures envisaged under drought conditions.

12.6 ID: DM NNA 06:FACTSHEET 32 - HIGH COMMISSARIAT OF WATER, FORESTRY AND FIGHT AGAINST DESERTIFICATION (HCEFLCD)

12.6.1 General information

Until 2003, the forest management in Morocco was supervised by the Water and Forest Administration (AEFCS), attached to the Ministry of Agriculture. It prepared watershed management plans and projects and regulated access to continental fishing. Due to the huge cost of dams siltation, it also cooperated closely with the DGH (Direction Générale de l'hydraulique) and AGR (Rural Engineering Administration) in order to protect the hydraulic infrastructures (dams and main canals). Late in 2003, this Administration was transformed into the High Commissariat of Water, Forest and Fight against Desertification (HCFWFD).

The new missions and organizational structure of this autonomous institution are to:

- Elaborate and implement the Governmental strategies in the fields of conservation and sustainable development of forest, *alfa* areas and rangelands resources, and also for the development of continental fishing and natural parks and reserves.
- Coordinate the implementation of institutional mechanisms for the preparation, the execution, the follow-up and the assessment of the Governmental action in the field of fight against desertification. This includes the implementation of a permanent watch of forest resources and desertification process and the development of an integrated and sustainable system to monitor, assess and diffuse all the information related to that observation as well as data and information related to ongoing projects and action programs.
- Participate to the elaboration and the implementation of the Governmental action in terms of rural development.

The financial resources of HCEFLCD are mainly public. In 2008, the assigned budget was 813.346.000 Dh (74 millions euro).

12.6.2 Who uses the system/network/forum?

HCEFLCD has a rank of Ministry and is attached to the Primature (Prime Minister).Within this institution, forest resources management and development are shared between a central Administration and 10 regional directions.

The main partners of the HCEFLCD are:

- The Ministry of Agriculture (MADRPM)
- The State Secretary in charge of Water and Environment (SEEE)
- The National Observatory of the Environment (ONEM)
- The Royal Center of Remote Sensing (CRTS)
- The National Drought Observatory (ONS)
- The National Direction of Meteorology (DMN)
- The Royal Gendarmerie
- NGO (forestry cooperatives, eco-touristic associations)

Moreover, HCEFLCD has signed several International conventions:

- United-Nations Convention on Fight against desertification
- United-Nations Convention on Climate Change
- RAMSAR Convention on Humid Zones

- CITES Convention on threaten species trade

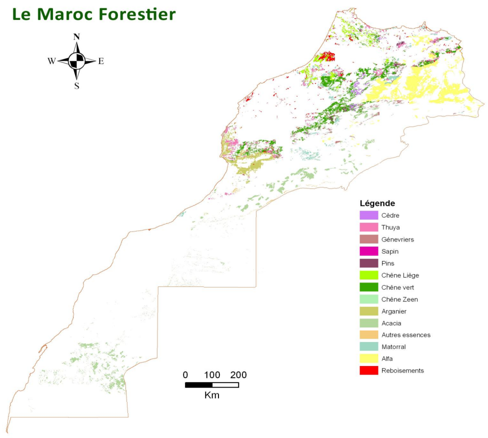
12.6.3 Description of how system/network/forum functions

The HCEFLCD receives the government's support in strengthening national capacities to establish a development partnership and resource mobilization strategy for the NAP (National action program) for fight against Desertification. The strategy focuses on building the resource mobilization capacity of NAP stakeholders, strengthening consultations with development partners, financing priority NAP projects, and promoting diversified sources of funding. Within the HCEFLCD, responsibilities are divided between the central administration and the regional directions. The NAP which is the main objective of HCEFLCD is based on 4 pillars:

- Struggle against poverty
- Rural development,
- Drought effect mitigation
- Natural resources protection.

12.6.4 Assessment of spatial coverage

The HCEFLCD manages the forest resources presented in the following map as well as rangelands.



Forestry Diversity in Morocco

12.6.5 Description of the Inputs to system/network/forum

The HCEFLCD is mainly oriented towards the fight against desertification, which is in part due to drought. Forest fires frequencies increase during drought periods.

Thus, the institution monitors the following parameters linked to desertification and forest fires watch:

- Meteorological data: rainfall, temperatures wind direction and speed, insulation, evaporation
- Soil parameters: soil texture, soil depth and soil moisture
- Field measurements regarding vegetation: structure, composition, moisture level.
- Evolution of forests and rangelands areas
- Socio-economic data

- Remote-sensing data: Satellite images from Landsat-TM, Spot-XS, ASTER, 1986 – 2003

12.6.6 Description of the methods/techniques/models and outputs

- Reduction degree of forests areas
- Reduction degree of rangelands areas
- Rangelands productivity
- Drought monitoring indicators from satellite data:
  - Standardized Vegetation Index (SVI),
  - Vegetation Condition Index (VCI),
  - Temperature Condition Index (TCI)
  - Vegetation Health (VH)

12.6.7 Procedures for developing and interpreting indicators

Remote-sensing monitoring of forest fires:

- Identification of forests fires risk areas, through a global and dynamic cartography of the sensitive and vulnerable zones and it, in the daily rhythm. The proposed method is based on the combination of two indicators derived of the evolution of the NDVI and land surface temperature, namely: vegetation drought index and vegetation regression index.
- Follow-up of fires by the detection and the characterization of hot spot, arisen before the passage of satellites. The developed algorithm is based on the threshold of thermal channel (channel 3 and channel 4) and reflectance channel.
- The evaluation of the damages through the cartography of the burned areas. At this level, two methodological approaches were developed. An approach of comparison of two images, in low spatial resolution, acquired before and after the fire. This approach can be envisaged in the case of the large fires. An approach based on a single image, of high spatial resolution, acquired after the fire, which allows a precise cartography.

12.6.8 Information available from the system/network/forum

In order to inform about its activities and realizations in the fields of conservation and valorization of natural resources, The HCEFLCD:

- Publishes a periodical bulletin called « La gazelle ».
- Organizes training sessions and workshops.
- Diffuses data and information through its website.

12.7 ID:DM NNA 07: FACTSHEET 33: NATIONAL DIRECTORATE OF METEOROLOGY– MOROCCO

12.7.1 General information

In Morocco, if the first meteorological observations were made in Essaouira in 1896 by a German diplomat, we had to wait for 1930 for these measures to be taken in a systemic way, 1960 for the creation of a national meteorological service and 1983 for the creation of the National Direction of Meteorology (DMN). 50 years after its creation and under the supervision of the National Secretary of Water and Environment(SEEE), the DMN is now a performing institution, assuring several missions as a public entity first but also as a service provider for many economic sectors (agriculture, transports, marine, tourism, fisheries…)of the country. The main missions of the DMN are to provide:

- Climate observation (network of 42 meteorological synoptic stations, radar stations, satellite reception)
- Data archiving and dissemination
- Climate evolution (trends, climate change indices)
- Climate studies (link between large scale fields and local climate)
- Weather and Climate prediction (seasonal forecasts
- Climatic production for specific socio-economic sectors
- Drought monitoring

The DMN also supports national organizations involved in climatology, forecasting, observations, instrumentation, and training. It conducts atmospheric research, meteorology and climatology theoretical research, and experimental and applied studies involving international exchange of data under the agreements ratified by Morocco. The DMN of Morocco also works with international authorities in meteorology and climatology to strengthen bilateral and multilateral cooperation and participation in the preparation and enforcement of international agreements regarding meteorology and climatology.

The DMN is a public institution but manages its own budget, which is estimated annually to 50MDH (about 4.3 M Euros). Although the DMN is still depending at 50% from state subventions, the institution is moving towards its financial autonomy thanks to the meteorological services it provides to the main socio-economic sectors of the country.

12.7.2 Who uses the system/network/forum?

The DMN is a financially autonomous agency that falls under the jurisdiction of the Secretariat of State in Charge of Water and Environment (SEEE) of the Ministry of Energy, Mines, Water and Environment (MEMWE). DMN operates four regional offices: in Rabat, Fés, Casablanca and Agadir. Aside from the regional operations, the DMN comprises five major functional divisions and operational units (Fig.13), namely:

• Commercialization and Finance Division (DCF);
• Technical and Equipment Division (DTE);
• Administrative Division (DA);
• National Center for Meteorological Research (CNRM);
• National Meteorological Operations Center (CNEM)

The DMN provides services to the main economic sectors of the country. Regarding drought monitoring, it has a narrow partnership with the main departments of agriculture and water resources management:

- DPV
- ORMVA
- INRA
- Users associations
- DGH
- ABH

12.7.3 Description of how system/network/forum functions

The DMN produces several meteorological drought indices that are used by National and Regional Authorities as triggers to implement proactive and reactive drought responses.

12.7.4 Assessment of spatial coverage

The DMN monitors daily weather and produces national and regional short term, medium range and seasonal weather and drought forecasts.

12.7.5 Description of the Inputs to system/network/forum

The DMN provides 24 hours on 24 hours a meteorological watch of the whole national territory. This watch is achieved thanks to several technical means of observation, analysis, treatment and diffusion of the meteorological data. The DMN currently manages 43 synoptic weather stations, most of which are located at airports. A synoptic weather station refers to a weather station that conforms to the World Meteorological Organization standards. The primary function of these stations is to support real-time forecasting and air navigation. Five synoptic stations are dedicated primarily to marine meteorology. In addition, there are some 45 automated weather stations plus some 600 "climatological units" managed by outside parties such as the Ministry of Interior or the Ministry of Agriculture. The DMN also operates a remote-sensing infrastructure comprising five weather radars; however, their coverage of the national territory is not complete.

Synoptic stations network of the DMN

Thanks to this network of monitoring stations, the DMN records the main following meteorological parameters such as:

- Air and soil temperatures
- Rainfall
- Atmospheric pressures
- Air moisture
- Wind direction and speed
- Sun radiation
- Evaporation
- Visual observations of weather (clouds, snow, fog, storms, …)

12.7.6 Description of the methods/techniques/models and outputs

In order to monitor drought and climate changes in the country, The DMN uses a certain number of indicators and models produced thanks to the different meteorological parameters recorded in the network of monitoring stations:

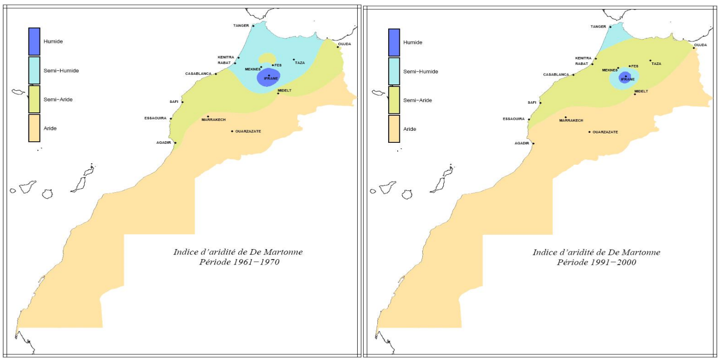
- Aridity aspect of climate
- Evolution of meteorological parameters
- Climate indices: wet days, dry periods, high precipitation events, hot and cold days, heat and cold wave durations
- Drought indices
- Rainfall seasonal prediction programs: “Al massifa” et “Al Moubarak” projects

These projects aim long term, seasonal prediction of the precipitation on the bases of climate modelling using the statistical correlation between the precipitation and the global climate patterns

- “Al Massifa” project is implemented in partnership with Météo-France, ONM (Algeria) and INM (Tunisia) with financial support from the EC. It predicts the “rainfall state”(dry, normal, wet) using the relationship between SST anomalies and regional precipitation.
- “Al Moubarak” project is an ongoing program developed with Oklahoma University. It aims Climate modeling through the use of the statistical correlation between the precipitation and the global climate patterns (NAO)

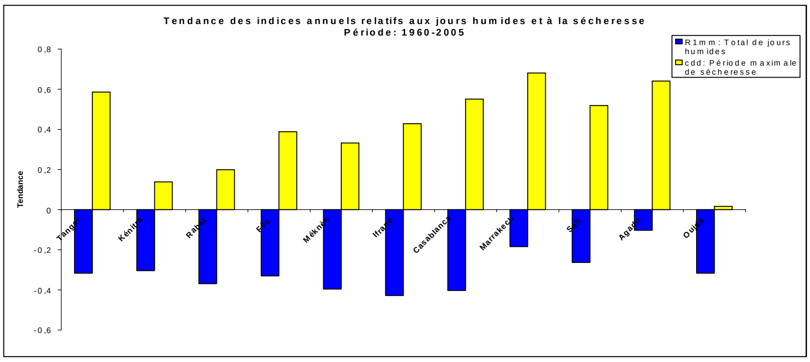
12.7.7 Procedures for developing and interpreting indicators

- Aridity aspect of climate:



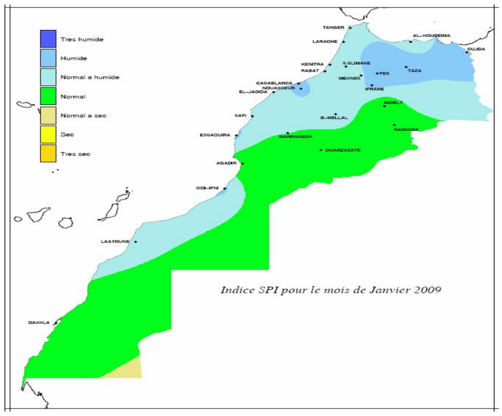
Evolution of arid zones in Morocco

- Evolution of meteorological parameters: Rainfall, temperature
- Climate indices: wet days, dry periods, high precipitation events, hot and cold days, heat and cold wave durations.

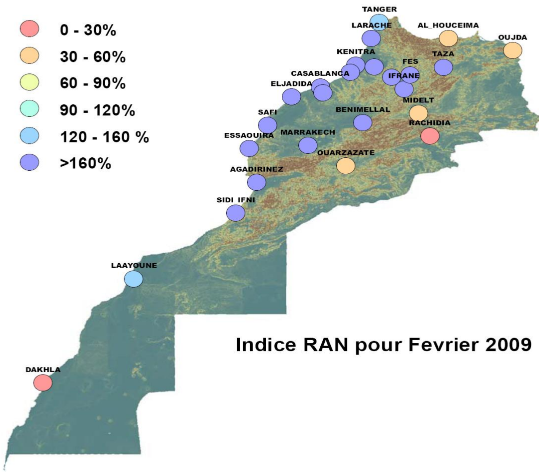


Distribution of wet days/dry days over a
35 years period in the main Moroccan stations

- Drought indices (SPI, RAN, Palmer index*)*



Map of the SPI index for January 2009



Map of the RAN index for February 2009

12.7.8 Information available from the system/network/forum

The DMN produce several bulletins:

- Weather forecast bulletins (warning of extreme events)
- Seasonal prediction bulletins (different model outputs)
- Monthly climate bulletins (for local and national scales)
- Agro-meteorological bulletins
- Drought monitoring bulletins
- Air quality measurements and reports

12.8 ID: DM NNA 08- FACTSHEET 34: ROYAL CENTER OF REMOTE SENSING (CRTS)

12.8.1 Description of how system/network/forum functions

The CRTS is the official distributor in Morocco of satellite pictures SPOT, Landsat, ERS and NOAA. It has a direct access to the archives of SPT IMAGE (France) and EURIMAGE (Italy) and its network of contact (stations of reception). To assist the users, The CRTS realizes the search catalogs and the studies for the choice of the best adapted satellite pictures (date, zone, type) to allow the users to benefit from the access to the various catalogs of images. The prices are function of the images chosen.

To set-up a drought study, 3 main steps are used (Boujiber 2010): i) Biophysical parameters are extracted from satellite data (NOAA/AVHRR) since 1999; ii) based on satellite data, drought monitoring indicators are calculated. Thematic indicators (meteorological, agronomic and forests) are established; iii) Dissemination through a bulletin edition.

12.8.2 Assessment of spatial coverage

National and regional coverage can be provided by the CRTS.

12.8.3 Description of the inputs to system/network/forum

Satellites are used

12.8.4 Description of the methods/techniques/models and outputs

The drought indicators are produced by a combination between vegetal indices and surface temperature. The main ones are:

- Normalized Difference Vegetation Index (NDVI)
- Standardized Vegetation Index (SVI),
- Vegetation Condition Index (VCI),
- Temperature Condition Index (TCI)
- Vegetation Health (VH)

Numerous other indices, related to the vegetation state and which can assess drought and/or desertification, were studied/developed by CRTS (FORMA project).

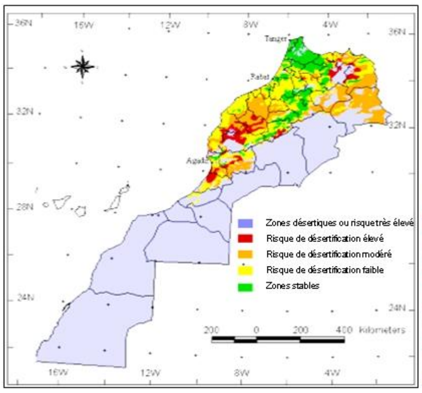
- LDI (Land Degradation Index)
- VPI (Vegetation Productivity Index)
- SMI (Soil Moisture Index)
- EVI (Enhanced Vegetation Idex)
- Le MGVI (Meris Global Vegetation Index)

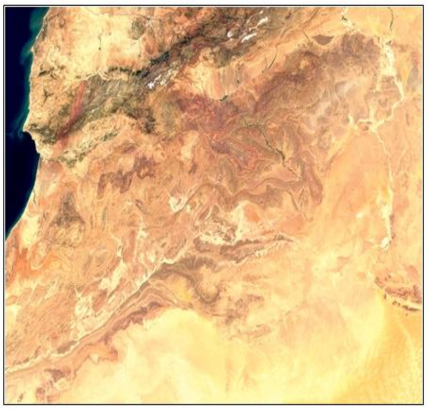
However, this study has shown that the most used indices by CRTS remain: NDVI, SVI, VCI, TCI and VH.

12.8.5 Procedures for developing and interpreting indicators

Desertification: Projects LIFE and FORMA

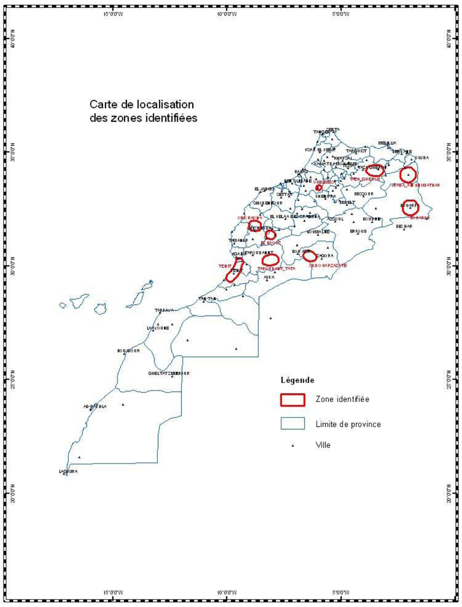
Satellite data and GIS offer key tools for desertification monitoring at two levels (Bijaber, 2010)
- A local monitoring by using high resolution data allowing a specific management and development of models to extrapolate results to other sites
- A national monitoring (low resolution data) allowing to reply to national plan objectives.





Vegetation changing map 1996/2002. (CRTS)

Zone Souss-Massa : Méso Geographic Indicators (CRTS)



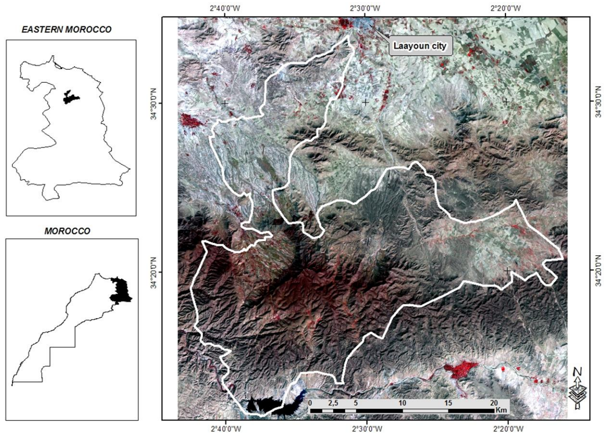
The red marked areas have been identified as being very sensitive to drought.
Synthetic map of sensible areas to desertification in Morocco.
(CRTS, FORMA Project).

Drought : Project SMAS (See SMAS Project, Part D)

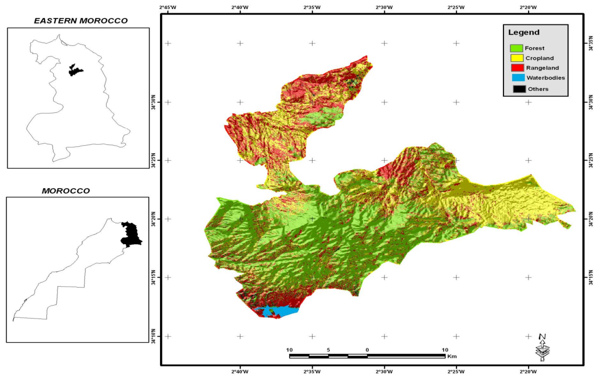
NDVI, CVI case Study

We will develop here one of the more recent studies using the data of CRTS remote sensing for assessing drought in a pasture arid area in Morocco .

To reach this objective, the authors (Mahou et al, 2010) used be-weekly TERRA Moderate Resolution Imaging Spectroradiometer (MODIS 250 m) data. A preliminary mapping using Landsat M5 of Major land covers types was carried out to extract the studied pasture area: Tancherfi commune.

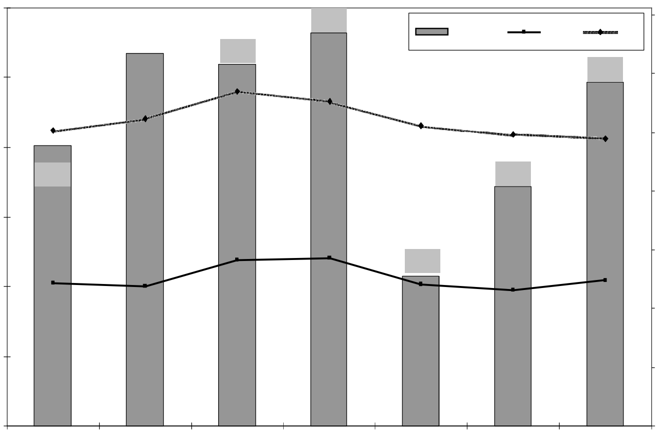


LandsatTM5 subscene ofTancherfi commune



Land coverofTancherfiCommune

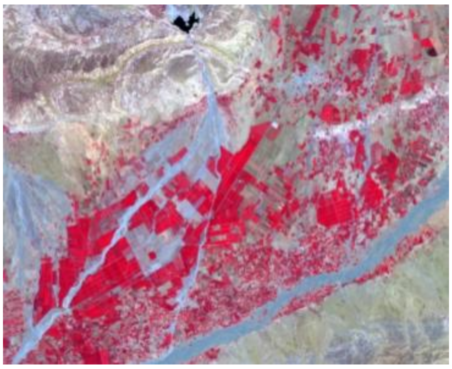
A comparison of annual and seasonal Normalized Difference Vegetation Indices (NDVI), Vegetation Condition Index (VCI) and the rainfall during the time period 2000-2008 were carried out.


Average NDVI,VCIand annual rainfallprofilesatTancherfipasture area

This study demonstrated the existence of stronger relationship of NDVI with previous seasonal rainfall as compared to VCI, indicating that NDVI variation is a good indicator of vegetation changes and consequently can give a better idea of drought conditions.

Other remote sensing applications can assess hydrological drought. (CRTS Web site).

Spot image of El Wahda Dam Morocco



Spot image of Imi El Kheng Dam Morocco

12.8.6 Information available from the system/network/forum

- A variety of information actions is undertaken by the CRTS to disseminate their knowledge and results as:
- Organization of seminars and exhibitions;
- Publication of a newsletter on space activities;
- Publication of a multidisciplinary, technical and scientific journal GEOOBDERVATEUR";
- Training of professionals and decision makers.

Examples of products:

- Weather forecast bulletins ;
- Seasonal prediction bulletin ;
- Monthly climate bulletins (for local and national scales)
- Agro-meteorological bulletin
- Drought monitoring bulletin

Air quality measurements and reports

12.9 ID: DMNNA 09: FACTSHEET 35: NATIONAL DROUGHT OBSERVATORY (ONS)

12.9.1 General information

The challenges associated with water scarcity, recurrent droughts and increasing water demands led the 'National Water Debate' to recognize that greater attention needs to be paid to the conservation and protection of water resources and to increasing on- and off-farm water use efficiency. Learning from the recent drought episodes also led to moving away from reactive crisis to proactive drought management. Consequently, a National Drought Observatory was proposed in 1999, and officially created in 2001 within the Ministry of Agriculture and Rural Development and located on the campus of Institute Agronomique et Vétérinaire Hassan II, as a coordinating structure and also as a link between the scientific community working on various drought issues and the decision makers in charge of drought management activities. At the time of its creation, The National Drought Observatory specific objectives in terms of drought monitoring were to:

- Collect, analyze and deliver drought related information in a timely systematic manner
- Characterize drought and define reliable indicators that can provide early warning or emerging drought conditions

- Conduct vulnerability assessments to determine those sectors most at risk from the occurrence of drought

The National Drought Observatory was designed to operate as an institutional network with a central management unit and regional sub-units, the whole system benefiting from existing structures, particularly the existing scientific human resources, both centrally and regionally.

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- **Central management unit**: The central management unit of the NDO is located in Rabat in order to be close to the central units of the key ministerial departments and institutions in charge of drought and water resources management. Like other drought observatories in the world and namely the US Drought observatory which is linked to the University of Nebraska, the NDO is based at the Institut Agronomique et Vétérinaire Hassan II (IAV Hassan II) in a scientific and technical environment that guarantees its independence and efficiency.
- **Regional sub-units**: The NDO cannot be operational without functional regional sub-units: INRA Settat, ENA Meknès and ENFI Salé that provide reliable regional data.

The National Drought Observatory has a scientific advisory committee and an orientation advisory committee to support the Board of Directors of the Partner Institutions which operate in the area of water and drought management. The operational activities are carried out by three committees: Drought monitoring and prediction committee, Drought impacts evaluation committee, and Strategic drought planning committee. Each committee is organized into working groups of subject matter specialists to address specific issues of drought management, including meteorological drought, hydrological drought, agricultural drought, and the resulting socio-economic and environmental impacts on the populations and national economy.

12.9.2 Who uses the system/network/forum?

At the national level, the Observatory is managed by the Ministry of Agriculture and Maritimes Fisheries, through a central management unit located at IAV Hassan II. In order to achieve its missions, it has functional links with all the national and regional actors involved in drought and water resources management. These partnerships allow the flow of information regarding drought monitoring and then a rapid implementation of drought reaction plans in case of drought onset.

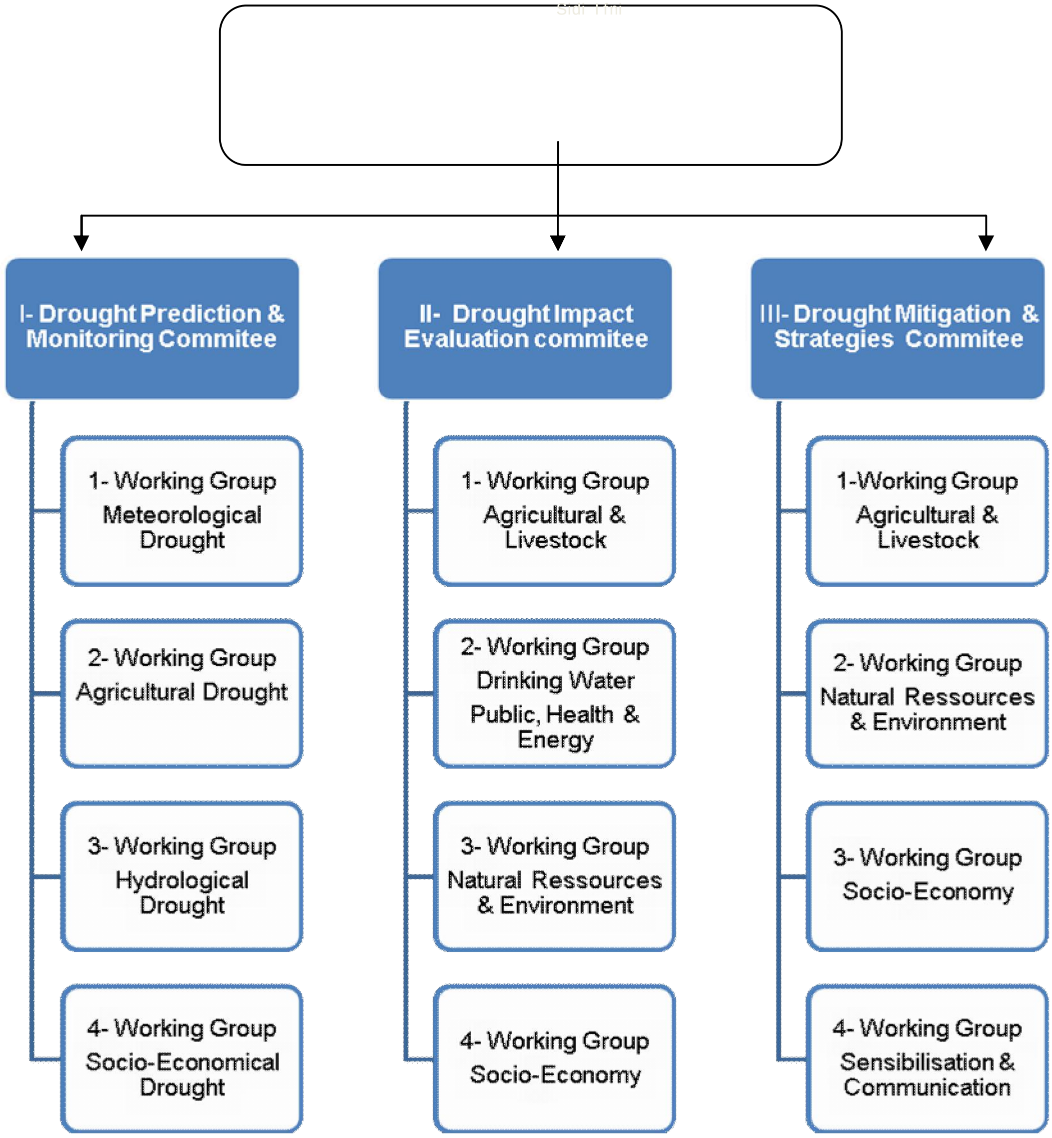
The NDO has indeed to work with:

- The central and regional Directions of the Ministry of Agriculture and Maritime Fisheries (MAMF): AGR, DCFC, DPV, DE, DPAE, DPA, ORMVA, chambers of agriculture....
- The National Direction of Meteorology (DMN)
- The Royal Center for Remote Sensing (CRTS)
- The central and regional Directions of the Ministry of Equipment
- The central and regional Directions of the Ministry of Interior
- The High Commissariat of water, forests and fight against desertification (HCEFLCD) (factsheet n°4)
- The secretary of state for Water and Environment and Water departments (SEEE, DGH/ABH)
- The Ministry of Public Health
- National institutions of research and higher education: IAV, INRA, ENA, ENFI

At the international level, the National Drought Observatory is supported by the US National Drought Mitigation Center, University of Nebraska - Lincoln, and by USDA.

12.9.3 Description of how system/network/forum functions

The NDO has a scientific advisory committee and an orientation advisory committee to support the Board of Directors of the Partner Institutions which operate in the area of water and drought management. The operational activities are carried out by three committees: Drought monitoring and prediction committee, Drought impacts evaluation committee, and Strategic drought planning committee. Each committee is organized into working groups of subject matter specialists to address specific issues of drought management, including meteorological drought, hydrological drought, agricultural drought, and the resulting socio-economic and environmental impacts on the populations and national economy.



Functioning diagram of the ONS

12.9.4 Assessment of spatial coverage

The National Drought Observatory monitors meteorological, hydrological, agricultural and socio-economic droughts at national and local scales.

12.9.5 Description of the Inputs to system/network/forum

In order to monitor drought in Morocco, assess and map drought vulnerability in Morocco, the National Drought Observatory use several parameters gathered from its main partners:

- Hydrological data: inflow and runoff, reservoir levels, groundwater table, snowpack (daily, monthly and annual records)
- Meteorological data: rainfall, temperature, evaporation (daily records)
- Agricultural data: weekly field survey reports (from planting to harvest), length of the agricultural season, impact due to parasitical attacks, yields previsions, food and water availability for livestock
- Data from remote-sensing
- Socio-economic data: commodity prices, feed prices, livestock prices, data on agricultural seasonal jobs and rural migration

12.9.6 Description of the methods/techniques/models and outputs

The drought indices mostly used for monitoring and prediction purposes are:

- Deviation from normal precipitation
- Precipitation deciles analysis
- Standardized Precipitations Index (SPI)
- Surface Water Supply Index (SWSI)

The NDO also uses the RIBASIM hydrological model (Delft Hydraulics, 2006) which is a modelling instrument for river basin planning and management used for analyzing the behaviour of river basins under various hydrological conditions. The inputs to the model are: water inflow; climatic data; dam reservoir characteristics; data from hydropower plants; data from water user sectors; and management rules. The outputs of the model are global basin water inflow, demand and supply in relation to probabilities of surpassing, and dam storage management curves which indicate different thresholds in relation to the water volume of the reservoir.

The periodicity of delivering of these indicators must take into account:

- The importance of the information at short and medium range time scale for each type of drought
- The type of indicator
- Time for collecting and treating data.

Usually, drought meteorological and hydrological indictors are delivered with a monthly frequency while agricultural drought bulletins can be produced every two weeks during the growing season. Seasonal bulletins can also assist decision makers for the implementation of global strategic orientations. Two seasons are important: the November-December-January period, which represents the snowing season and the February-March-April period for yields prevision and dams water resources management.

12.9.7 Procedures for developing and interpreting indicators

In the frame of the MEDROPLAN project, The NDO proposed a methodology to evaluate drought impacts and vulnerability and assess drought risks in agriculture. The analysis was applied at river Basin scale by considering the case study of Oum Er Rbia Basin, which is the largest Basin of Morocco and focus were made on rainfed cereal production system.

Three steps were followed:

- Characterization of drought hazard in rainfed agricultural system
- Spatialization of the drought hazard

- Drought vulnerability assessment of agricultural systems

Step 1: Characterization of drought hazard in rainfed agricultural system

In rainfed systems, cereals are the dominant crop and cereal yields are appropriate drought indicators. To characterize drought years, and their impact on cereal yields, two methods were used. The first is based on the yield threshold for profitability which is supported by field surveys and consists of defining a minimum yield level to cover the production charges for the crop to be profitable. The second method is based on the cereal production regression line over time which considers official recorded cereal yields to calculate the trend and its confidence intervals.

- ***Yield threshold for profitability***

For the purpose of this analysis, the following points were considered:

- Yield reduction by 25 % or more implies a dry year;
- Bread wheat crop (which is more responsive to drought) and its annual yields for each province within the river Basin (8 provinces), over at least 30 years record;
- Monthly rainfall data for different climatic stations within the Basin (34 stations);
- Estimated annual and seasonal critical rainfall thresholds (mm).

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). The characterization of drought years based on the yield threshold profitability over the cropping seasons from 1980 to 2000 showed high inter-annual yield fluctuations and on average, 9 severe drought years during 1980 – 2000 of which 6 dry years in the decade 1990 – 2000.

- ***Production regression line over time***

In this analysis, drought yield threshold is the average long term yield regression, minus 95 % confidence interval on the regression line. Those years with yields below the lower confidence interval are considered drought years; above this line, years are considered to be normal or wet.

Both the Yield Profitability Threshold and the Production Regression Line technique are simple to work out and can be usefully used to quickly identify the drought years in a drought risk analysis study. Once the dry years have been identified, several drought indices were tested for their predictive value of dry years. Among the tested drought indices, Deviation from Normal Rainfall, Deciles and Standardized Precipitation Index have proved to be simple and very useful for drought managers.

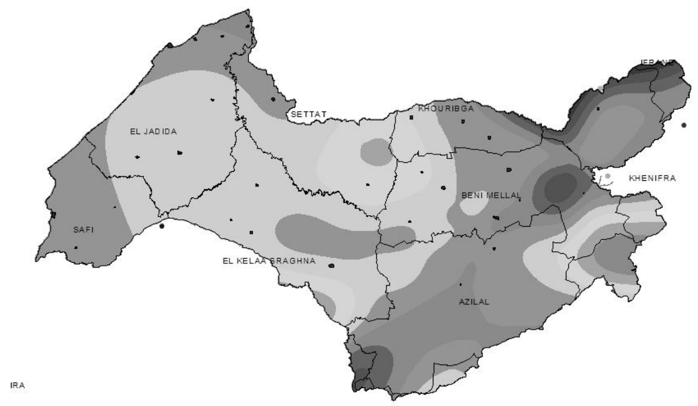
Step2: Spatialisation of the Drought hazard

The SPI was also used to map seasonal drought intensities for characterizing early season drought, mid-season drought and late season drought over the growing cereal crop cycle.. The characterization of seasonal drought risk is important for farmers to select adapted crop species and appropriate planting dates, and for decision makers to decide whether or not to import cereal grains to meet domestic needs.

Step 3: Drought vulnerability assessment of agricultural systems

Following Wilhelmi (1999), probability of seasonal crop moisture deficiency, soil root zone available water-holding capacity, and land use types maps were combined to produce an agricultural drought vulnerability map; GIS was used to determine the area extent of combinations of classes present. A numerical weighting scheme was used to

assess the drought vulnerability potential of each factor. This approach is similar to those described for food security mapping(Eastmanet al., 1997) and drought proneness mapping (Thiruvengadachari and Gopalkrishna, 1993).
The key factors of agricultural drought vulnerability, available for this assessment, include probability of crop moisture deficiency, soil root zone available water-holding capacity and land-use types. A numerical weighting scheme is used to assess drought vulnerability potential for the classes within each factor. The output map contains four classes of vulnerability: `low', `low to-moderate', `moderate', and `high'. However, drought vulnerability should also include socio-economic data such as sources of income, percent of acreage insured under crop insurance. But, more research needs to be done in developing weighting schemes of vulnerability factors.



Agricultural drought vulnerability of Oum Er Rbia basin

Low   Low to Moderate   Moderate   High

The map of drought vulnerability can help decision makers visualize the hazard and communicate the concept of vulnerability to agricultural producers, natural resource managers and others to adjust agricultural practices and select more appropriate cropping patterns in order to alleviate reduction in crop yields and income loss during drought years. Vulnerability maps are also important tools to orient policies, strategies and actions at national, regional and local levels.

12.9.8 Information available from the system/network/forum

The National drought Observatory contributed through the Medroplan project to the development of the Drought Management Guidelines. It also produces vulgarization posters in Arabic, French and English languages that are presented in the Agricultural and water resources management services and departments. The Observatory has also organized a joint workshop with the US Corps of Engineers on the shared vision methodology for water management under drought conditions. Since its creation in 2001, the Observatory has developed training programs on proactive drought management approaches to meet the needs of national professionals and has organized an advanced course at IAV Rabat with IAM Zaragoza on drought management strategies in the Mediterranean. Of direct relevance to the MEDROPLAN project, the National Drought Observatory organized the Regional FAO Workshop on ‘’National Capacity Building for Drought Mitigation in the Near East Countries’’ which was held in Rabat, 1-5 November 2002, and where the latest developments on water management policies and drought preparedness issues in 14 countries of North Africa and the Middle East were presented and discussed.

12.10 ID: DM NNA 12:FACTSHEET 32: MINISTRY OF AGRICULTURE, WATER RESOURCES AND FISHERIES (MARHF)

12.10.1 General information

In Tunisia, the Ministry of Agriculture, Water Resources and Fisheries (MARHF) duties are carried out by its different directions and departments. The complexity of the Tunisian water system results in an intricate institutional water management framework, where the water competencies and responsibilities are spread among several services, departments and institutions. Consequently, most of those institutional bodies are involved in drought management processes and some of them are in charge of hydrological and meteorological drought monitoring. Agricultural departments of the MARHF such as the National Observatory of Agriculture (ONAGRI), are involved in the agricultural drought monitoring process.

- **Hydrological and meteorological drought monitoring:**

The main departments of the MARHF, which are involved in drought monitoring are:

- Bureau of Water Planning and Hydraulic Equilibriums (BPEH)

The BPEH is directly attached to the cabinet (departmental staff) of the MARHF Minister. The competencies assigned to this bureau are:

- Mapping the conventional and non-conventional water sources.
- Identifying the different socio-economic water needs (demands).
- Collecting the available and exploitable water resources information.
- Collecting and analyzing all data related to the water demand.
- Propositions of plans and programs on the water resources allowance for all users, according to the supply and demand

Regarding its important role within the MARHF, the BPEH is continually in relation with all organizations andinstitutionsinvolvedinwaterresourcesmanagementinthecountry.Consequently,an important database on water resources is continually collected and updated.

- Central Directions of MARHF

The Central Directions of the MARHF that have extensive competencies in the water resources management field, are the General Direction of Dams and Large Hydraulic Works (DGBGTH), the General Direction of Water Resources (DGRE), and the General Direction of Rural Engineering and Water (DGGREE). On the other hand, the General Direction of Planning, Management and Conservation of Agricultural Lands (DGACTA),is involved in the natural resources evaluation and preservation as well as in the hydrological and hydro geological aspects linked to the water resources.

a) DGBGTH

Responsibilities in water resources planning and management are shared by the DGBTH and the DGRE through the following competencies:

- Elaboration of the hydraulic studies.
- Elaboration of mastering surface water resources planning.
- Elaboration of water mobilizations studies.
- Making up the dams and lakes building studies.
- Elaboration of important water planning studies for surface water resources mobilization (big dams, water transfer…).
- Control and maintenance of dams.
- Realization of the planning and large hydraulic works related to the rural and agricultural zones protection against floods.
- Ensuring a platform to encompass all the areas of flood prevention and disaster management.
- Supervising the drought management system.

b) DGRE

The DGRE is responsible for:

- 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.).
- Elaboration of basic and applied studies on the water resources evaluation and setting their general balance.
- Drawing the principal and specific methods for the water resources management, according to the supply and the demand.
- Promotion of the research and experimentation activities related to the conventional and non-conventional water uses.
- Finalizing and perfecting the different ground (basics) of water mobilizations planning and their exploitation.

c) DGGREE

The attributions of the DGGREE are:

- Realization of strategic studies and elaboration of political plans related to rural engineering and agricultural water exploitation.
- Attending and evaluation, planning, equipping, soil sweetening and drainage of irrigated areas, management of irrigation water exploitation, maintenance of hydraulic works and equipments, and conceiving the appropriate technical and economic management of the irrigated areas.
- Optimizing the water use and valorisation of there claimed used water, attending all NGO (GIC),and implementing the management and the balance of the water demand and supply in the agricultural sector.
- Coordination of rural and urban domestic (drink) water programs, and elaboration of water supply planning and projects and attending them.
- Coordination of rural infrastructures and basic equipments, and studying the technological and economic aspects related to the agriculture mechanization promotion.

d) DGACTA

The DGACTA is involved in the natural resources management by realizing the following missions:

- Elaboration of plans and orientations related to natural resources (soil, plant and water).
- Proposition, elaboration and promotion of measures ensuring the optimization of natural resource utilization.
- Soil resources evaluation (vocation and agricultural aptitude).The GIS and remote sensing technique are used.
- Realization of research on soil sciences, using advanced techniques and equipped soil and water analysis laboratories.
- Control of soil evolution under the different exploitation modes, and their protection against salinity, degradation, and desertification.
- Coordination between all parties working on the soil and water conservation.
- Elaboration of the basins planning, and drawing out the anti-erosive studies and implementing them.
- Control and attending the soil and water conservation projects realization.
- Evaluation of the soil and water conservation planning and programs.
- Setting and promotion of approaches targeted on the natural use optimization and preservation and associating all operators in the preservation process.
- Ensuring the valorization and exploitation of the soil and water conservation infrastructures and planning works realized.

- Institutions supervised by MARHF

a) The Hydraulic Inventory and Research Bureau

The Hydraulic Inventory and Research Bureau (BIRH) has a financial autonomy and is under the DGRE administrative authorities. The BIRH participates, by using advanced technological instrumentations, in the mounting and management of measurements and observations networks related to all country water resources components (surface and groundwater).BIRH is loaded by the realization of the following duties:

- Establishment and updating of the national surface and groundwater resources inventories and development of prospecting for new water resources identification.
- Mounting and management of measurement and observation networks related to all the country water resources components (surface and ground water).
- Realization of pumping operations in order to determine the technical aquifers characteristics.
- Computation and optimization of water information and data base management.
- Dissemination of water data and information recorded and analysed, by publishing bulletins and technical yearbooks (annuaires).

b) SONEDE:

The Water Exploitation and Distribution National Company (SONEDE), is an autonomous institution under the umbrella the MARHF authorities, and ensures the management of the domestic water and also the industrial and other (non agricultural) uses in the country. Organized by several directions, SONEDE is responsible for the quantitative and qualitative fresh water management. It has to realize the water network exploitation, maintenance, transportation (transfer and canalization), and all activities related to the area of drinking water such a water treatments for normalized qualities (physical, chemical, biological and bacteriological) and its equitable distribution. SONEDE establishes the population water needs, realizes the infrastructure required, and draw sup statistical data related to the evolution of the domestic, industrial and tourist water demand, production and treatment operations required, and establishes they early freshwater provision for the different users. SONEDE collaborates with DGBGTH, DGGREE, DGRE and SECADENORD.

c) SECADENORD:
The Company of Exploitation, Canalization and Adduction of the Northern Canal and Waters (SECADENORD), has a financial autonomy and is under the MARHF authorities. It ensures the management and maintenance of the North West part of the network of water transfer (pipes and channels) from the extreme North West to the users located in the North East, Centre and South of the country were the is fresh water shortage. The water quality is controlled by several analyses, and water pollution risk during transferring is monitored.

d) IRESA
The Agricultural Research and Higher Education Institution (IRESA) supervises agricultural research and higher education institutes. 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. The Direction of the Scientific Information Processing (DTIS) is the linkage organ between the agricultural research and education institutions and the development departments, and ensures the internet service supply for the agricultural sector (Authorization No.1002, 30 December 1997), by mean of AGRINET National network(www.agrinet.tn). DTIS is entrusted notably with conservation, elaboration, and processing of scientific databases(e.g. implementing of an information system on the agricultural water research,WATER2000)for research and planning uses purposes, and also in order to establish a simplified Decision Support System (DSS). Moreover, DTIS identifies and manages the databases (national and international) connections.

- *Regional Commissaries of Agricultural Development or Regional District Department of MARHF (CRDA)*

Within the framework of the Tunisian decentralization policy, the MARHF central direction, involved in all the agricultural activities (natural resources, food production, vegetal and forestry domains, economic aspect…) are represented in each governorate (24 governorates), by regional services or district departments. It is an administrative and technical structure, called CRDA. CRDAs are entrusted with numerous responsibilities targeted on the realization of all operations related to the regional agricultural development and natural resources valorizations. CRDA has technical and administrative services ("Arrondissement"), which are the representatives of the central directions and realize their duties at the regional level. The principal services "Arrondissements" involved in the water management and producing linked data and information are:

(ii) Water Resources Service (A/RE, Arrondissement des Ressources en Eau);
(iii) Public Irrigated Areas Exploitation Service (A/EPPI, Arrondissement de l'Exploitation des Périmètres Publics Irrigués)
(iv) Maintenance of Equipments Service(A/ME, Arrondissement de la Maintenance des Equipements); and (iv) Rural Engineering Service (A/GR, Arrondissement du Génie Rural).

- **Agricultural Drought Monitoring**

Within the MARHF, several directions and departments contribute to the agricultural drought monitoring:

- *National Observatory of Agriculture (ONAGRI)*

The National Observatory of Agriculture (ONAGRI) is a public administrative nature under the Ministry of Agriculture, Hydraulic Resources and Fisheries. The ONAGRI is responsible to perform the following tasks:

- Develop a reliable information system to analyze the situation of agriculture and fisheries at the national and international level through relevant, reliable and regular indicators, reliable
- Collect information and data on national and international sector of agriculture and fisheries, analyze and process.
- Disseminate information and data collected and make them available to various stakeholders including policy makers, planners, researchers, producers, exporters and others.

- *Office of Livestock and Pasture*

The Office of Livestock and Pasture (OEP) is charged to promote the development of the livestock sector. Hence, it ensures the sector follow up and contributes to its development through the analysis of the sector's indicators.

- *Cereal Agency (OC)*

The Cereal Agency (OC, Office des Cereals) is in charge of the promotion and the management of the cereal production.

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- *General Direction of Agricultural Production (DGPA)*

The General Direction of Agricultural Production (DGPA) is a central direction and is responsible for the promotion of agricultural production (cereal, forage, horticulture, arboriculture, fruit and olive trees particularly, industrial crops, biological agriculture, animal production). DGPA contributes through its central and regional services ("Arrondissements") in the CRDAs in the different steps of drought management.

- *General direction of Veterinary Services* (DGSV)

The General Direction of Veterinary Services (DGSV) defines the national programs and policy in the animal health sector and all components related to the livestock preservation and safeguard. This General Direction is associated in the drought mitigation process by its central directions and regional services in the CRDAs.

- *General Direction of the Agricultural Studies and Development (DGEDA)*

By its Directions (Studies and Plans, Statistics and Agricultural Circumstances, Development Programs and Projects), DGEDA contributes on drought management by analysing its different phases, attending the evolution of the agricultural circumstances, and evaluating drought social and economic impacts.

- *Forest General Direction (DGF)*

Forest General Direction (DGF), contributes in the forest lands management and acts against forest fire, especially during drought events. DGF manages several range lands that are open for farmers during drought. DGF has numerous forest lands data and maps containing numerous water resources information.

12.10.2 Who uses the system/network/forum?

There are several services and departments of the MARH and institutions supervised by this ministry that are in charge of meteorological, hydrological and agricultural drought monitoring. In order to achieve their missions, these entities developed links with:

- The National Meteorology Institute (INM)
- The National Institute of Cartography and Remote-sensing (CNCT)
- The Ministry of Research and Higher Education
- The Treasury or Finance Ministry(MF),
- The Ministry of Economic Development and International Cooperation (MDECI)
- The Public Health Ministry (MSP),
- The Ministry of Communication Technologies and Transport(MTCT),
- The interior Ministry (MI) and
- The Commerce Ministry (MC)
- The international collaboration (ICARDA, CIHEAM, FAO,IRD, GTZ, ACSAD….)
- The Sahara and Sahel Observatory (OSS)

12.10.3 Description of how system/network/forum functions

Under the supervision of MARH, institutions involved in water and drought management are invited to periodical coordination meetings in order to specify the major decisions related to water resources allocation and management. Emergency sessions are conducted depending on the weather extremes situations (flood and drought). In every water management plan that is realized and supervised by one institution, numerous institutions are associated in the relevant study as well as in the realization process. Coordination is already consolidated by the representatives of the institutions linked by the water resources.

12.10.4 Assessment of spatial coverage

The different services and departments of MAERH monitor meteorological, hydrological and agricultural droughts on regional and national scales.

12.10.5 Description of the Inputs to system/network/forum

Water resources in Tunisia are classified as surface, aquifers and non conventional resources. Tunisia devoted great attention to the data information system on water resources(quantity and quality), in order to satisfy equitably the different water demands. Since the Tunisian water system is complex, the water data system includes eight major components: (i)precipitation (rainfall); (ii)surface water (hydrometric data, reservoirs data–dams, hill dams, lakes–water transfer by network connection, etc.); (iii) aquifers

(management and artificial discharge); (iv) non conventional water (desalinized and reclaimed used water); (v) water quality monitoring network; (vi) water demand, cost and pricing;(vii) soil sweetening and drainage; and (viii) demography (population).
The following table presents all the services and departments of MAERH involved in water and meteorological and hydrological drought data collection and processing.

Summary of the services and departments of MAERH involved in water and meteorological and hydrological drought data collection and processing (from MEDROPLAN).

Institution	Data	Type of data	Frequency	Transmission mode
DGBGTH	Dams data	Location, capacity, year of creation, silting & life duration	Monthly & yearly	Report
	Basin hydrologic and dams data management	Water quality and quantity in dams, daily water harvested, rainfall, and rainfall Management, dam control, management of hydrometric and hydrologic measurements, volume used	Daily	48 radio VHF,39 mobile transceivers, 60 walkie-talkies. Phone modem, fax, Telemetry system for rainfall and hydrometric data every30 minutes
	Dams simulation and statistical analysis	Transfer, losses, exploitation	Monthly &yearly	Report
	Dams management	Annual volume, annual hydrologic situation, water losses in dams, water dams balance, water demand	Yearly	Report
	Water exploitation	Dams balance, hydrologic studies, statistics studies, water demand	Monthly	Report
	Early flood warning	Instantaneous hydrologic situation	Instantaneously	Phone modem, fax, radio
DGRE& BIRH	Rainfall	Observation and measurement weather stations	Daily, monthly, yearly	Phone modem, fax, radio, satellite, report
	Hydrometric	Basin data, oued (river), discharge, stations, maps, water quality	Instantaneously, daily, monthly and yearly	Magnetic support
	Flooding	Discharge of flood, initial and final date and hour, runoff	Instantaneously	Magnetic support
	Aquifers supervision	Shallow and deep aquifers quantitative and qualitative situations and exploitation	Continually supervision and Yearly data compilation	Report
	Shallow aquifers	Artificial recharging	Yearly	Report
	Aquifers water supervision	Quantity and quality (BIRH)	Yearly	Report

Summary of the principal institutions and organizations involved in water and drought data collection and processing

Institution	Data	Type of data	Frequency	Transmission mode
DGACTA-IRD	Rainfall	Observation and measurement around hill lakes	Instantaneously	Telemetry ARGOS system
	Water reservoir hydrologic balance	Volume, evaporation, runoff, overflow, emptying	Yearly	Report
	Strong rainfall	Intensity,volume, Qmax	Instantaneously	Telemetry

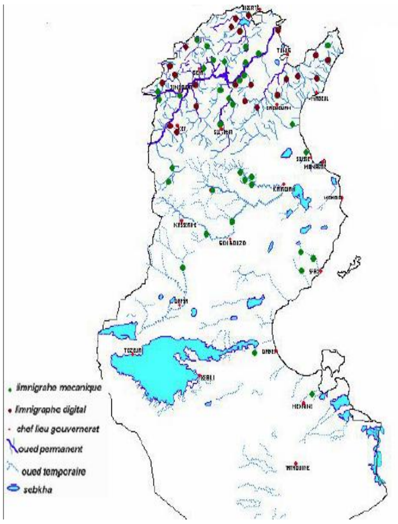
	characteristics			ARGOS system
	Overflowing risk	Spillway maximum discharge, instantaneous maximum discharge, dyke overflowing	Instantaneously	Telemetry ARGOS system
	Water quality	pH & salinity	Half-yearly	Report
	Water reservoir silting & life duration	Creation date, initial and final volumes, estimation of life duration	Yearly	Report
	Hill lakes exploitation	Water quantities, irrigated areas	Yearly	Report
DGGREE	GIC associations	Number, water resources, water quality, volume & cost	Yearly	Report
	Public irrigated areas	Surface, intensification rate, water resources, water quality, volume & cost	Yearly	Report
	Rural domestic water prevision	Statistics data: supply& demand evolution	Yearly	Database using GIS &report

- Rainfall

-The DGRE has an important precipitation stations network (1157stations). More over, DGRE has 67 pluviograph stations distributed in the different regions.
-The DGACTA/DGRE has a network of meteorological stations located at the 30 hydrologic stations, 4installed by DGBGTH nearby the hill dam sand supervised by DGRE and the remaining 26 are equipped with telemetry systems realized in collaboration with IRD.
- The DGBGTH includes a station network localized on the dams' sites. The precipitation quantities are recorded daily with other data related to the dam situation.
- The CRDA has a network in each district (Governorate), where the DGRE has a precipitation measurement post that is managed by A/RE (the regional department of DGRE).

- Surface water

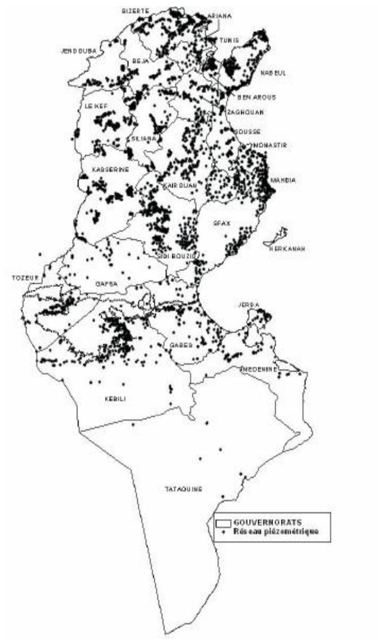
Three institutions represent the hydrologic measurement network stakeholders are: DGRE, DGBGTH and DGACTA. Data are collected by the Hydrometric Network and by the Flood Early Warning Network. The Hydrometric Network includes a hydrometric station in each basin.There are 52 principal stations. The oldest is in Medjerda basin where data have been available for 80 years, and the newest are located in the centre and the south, which have been in place for 14 years. The Flood Early Warning Network started in 1970. The DGRE network focuses on the short term prevision of flood by the principal oueds (rivers). The objectives are the hydraulic system protection and the population preservation. Information is communicated by phone modem, and/or by 26 radio systems. The DGRE system is enhanced by the DGBGTH Flood Early Warning Network which is based on 48 radio VHF communication system, vehicle mobile 39 transceivers and 60 walkie-talkies.
Streams flows are recorded thanks to a national limni graphs network (Fig. 3.29)



National limnigraphs network

- Aquifer water management and artificial recharging

Shallow and deep aquifers data are provided by DGRE and CRDA (A/RE). Quantitative and qualitative data are recorded and published in special technical issues (Annuaires). Hydro-geologic information on the deep aquifers is well mastered and simulated by numerical models. Shallow aquifer data are targeted on the quantitative and qualitative information, where artificial recharging is monitored.



National piezometric network (DGRE et F. Horriche 2005)

- Agricultural data

The MARH department and services of MARH monitor the following agricultural data: weekly field survey reports (from planting to harvest), length of the agricultural season, parasitical attacks, food and water availability for livestock, commodity prices, feed prices, livestock prices.

12.10.6 Description of the methods/techniques/models and outputs

Thanks to the data collected through its monitoring networks, the MARH produce several drought indicators:

- Meteorological indices: pluviometric indices (SPI, Drought index), ETP,
- Hydraulic and Hydrologic indices: Reservoir levels, Runoff, inflows, dams balance
- Hydrogeologic indices : Piezometric levels
- Agricultural indices: yields previsions, impacts from parasitical attacks
- Ecologic indices: Forests and Rangelands areas evolution

- Rainfall and surface water data are managed by the PLUVIOM and HYDROM softwares developed by the French Institute for Research and Development (IRD, former) ORSTOM.

- Drought identification and characterization are conducted with the REDIM software (DICA, 2000): the identification and characterization of drought is performed by means of run method, and different threshold levels can be selected namely, the mean, the median, the average minus, the standard deviation, or sample quantile at a fixed frequency. Graphical output of results allows to easily identify droughts on a given time series, and/or region. (Rossi and Cancelliere, 2003) .

- SINEAU

The actual water information system is characterized by highly diversified but complementary sources of information and data on water. Nevertheless, this diversity leads to constraints in the water data and information exchange, and consequently hamper the efficient valorization of the important recorded information. To avoid this weakness, the Tunisian Government decided to establish a Unified Water Resources National Information System called “Système d’Information National des Resources en Eau (SINEAU)”. The first phase of the identification study was completed in October 2003. The SINEAU system will add more efficiency in the water data collection, analysis and its real time diffusion.

12.10.7 Procedures for developing and interpreting indicators

The Drought National Commission (DNC) regroups representatives of MARHF, Interior, Economic Development, Finances, Commerce, Transport, and Public Health Ministries. It has principally: (i) to keep track of the drought circumstance; (ii) to elaborate the measures and provisions against the drought situation (intensity, duration, etc.), according to regional and national indices analysis; and (iii) to coordinate the execution of drought mitigation operation programmes. This commission is supported by the Specialized Sectors Commissions (DSC) at the national level and by the Regional Commissions (DRC) in each province (Governorate). The Drought Specialized Commissions (DSC) 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:

(i) Water Resources Management Committee: This Committee regroups representatives of all departments involved in the water management in MARHF. 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 Drought National Commission.

(ii) 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 MARHF. The Ministries of Commerce, Transport, Interior, Finances and Economic Development are associated to this Committee. 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 program and to establish the eventual importations needs in order make up the eventual forage deficit.

(iii) Cereal Sector Management Committee. This committee is organized by the cereal sector intervening parties. Its members are representatives from different departments of the MARH that are working in the cereal field. This committee has to quantify the cereal production stocks and seeds reserves, to propose a program 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 cereal an importation program is elaborated.

(iv) Fruit trees Sector Committee. The members of this committee work in the arboriculture departments of MARH and are concerned with the situation of all trees and aim the fruit trees heritage (patrimony) safeguard.

12.10.8 Information available from the system/network/forum

The MARH produce meteorological, hydrological, agricultural and socio-economic drought indicators that are diffused and disseminated through several bulletins. The ONAGRI bulletin is a weekly bulletin that informs users on the marking facts of the ongoing agricultural season.

In addition to reports, publications and various notes produced by evening primrose, dissemination of information is ensured through an information network consisting of a website Department internal (intranet) and an Internet Web site.

The sites include several windows including in particular: the national and international news, the journal of the national press, newsletters, agricultural markets, the agro-food balance, rainfall, dams situation and two databases relating to legislation and to agricultural literature.

ID: DM 31: FACTSHEET 31: NATIONAL CENTRE OF CARTOGRAPHY AND

12.11 ID: DM NNA 12: FACTSHEET 38: NATIONAL INSITUTE OF METEOROLOGY (INM)

12.11.1 General information

The first meteorological unit for rainfall and climate observation was established in 1885 at Tunis-Manoubia. The establishment of synoptic observations network by FMO (French Meteorological office) with one major station located at El Aouina aerodrome occurred in 1923 and 1945, FMO creates a climatologic station.The Tunis-Manoubia unit becomes an office for the inventory of water resources and rainfall data, and El Aouina station becomes the National Service of Meteorology in the Department of Aeronautical and Marine Services under the supervision of the Ministry of Public Works and Housing in 1958. The National Service of Meteorology becomes Department of Meteorology in 1973 and the Department of Meteorology becomes the National Institute of Meteorology (NIM) in 1974. The INM was certified ISO 9001 in 2009.

The INM is the main precipitation network in Tunisia and its main missions are to ensure the meteorological observations, particularly weather forecasting, Climatology, and applied meteorology by managing the nationwide meteorological observation Network that comprises synoptic, agro-meteorological, climatologic, rainfall, marine and upper-air Observation stations. Its mission is namely:

- Meteorological observation
- Seismic recording and location.
- Astronomic observation and calculation of ephemeris.
- Weather prediction.
- Geophysical data.
- Drought monitoring

INM also provide technical coordination of the activities related to meteorological and geophysical aspects, conduct theoretical and applied research and implement international agreements related to matters of its skill and technical cooperation with international centers and specialized organizations.
Within the Ministry of Communication Technologies and Transport framework competencies, the National Institute of Meteorology has an independent budget of 6MDT (about 3.2 M Euros).

12.11.2 Who uses the system/network/forum?

A communication system dedicated to meteorological data handles data exchange. Observation data obtained from national stations is dispatched to internal and external users while data obtained from external sources is dispatched to local users.
Different economic sectors are interested in forecast bulletins (aeronautical and marine services, agriculture, industry, environment, energy, and tourism) and other fields like health, sports, recreation, and media.

- **Agro-meteorology** : Agriculture and farming, Irrigation planning and management; Fight against diseases and natural disasters (drought, frost, hail, forest fire, etc.).

- **Hydrometeorology** : Provide basic data for hydraulic works (sanitation, dams, drainage, etc.), Contribute to elaborate statistics for rain and drought previsions. In order to achieve its missions, the INM is organized around a central department with six regional subdivisions (Tunis, Jendouba, Sousse, Sfax, Tozeur, and Medenine).

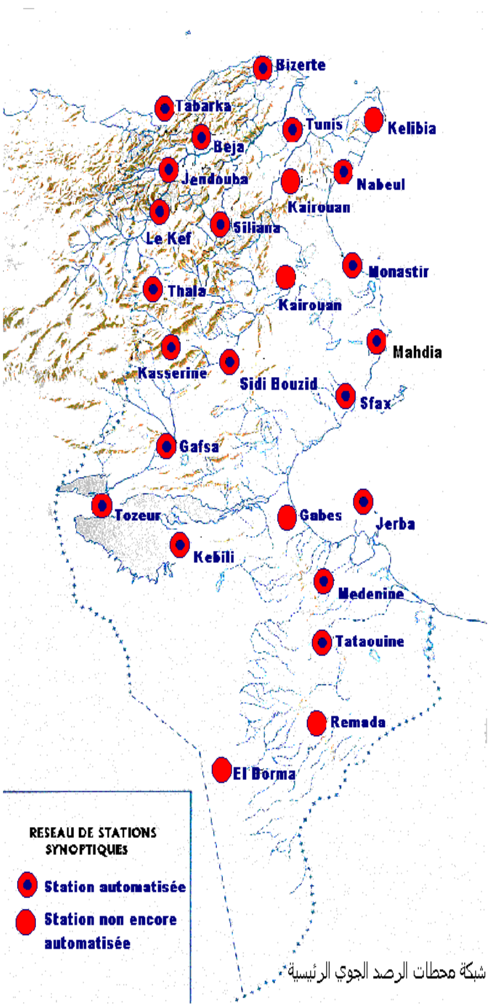
12.11.3 Description of how system/network/forum functions

INM archives daily meteorological data which are sold to the users. There is a web site to place an order for buying data: http://www.meteo.tn/htmlfr/usager/formulaire.html. and a web site fixing princes according to the requested data: http://www.meteo.tn/htmlfr/usager/decret/index.html
Also, INM is in charge of weather forecasting which consists of collecting, analysing and interpreting the different observations products, direct measurements or from remote sensing sources, as well as the products of the models of numerical weather prediction. Weather forecasts are provided in the form of bulletins, directives, or files in communication supports. Specific data could be obtained by subscription.

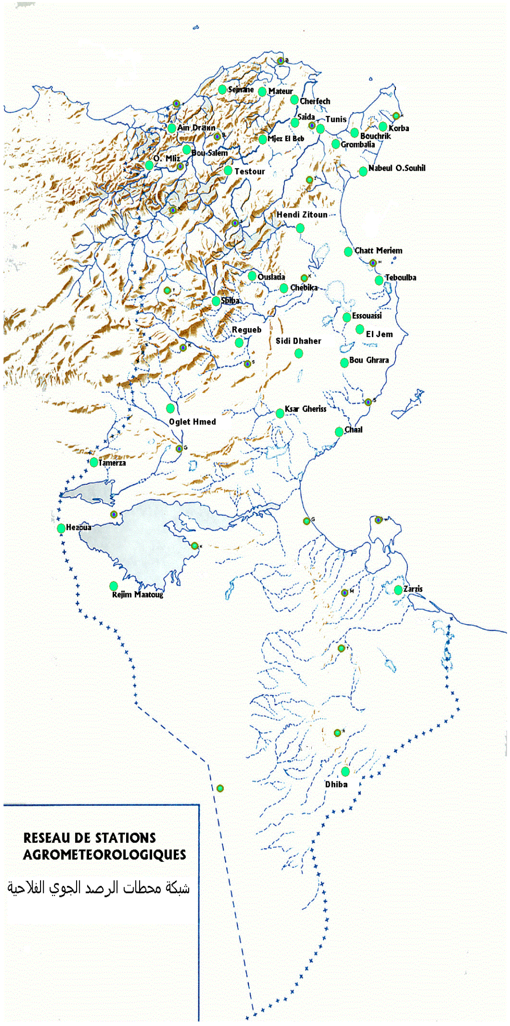
12.11.4 Assessment of spatial coverage

INM has an observation network classified by station types:

- Synoptic network : 26 stations.
- Agro-meteorological network : 31 stations.
- Climatologic network : 58 stations.
- Rainfall network : 208 stations.
  Radar network : 1 Radar.
- Seismologic network : 15 stations.


Bizerte
Tabarka
Tunis
Kelibia
Beja
Jendouba
Nabeul
Kairouan
Le Kef
Siliana
Monastir
Thala
Kairouan
Mahdia
Kasserine
Sidi Bouzid
Sfax
Gafsa
Tozeur
Gabes
Jerba
Kebili
Medenine
Tataouine
Remada
El Borma
RESEAU DE STATIONS SYNOPTIQUES
Station automatisée
Station non encore automatisée
شبكة محطات الرصد الجوي الرئيسية

a)


Sejnane
Mateur
Cherfech
Ain Drahm
Saida
Tunis
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Grombalia
Bou Salem
O. Mliz
Testour
Nabeul O.Souhil
Hendi Zitoun
Chatt Meriem
Ouslada
Teboulba
Chebika
Sbiba
Essouassi
El Jem
Regueb
Sidi Dhaher
Bou Ghrara
Ksar Gheriss
Oglet Hmed
Chaal
Tamerza
Hezoua
Rejim Maatoug
Zarzis
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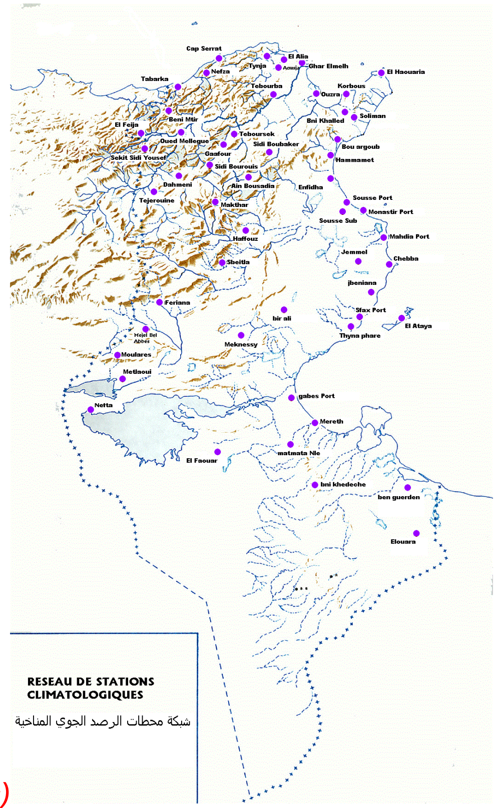
RESEAU DE STATIONS AGROMETEOROLOGIQUES
شبكة محطات الرصد الجوي الفلاحية

b)



c)

Spatial coverage of stations: a) synoptic, b) agro-meteorological, c)climatic

12.11.5 Description of the Inputs to system/network/forum

The weather observations proceed 24 hours a day, 7 days a week.

The rainfall quantity and intensity are taken daily and archived, daily, weekly, decadal, monthly and yearly.

Forecasts are established for periods of a few hours up to 6 days. A distinction is made between very short and short-range for the next 24 or 48 hours and medium-range for the next 3 to 6 days.

Weather forecasts are provided in the form of bulletins, directives, or files in the various communication supports.

12.11.6 Description of the methods/techniques/models and outputs

The major data sets and their terminology are:

- **HOBS:** Hourly data of basic stations
- **QP :** Daily data of basic stations
- **TSOL** : Ground temperature
- **PHENO** : Meteorological phenomena
- **PLUIE** : Rainfall data
- **MOBS** : Monthly data of basic stations
- **TCMS** : Daily data of minor stations
- **MTCMS** : Monthly data of minor stations
- **NORMALES** : climatologic normal
- **RECM** : Monthly records

- **PARAMETRE** : Meteorological parameters
- **STATION** : Stations dictionary
- **RESEAU** : Observation network operation

The indices used to assess drought are:

- Evolution of meteorological parameters: Rainfall, temperature,
- Albedo, Evaporation
- Wet days, dry periods, high precipitation events, hot and cold days, heat and cold wave durations,
- SPI, (see examples in point 1.7)
- percentage of precipitation deviation, Autumn rain and January rain (see examples in point 1.7)

26 principal stations measure 40 hourly parameters and 64 daily parameters, and 70 secondary stations measure 16 daily parameters. An open system using the latest version of ORACLE SGBDR guarantees data security and allows the supply of quality climate products to the various sectors and users in the shortest possible time.

12.11.7 Procedures for developing and interpreting indicators

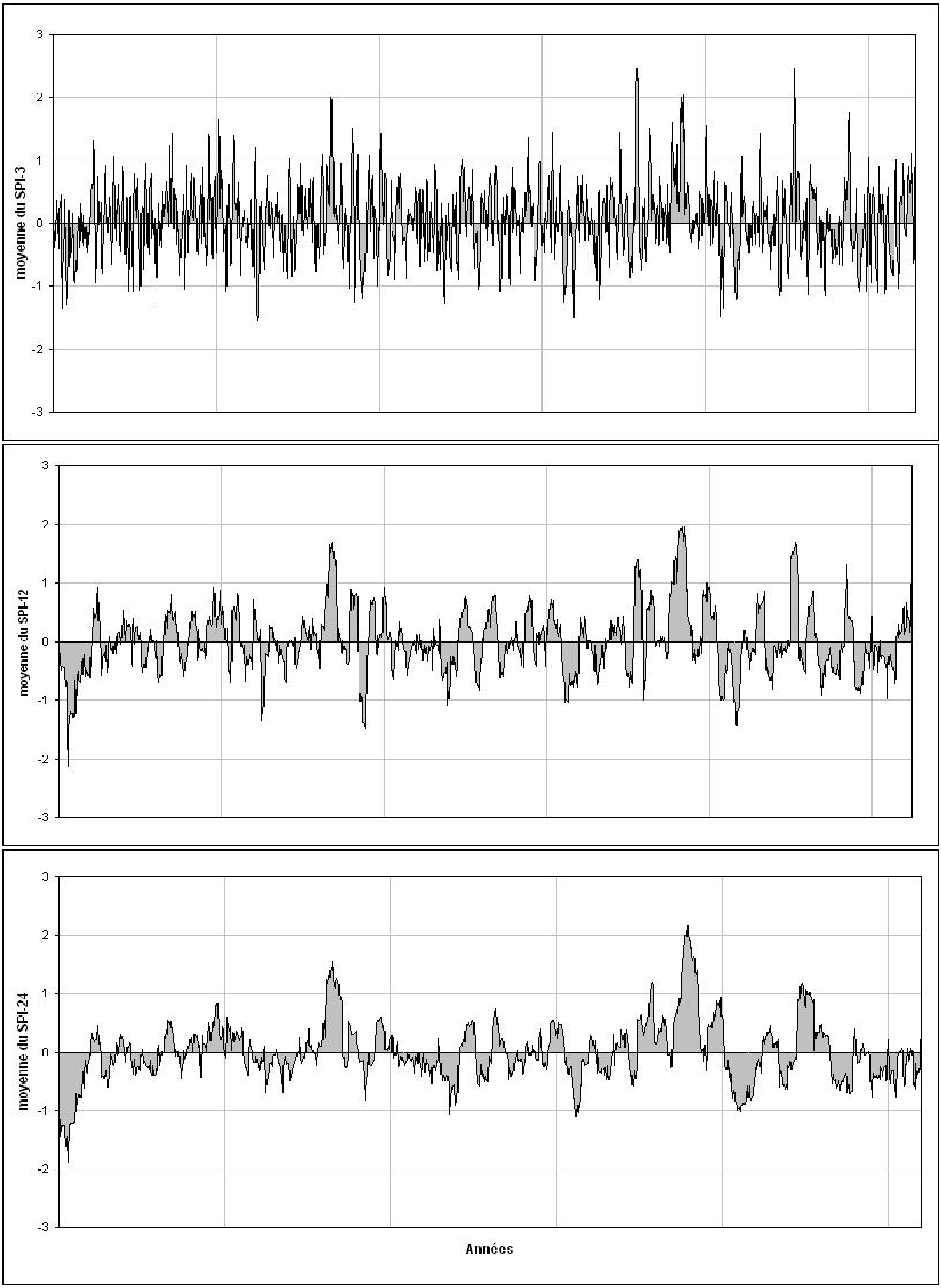
The indicators and used parameters are regularly editing and dispatching of climate tables and statistics. When needed, there is a use of methods that combine climate data and socio-economic and physical data to meet the requirements of planners and decision makers.
The use of meteorological data for assessment and interpretation of drought:

- **Percentage of precipitation deviation from the mean historically established values**: According to the experience in Tunisia, when precipitation quantities are ranged between 70 to 50% of the historical mean value, drought is declared and when they are less than 50%, a severe drought is declared. Yearly, the first kind of drought is predominant, but the second one is rare in the North and frequently occurred in the Centre and the South of the country.

- **The delay of the first autumn precipitation (September-October)** is judged as a pertinent index relevant to the meteorological conditions during the remaining year. The rainfall data analysis showed that during the last century there was a highly correlated relation between autumn rainfall quantities and the yearly precipitation amount. Around 70% of the autumnal drought cases are generally followed by an annual drought event. This percentage is 78 and 90% respectively for the North and both the Centre and the South. Precipitation during autumn is very important since it is representing 40% of the mean annual quantity.

- **Black night:** On the other hand, if the drought persists during the beginning of the winter, especially from 13 January to 2 February (called in the agricultural local language the black night), the drought is confirmed. The March precipitations are impatiently awaited. Such precipitations are very important; they are a great weight off of farmers' minds since they save their crops, especially the cereal and the young trees. The importance of that precipitation appears in the popular proverb: "rain of March is pure gold".

Example for use and interpretation of SPI:



1899 1919 1939 1959 1979 1999

Evolution of historic SPI at short (3 months), medium (12months) and long (24 months) terms

According to the SPI values classifications (McKee et al, 1995) which are:

0 to 0.99: Normal
-1 to 1.49: Moderate drought
-1.5 to -1.99: Severe drought
<-2: Extremely severe drought

Results of the above figure show a high variability of SPI values at the short term with dry periods which are frequent and short. However, at the two other scales, the values stabilize and reveal less frequent, but more prolonged dry sequences. The more important drought was the year 1976, especially at its last period.

12.11.8 Information available from the system/network/forum

The system provides information through internet or through bulletins

- Short-dated bulletins (2 days).
- Medium-dated bulletins (5 days).
- marine bulletins
- Agricultural bulletins.
- Rain flash.

12.12 ID: DM NNA 13: FACTSHEET 39: NATIONAL CENTRE FOR REMOTE SENSING (CNCT)

12.12.1 General information

Created in 1988, the CNCT is a non-administrative public establishment under the trusteeship of the Ministry for National Defense. It is located in Tunis, 05mn far from Tunis Carthage airport.
The main CNCT mission is to develop methods based on space technologies in the country's economic sectors having priority, in particular in the fields of agriculture, urban planning and environment.The CNCT has a multi disciplinary team of engineers and technicians specialized in field work (topography, geodesy, cartography.) and who master the techniques of space, data processing, databases. With regard to the drought, CNCT provides maps and data about the land cover, the water resources used as indicators of agricultural and hydrological level drought, the vegetal cover and the soil and water surface temperature.

12.12.2 Who uses the system/network/forum?

The National Mapping and Remote Sensing Centre is organized in the following way: Two advisory authorities support the General Direction:
- An advisory council charged to examine the administrative, legal and financial aspects as well as the ones related to the CNCT activities;

- A scientific committee charged to examine the scientific and technical aspects as well as the ones related to the scientific research
To the General Direction are directly attached:
- A commercial unit
- An internal audit unit
Moreover, the Centre includes three operational structures:
- A Technical Direction in charge of the studies, the applications' development in various disciplines of Geomatic as well as the training for the benefit of many users;
- A Direction of Production in charge of topography and geodesy work, data processing, cartography, reproduction and printing works;
- A Direction of the Common Services in charge of the management of the human and material means.

CNCT works in relationships with national and foreign institutions in the fields of remote sensing and the GIS.

- **At the national level**: Within the framework of national projects, the Centre collaborated with various the Ministry of Scientific research, Technology and competencies' development (MRSTDC) in the fields of sustainable management of the natural resources, protection of the coastal zone and environment. In the same way, the CNCT seeking to promote the techniques of remote sensing and GIS, established relations of partnership with establishments of higher education and of research.
- **At the regional level :** The CNCT chairs the council of administration of the Regional Centre for Remote sensing of the States of North Africa (CRTEAN), in addition to the presidency of the board of directors of the African Organization of the Cartography and Remote sensing (OACT).
- **At the international level:** The CNCT established with the laboratories and research centers of the Euro-Mediterranean States, relations of partnership for the realization of scientific and research projects through the cooperation scientist and technical programs between the European Community and the countries of Mediterranean southern bank.

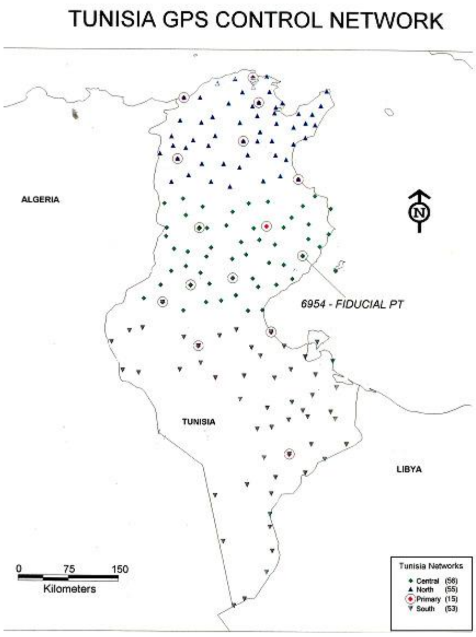
12.12.3 Description of how system/network/forum functions

To achieve its missions, the National Mapping and Remote Sensing Centre has in its provision:

- A centre of geographical data processing equipped with work stations with various softwares such as ERDAS, ENVI, Arc Info, Arc View, MapInfo.
- A numerical data bank (satellite images from various sensors, with various space and spectral resolutions);
- A Geodesy workshop equipped with differential GPS;
- A workshop of analogical, semi-analytical and numerical photogrammetry equipped with appropriate softwares;
- Means of edition with great pulling (A0 tracers, printers, CD duplicators);
- A topography workshop equipped with total stations and levelling equipment; A NOAA reception station;
- An amphitheatre of 200 places

The CNCT conceives and sets up geo-referenced databases. It archives the information in main axes: The urban and regional information, the sectoral information, and the standardized information

12.12.4 Assessment of spatial coverage



Tunisia GPS control network

12.12.5 Description of the inputs to system/network/forum

The used images by CNCT are: (*CNC, 53 Session COPUOS June, 9-18, 2010*)

SPOT: 80%
LANDSAT: 10%
RADAR: 1%
OAA: 6%
Others: 3%

12.12.6 Description of the methods/techniques/models and outputs

Thematic maps whose contents present a topic where information results from radiometric treatments of the images and/or by photo-interpretation. This product can be provided to various scales under numerical format or on paper format.

NOAA provides the following outputs:

- NDVI
- Surface water and soil temperatures
- Water distribution
- Meteorological data
- Environment hazards

The drought indicators are produced by a combination between vegetal indices and surface temperature. The main ones are:

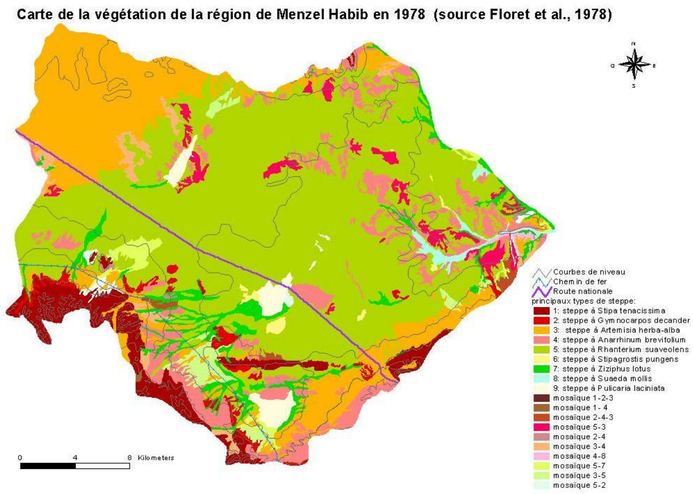
- Normalized Difference Vegetation Index (NDVI)
- Standardized Vegetation Index (SVI),
- Vegetation Condition Index (VCI),
- Temperature Condition Index (TCI)
- Vegetation Health (VH)

12.12.7 Procedures for developing and interpreting indicators

Desertification

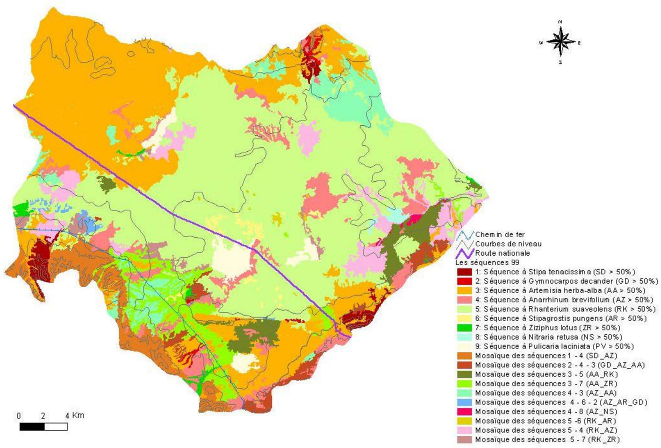
In the topic of desertification, the Centre contributed to the implementation of projects such as:

- Study of the dynamics of desertification in the area of Menzel Habib.
- Desert monitoring by satellite in Southern Tunisia (VSD);- Contribution of the Radarsat data for interpretation of the natural phenomena (GLOBESAR);
- Long-term Changes of the arid Mediterranean Ecosystems and soil observation “Exchanges in Arid Mediterranean Ecosystems one the Long term through Earth Observation (CAMELEO);- Dynamics of the Populations and Environment (DYPEN);
- Desertification monitoring in the countries of southern bank of the Mediterranean: installation of pilot systems in Morocco and Tunisia, study of the extension in Algeria (LIFE-TCY/OO/TN/O18)
- Application of a methodology based on the remote sensing techniques and the geographical information systems for the monitoring and desertification prevention and its extension to the Arab countries.



Vegetation mapping Menzel Habib commune (1978)

Carte des séquences de la végétation de la région de Menzel Habib en 1999 (source: Hanafi, 2000)



12.12.8 Information available from the system/network/forum

- Organization of seminars and exhibitions;
- Publication of a newsletter on space activities;
- Training of professionals and decision makers.

Example of products:

- Weather forecast bulletins;
- Seasonal prediction bulletin;
- Monthly climate bulletins (for local and national scales);
- Agro-meteorology bulletin;
- Drought monitoring bulletin;
- Air quality measurements and reports.

13 DETAILED DESCRIPTIONS OF NATIONAL DROUGHT MONITORING AND FORECASTING SYSTEMS/NETWORKS/ INSTITUTIONS:EASTERN AFRICA

13.1 ID: DM NEA 01: FACTSHEET 40 RELIEF AND REHABILITATION COMMISSION

13.1.1 General information

The relief and rehabilitation commission (RRC) was established in 1974 (RRC, 1984). In 1973/74, Ethiopia experienced one of its worst famines that claimed more than a quarter of a million lives and affected more than three and half million people in almost ten administrative provinces of the country (RRC, 1984). Pastoralists also lost 80 % of their herds (ibid). Not only did it make headlines in the international media for several months, but also did it become the most salient immediate cause of the downfall of Haleselassie's government in 1975. On a positive note, the international media contributed immensely in attracting humanitarian relief supplies for the millions of affected people.

On August 29, the defunct Emperor issued Order No. 93/1974 to establish a government agency (RRC) whose immediate responsibilities included mobilizing relief resources from domestic and international sources and providing the same to areas affected by drought. Although the legislation conferred RRC enormous responsibilities of dealing with all natural disasters (flood, fire, whirlwind, drought, earthquake) (Order No. 1973/74), meeting the challenges of 1973/1974 happened to be intractable for the new agency.

13.1.2 Who uses the system/network/forum?

The system is managed by Government of Ethiopia.

13.1.3 Description of how system/network/forum functions

The RRC was set up to organize and coordinate government's relief and rehabilitation measures for the millions of people affected by the 1973/74 famine. The awkward manner in which RRC was created, the magnitude of tasks (reaching out millions of victims, inexperienced and unprepared staff, archaic government bureaucracy with little skills in sheltering victims, warehousing, stockpiling and emergency operations), the rampant corruption inherent in the administrative system and absence of a clear policy and/or legal framework had all operated to undermine disaster management efforts. A tumultuous social and political milieu coupled with a series of disaster situations never allowed sufficient breathing space to look towards a coherent, integrated and comprehensive DM system. The arrival of another famine in 1983/84 made the work of the agency (RRC) all the more intractable.

13.1.4 Evaluation: Assessment of system/network/forum capabilities

Exactly ten years after the first great famine in recent history, another drought-induced famine struck in 1983/84. Lacking in advance preparedness and contingency plans, RRC found itself still groping in the dark .With the exception of some early warning that would alert the UN agencies and donor community, RRC did not succeed in putting in place a preparedness plan (People's Democratic Republic of Ethiopia [PDRE], 1989). Absence of coordinated and integrated prevention, preparedness and response effort between central government and local government institutions on the one hand, and RRC and line ministries on the other were the major predicaments facing the EDM system (PDRE, 1989). Lack of organized information system and planned logistical support undermined the post-disaster response and recovery efforts of the agency (ibid), let alone thinking strategically towards mitigation and preparedness measures. This trend continued till 1989During the period from 1974 to 1989, therefore, the disaster management machinery in Ethiopia heavily invested in response and recovery rather than in preparedness and prevention.

13.1.5 General information

Ethiopian constitution requires government to take long-term preventive measures to avert natural and man-made disasters, and effective response measures to alleviate the suffering of communities affected by disasters (Federal Democratic Republic of Ethiopia [FDRE], 1995). Relief and Rehabilitation Commission (RRC) w renamed Disaster Prevention and Preparedness Commission (DPPC) by Proclamation No. 10/1995. The latter lays the legal framework for modern disaster management that places premium on formulating strategies towards prevention and risk reduction measures, while at the same time laying stress on a coordinated and concerted effort for relief and recovery (PDRE, 1995). In brief, the legislation seeks:

- to prevent disasters (particularly, drought induced famines) by targeting the basic causes which ensue them
- to build resource, managerial, and institutional capacity well in advance of disasters, so much so that the magnitude of destruction that disasters are likely to result can be mitigated
- to put the necessary logistics (for response as well as recovery) in place to be able to alleviate suffering during and immediately after disasters

Drawing from ministers of key government ministries (Agriculture, Finance, Health, Defense, Economic Development and Cooperation, Public and Urban Development, and the Commissioner of DPPC), the legislation also established a National Disaster Prevention and Preparedness Committee (NDPPC). Among others, Proclamation 10/1995 empowers NDPPC to ensure that disaster prevention programs are dovetailed into the country's long term development policies, to authorize expenditures for disaster prevention, preparedness, response, and recovery as situations demanding them arise, and to declare a state of emergency in the event of disaster. The organizational establishments, created at the national level, were also paralleled by similar entities at regional and local levels in the entire country. The policy and legal framework, coupled with the institutional mechanisms created at all levels in the country, with a lot more investment in prevention and preparedness than ever before, attest to the fact that remarkable transformation has indeed been introduced into the system of disaster management in Ethiopia.

The Disaster Prevention and Preparedness Commission (DPPC) formerly known as the Relief and Rehabilitation Commission (RRC) was first established in June 1974 following the outbreak of famine in the two northern provinces of Ethiopia, namely, Wollo and Tigray. Since then, it has undergone several transformations the latest of which is its re-establishment, in August, 1995, as the DPPC under Proclamation No-10/1995. The Objectives of the Commission:

- To prevent disasters by tackling their root causes (i.e. Prevention),
- To build, in advance, the capacity necessary to reduce the impact of disasters (i.e. Preparedness),
- To ensure the timely arrival of necessary assistance to victims of disasters (i.e. Emergency Response).

13.1.6 Description of the methods/techniques/models and outputs

The objectives of the Commission reflect its main activities and cover prevention, preparedness and response.

Prevention activities are conducted to tackle root causes of vulnerability to disasters and to promote food security. Employment Generation Schemes (EGS) are the mechanisms through which relief is provided to be able bodied disaster victims in exchange for work. EGS help build assets and reduce the vulnerability of the affected populations to disasters. Many development works have been undertaken in different regions using relief food. Relief focused NGOs have reoriented their approach towards linking relief and development. The development efforts currently being undertaken by Regional Government agencies towards overcoming famine conditions and attaining food self-sufficiency have already demonstrated positive effects. The Government has furthermore formulated a Food Security Program, for which EGS is a major instrument, to ultimately attain food security at the household level.

Several of the key **preparedness** components have been in place for some time. At present, maximum efforts are being exerted to improve them, while new modalities are being introduced. Through such efforts it is believed that disaster victims would be better served and that the lives and livelihoods of disaster victims would be protected. The major preparedness modalities include:-

An **Early Warning System (EWS)** has been in place since 1976 to monitor and warn the threat of disasters ahead of time, and to trigger timely, appropriate, and preventative measures. It monitors closely factors which affect food security at household, woreda, regional and national levels.

The system is an inter-agency activity involving different relevant government institutions. It is led at the national level by a committee with the DPPC acting as its secretariat. Since 1993, The EWS has been decentralized in line with the regionalization policy and bottom-up planning approach. Training in data collection for early warning and analysis has been given to functionaries at regional and lower levels.

As part of the regular activity of the program, all relevant indicators of food security are monitored on a monthly basis culminating in an annual nation-wide pre and post-harvest crop assessments. Pastoral assessments are also carried out in the livestock dependent regions, while disaster assessments are conducted in an emergency situation.

Early warning reports are regularly issued to Government, donors and the international community. Efforts are now underway to improve the system through the introduction of enhanced methodologies, and tools for data analysis. The system enhancement work which is in progress focuses on six major components: The monitoring of national food security, and crop, livestock, market and agro-metrology assessments.

The Emergency Food Security Reserve (EFSR)

The Emergency Food Security Reserve was established, in its present status, in October 1992, to provide, on a loan basis, a readily available relief food in times of emergencies. Since its establishment, the EFSR has been operating successful and has created confidence among the donor community. It has proved to be an important preparedness strategy providing in-country food for immediate relief until requested relief food aid shipments arrive from overseas or are locally purchased.

The physical storage capacity of the Reserve has been upgraded to nearly 212,000 MT with an additional 79,000 MT of warehouse capacity planned for construction. The reserve stock has almost reached its mid-term target of 307,000 MT. At the same time, the grain mix in the Reserve has been diversified to accommodate the food habits of the population living in targeted areas.

Logistics

In the past, the Commission was transporting relief cargo to different distribution sites by its own Emergency Relief Transport Units (RTP 1, 2, 3). In this effort, NGOs and UN transport fleets had also played a significant role. In line with the free-market economic policy of the Federal Government, however, the RTPs, NGOs and UN trucks have been privatized, and the DPPC has since then been able to effect the distribution of relief and other emergency items to disaster prone areas using the private sector trucks. Given the poor infrastructure in the country, however, full reliance on the Private Sector for the transport of emergency relief is risky. Some of the disaster prone areas are not easily accessible, and, hence, are not attractive to private truckers. To minimize the risk of not reaching disaster victims in such areas, the Government has recently established a strategic transport fleet, consisting of trucks with the right configuration for tackling difficult terrain. In order to improve the overall relief transport and logistics coordination in the country, efforts are also being made to develop a logistics master plan. Other improvements in this area include infrastructural development, such as warehouse construction, and establishment of a well networked logistics information system.

13.2 ID: DM NEA 02: FACTSHEET 41: THE NATIONAL DISASTER PREVENTION AND PREPAREDNESS FUND (NDPPF)

A National Disaster Prevention and Preparedness Fund has been established to cover funding shortfalls of regions in their efforts to link relief with development programs. The fund will provide withdrawal rights to regions to support relief programs based on prioritized needs in the event that such programs cannot fully be resourced from regular budget sources.

Substantial progress has been made towards the creation of the fund: the Government has allocated US$ 8.3 million, and USD 287, 400 has been secured from donors. Moreover, a Board of Management for the NDPPF has been formed and has assumed its duties. A study on the managerial and procedural elements of the Fund is soon to be finalized.

13.2.1 National Non-Food Contingency Stock

The traditional focus at the DPPC has been on drought-related emergencies and food based response. However, the widespread occurrence of disasters such as floods and epidemics, the loss of life and property damage, and the economic and social disruption which they cause have been such that the current state of preparedness (in terms of area-specific plans, stock of non-food emergency items, procedures, etc.,).

For such disasters has been found to be inadequate. Hence, the need for more effective non-food response capacity building has become apparent. This task calls for action to be taken to strengthen the emergency preparedness capability of the country through the establishment of a national contingency stock of essential materials in order to build up a quick intervention capacity when disasters occur. In this regard, the first measure to be taken is to immediately embark on building the stock initially through pooling of available resources. Subsequently, the gap will be filled by mobilizing additional resources.

13.2.2 Emergency Responses

Emergency interventions are undertaken with the aim of saving lives and livelihoods. The first phase includes the provision of food, shelter and medical services to victims of disasters, and every effort is made to make the response timely so as to prevent the disposal of key assets. The second response comprises, where and when it is needed, the provision of farm inputs such as draught oxen, seeds and hand tools in cropping areas, and restocking of depleted livestock herds in pastoral areas.

13.2.3 Partners

As disaster prevention and preparedness activities are multi – agency undertakings, the DPPC is not alone in carrying out its mandated responsibilities. Within the Government, the DPPC works closely with concerned line departments both at regional and federal levels, and outside the Government, with NGOs, the UN system, and donor community.

13.2.4 Structure, Number and Composition of Staff

The DPPC is headed by a Commissioner and a deputy both assigned by the Government. It has recently undergone a restructuring process which aimed at reducing overlapping of responsibilities and downsizing of its staff. Currently, the DPPC has 815 employees of which 329 are women. In order to effectively carry out its activities, the Commission has streamlined its organizational structure. The main departments represented in the new structure include, among others:

- Early Warning
- Aid Programs Coordination and Monitoring
- Policy, Plan and Program
- Property Administration and Transport Coordination
- Fund Raising and Public Relations
- Drought Update

The National Disaster Prevention and Preparedness Committee (NDPPC) is the overall body charged with the responsibilities at the national level for all matters regarding disaster prevention and management. 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 Defence; and
- 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.

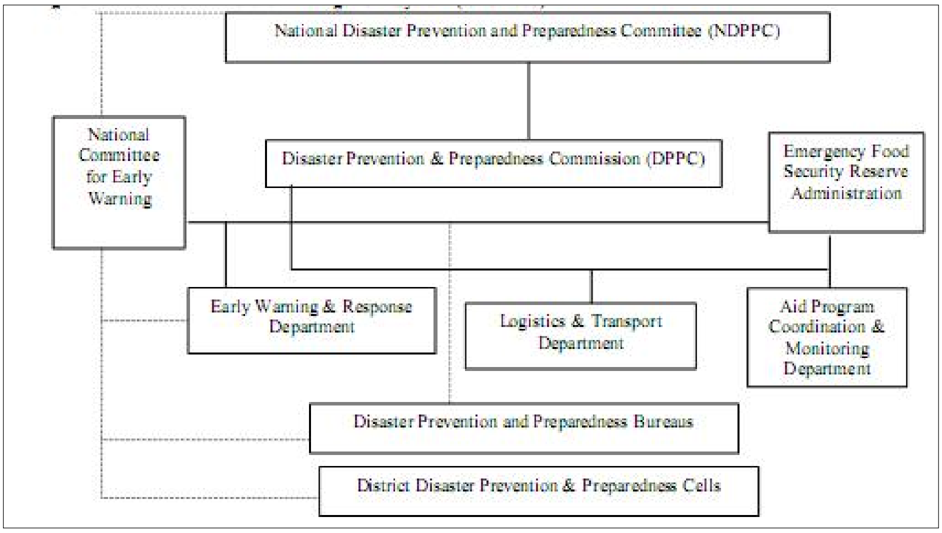
Four other government bodies are also associated with the work of the NDPPC at national level:

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

13.2.5 A conceptual description of how the system/network/forum functions

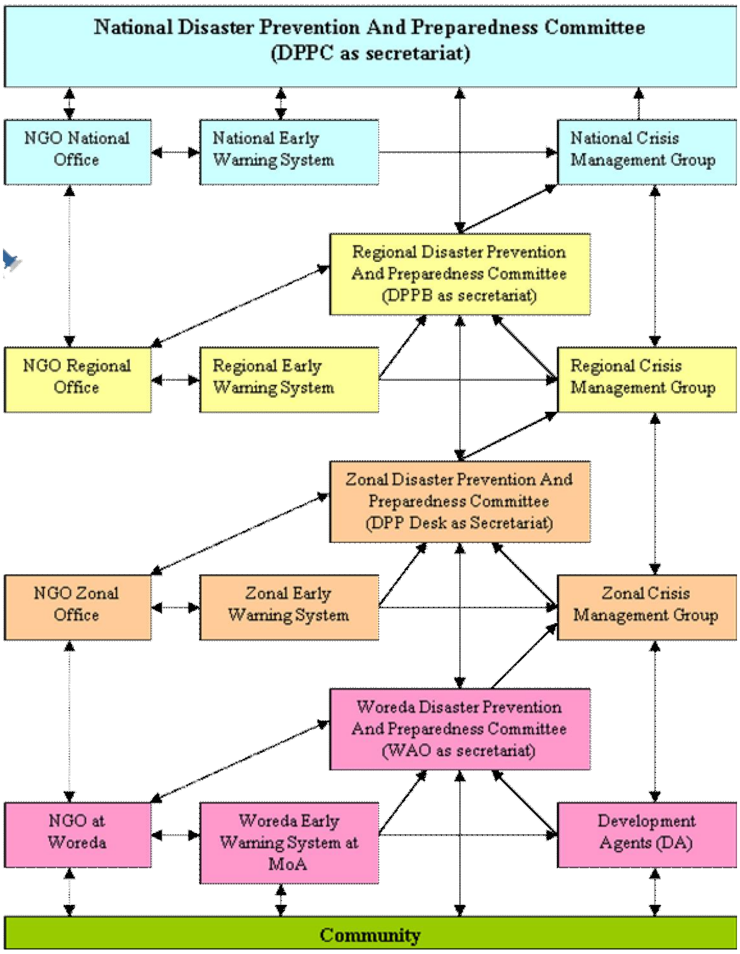
The figure below shows the follow up and links between different actions

- Prevention
- Preparedness
- The Early Warning System
- The Emergency Food Security Reserve (EFSR)
- Logistics



National Disaster Management System 1995-2008

Source: Sketched by Mulugeta Abebe based on the Archival of DPPC (now Disaster Management and Food Security Sector)



Structure for NPDPM in Ethiopia

13.3 ID: DM NEA 03: FACTSHEET 42: PRODUCTIVE SAFETY NET PROGRAM

13.3.1 General information

In 2003 the government of Ethiopia initiated a productive Safety Net Program (PSNP), with the objectives of reducing household vulnerability to the effects of disaster mainly drought, improving household and community resilience to shocks, and breaking the cycle of dependence on food aid. The overarching principle of the Productive Safety Net Program is to facilitate "a gradual shift away from a system dominated by emergency humanitarian aid to productive safety net system resources via multi – year framework" (Government of Ethiopia 2004).

The PSNP has two components:

- Public works-provision of counter-cyclical employment on rural infrastructure projects such as road construction and maintenance, small scale irrigation and reforestation;
- Direct Support- provision of direct unconditional transfers of cash of food to vulnerable household with no able bodied members who can participate in public works projects.

The PSNP is complemented by a series of activities, such as productivity enhancing transfers or services, including access to credit, agricultural extension services, technology transfer (such as advice on food crop production, cash cropping, livestock production, and soil and water conservation), and irrigation and water harvesting schemes. The PSNP is designed to protect existing assets, ensure a minimum level of food consumption, and encourage household to increase income generated from agricultural activities and to build up assets.

The annual budget in 2009 was 2,136,734,460 ETB in cash and 457,966 21 MT of cereals. This is equivalent to approximately $360 million or about 1 2% of Ethiopia's GDP. In addition, the Government estimates that roughly $54 million in government staff time is devoted to the program annually. The budget components are:

(a) Transfers (wages for Public Works participants and payments to Direct Support beneficiaries);
(b) Administrative and capital budgets (for program running costs and for capital inputs and material for public works);
(c) Contingency funds to allow for variations in need during the year; and
(d) Capacity building budget, based on an annual assessment of woredas, regions and the Federal Government.

The PSNP is integrated into the national budget system in Ethiopia. Budgets are prepared as part of the annual planning process by the woreda and are then consolidated by the regional government for onward submission to the Federal Government. The regional budgets are consolidated with federal budget line items into a single federal budget that is approved as part of the MOARD annual budget. In addition to determining the budget, the annual woreda planning process also identifies eligible households and priority public works projects based on community and kebele plans. Annual budgets are adopted within the context of a longer term financial framework in order to meet the program objective of predictable financing.

13.3.2 Who uses the system/network/forum

In 2009, the Government estimated that there were 725 regular staff members working on the PSNP at federal, regional and woreda levels. Additionally, the 14,295 DAs in chronically food insecure woredas spend much (but not all) of their time on PSNP related activities. Added to this are a number of contract staff and technical assistants (TAs) at all levels.

Based on these figures, there are at least 1,780 regular staff and TAs working on the PSNP full-time, with support from 14,295 DAs.

The partners are: Government, donors and NGOs
For the Government, through implementation of the Food Security Program (FSP), which consisted of the following three strategic pillars:

(a) Resettling households from unsustainable and environmentally degraded lands;
(b) Developing a safety net for chronically food insecure households; and,
(c) Supplying agricultural and financial services to food insecure households to promote their graduation out of food insecurity

13.3.3 Description of how system/network/forum functions

The program was established as a government led program where government systems and personnel implement the activities with coordinated donor support. The nature of the program does not fit neatly into the mandate of a single government agency or department. Rather the objectives of the PSNP span the mandates of two Ministries and multiple departments within each Ministry. The roles and responsibilities of these Ministries and departments are described below:

The Ministry of Agriculture and Rural Development (MOARD): is responsible for the management of the PSNP, with the Disaster Risk Management and Food Security Sector (DRMFSS) responsible for overall program coordination. Within the DRMFSS, the Food Security Coordination Directorate ((FSCD) previously called the Food Security Coordination Bureau) facilitates the day-to-day management and coordination of the PSNP It is directly responsible for the timely delivery of transfers to beneficiaries and supports the implementation of public works Its key responsibilities include:

(a) Coordination support and oversight of the PSNP;
(b) Ensuring proper linkages of the PSNP with other FSP and development interventions;
(c) Consolidating PSNP work plans and budget proposals from the regions, and making resource allocation proposals to be submitted to the Minister for approval;
(d) Allocating PSNP resources approved by the Minister to the Regions;
(e) Providing technical support to regional food security offices;
(f) Monitoring overall capacity to implement the PSNP; and,
(g) Monitoring and evaluating the efficiency, effectiveness and impact of the PSNP

The Early Warning and Response Directorate (EWRD): Previously called the Disaster Prevention and Preparedness Agency), which is also under DRMFSS, provides accurate and timely early warning information for the PSNP Risk Financing (RF) (see PSNP Risk Financing Mechanisms) and ensures adequate linkages between PSNP RF and other humanitarian response activities. The EWRD is responsible for the timely delivery of food resources.

The Natural Resource Management Directorate (NRMD) within MOARD is responsible for coordination and oversight of the public works. This includes capacity building and technical support, supervision of environmental guidelines, liaising with FSCD and other PSNP partner institutions on coordination and management of public works, and participation in PSNP design and management forums, including policy issues and the roll out of the pastoral PSNP

The Ministry of Finance and Economic Development (MOFED) oversees financial management of the program and disburses cash resources to implementing federal ministries and to the regions based on the annual plan submitted by MOARD

These federal implementation arrangements are replicated by regions and woredas. Within the regions the ultimate authority for the PSNP resides in the regional council, which is the highest regional level decision-making body. Concurrently, the regional president is responsible for the performance of the PSNP through the regional bureaucracy. Similarly, at woreda level, it is the woreda council that approves the allocation of PSNP resources within the overall woreda development plan prepared by the woreda cabinet. In addition to program implementation, regional and woreda bodies are responsible for ensuring sound multi sectoral coordination of the public works. For example, they must ensure that health centers constructed by the PSNP are staffed by the Ministry of Health. They must also generate the development coordination necessary to promote household level graduation from food insecurity.

DPPC is not alone in carrying out its mandated responsibilities. Within the Government, the DPPC works closely with concerned line departments both at regional and federal levels, and outside the Government, with NGOs, the UN system, and donor community.

13.4 ID:DM NEA 04: FACTSHEET 43: NATIONAL METEOROLOGICAL SERVICES AGENCY

13.4.1 General information

Meteorology in the country first attained its importance in Aviation, and a small Meteorological unit was established in 1951 with in the Civil Aviation department (now Civil Aviation Authority) to cater solely for aeronautical purposes.

The unit comprised of:

- Aeronautical Meteorology
- Climatology
- Research and instrumentation

As the other economic sector slowly began to realize the importance of Meteorological information and advice for their respective activities, requests began to flow into this small unit. The number of stations increased, the meteorological data for aviation purposes increased in quality and quantity, the flow of request for meteorological information from the other sectors of the national economy became tremendous and with a view to carrying out the task of fulfilling these national needs and discharging international obligation regarding meteorology, meteorological unit was promoted to Meteorological Department under the auspices of civil Aviation Authority in 1964 E.C. The established meteorological Department composed of two main units:

- Synoptic meteorology
- Climatology and research

The agency restructured its organization in such a way that it comprised four implementing and four supporting services.

- Basic Meteorological Services
- Development Meteorological Services
- Central Analysis And Forecast Services
- Operational Meteorological Services

In accordance with the Government's new restructuring policies, it was decided that the Agency remains in the name of National Meteorological Services Agency without bringing any change in its functions. But, for better attainment of its objectives the Agency is organized in one General Manager, one Deputy General Manager, Five Departments and Eleven Teams such as;

- **Planning and Programming Department**

This department is responsible for preparation and consolidation of short medium and long term plans and programs of the agency.

- **Meteorological Research and Studies Department**

Responsible for the activities of meteorological research and studies and climate change and air pollution studies teams. Coordinates and facilitates the works of meteorological research board.

- **Meteorological Research and Studies Team**

Responsible for research and studies carried out by individuals and team of experts of the agency and coordinates the operation and research tasks obtained from meteorological satellite data.

- **Climate Change and Air Pollution Team**

It is responsible for the organization and supervision of the various tasks of climate change and air pollution studies team. It provides guidance and directives on the investigational works with special emphasis on substance, which may affect weather, climate and the well-being of man and ecosystems.

- **Meteorological Analysis and Forecast Department**

It is responsible for the various activities of weather forecast and early warning, aeronautical meteorology and meteorological communication teams. Ensures the timely issuance of short-medium and long-range forecast and warning, on hazardous phenomena of the atmosphere, to concerned Government Authorities and to all users of all socio-economic sectors of the country.

- **Aeronautical Meteorology Team**

Responsible for control and operations of Aeronautical meteorology services that contribute towards the safe, efficient, regular and economic operation of national and international air navigation services. It ensures that exchange of meteorological data and information for national and international use. Aviation is carried out in accordance with provisions of the International Civil Aviation Organization (ICAO) and that of the World Meteorological Organization (WMO).

- **Meteorological Communication Team**

It is responsible for the control and operations of data exchange facilities for the real-time collection and dissemination of meteorological information for national and international use. Co-ordinates and controls the operation of aero logical and satellite data reception. Develops operational procedures, schedules arrangement for communication systems in accordance, with the lows and regulations for the collection and dissemination of meteorological data in collaboration with the various units of the agency.

- **Weather Forecast and Early Warning Team**

It is responsible for the control and operations of short-medium-and long-range forecasts and early warnings. Medium Develops ways and means for adopting new systems, better techniques and simplified procedures so as to render an efficient and effective weather forecast services.

- **Data Management and Dissemination Department**

Responsible for the activities of computer technical support, Data Management and Data Users services teams. It is responsible for cost effective installation and operation of computer and data management system.

The main activities of the agency include:

- To investigate and study the weather and climatic conditions of Ethiopia in order to exploit the beneficial effect for economic and social development
- To carrying out the task of fulfilling these national needs and discharging international obligation regarding meteorology
- To give Meteorological Services
- To establish stations and operate communications systems for the collection and exchange of meteorological data according to international agreements
- To disseminate advise and educational information to the public on weather
- To give warning on adverse weather conditions

Number and type of staff
NMSA current staff as of 2002

- Meteorologist ----------------------------------29
- Meteorological Officer ----------------------27
- Assistant Meteorologist --------------------39
- Meteorological Observer ------------------115
- Assistant Meteorological Observer ---102
- Administrative & supporting Staff ----231
- Total staff --------------------------------------543

13.4.2 Who uses the system/network/forum?

Contact information: National Meteorological Services Agency

Meteorological data have a vital role to enhance the development of the countries socio economic activities. Therefore the followings are some of the economic sectors, which are **major users of meteorological information:**

- Agriculture
- Transport
- Recreation and tourism
- Electrical utilities and Energy
- Information media and general public
- Construction
- Environment and health
- Water Resources
- Aviation
- Industry

13.4.3 Description of how system/network/forum functions

- **Analogue method**

This forecasting method is based on the assumption that a current synoptic situation will likely develop in the same way as similar past synoptic situations (WMO, 1992). Therefore, a proper selection of the analogue year is very important. ENSO information is used in this method to facilitate the selection of analogue years. ENSO stands for the coupling of El Niño (oceanic component) and the Southern Oscillation (atmospheric component). After obtaining sufficient information about the status of the ENSO event of the current year, years which had the same ENSO status would be identified from past records. Then, the rainfall distribution and the synoptic features of the preseason months of the current year would be compared with the rainfall distribution and synoptic features of the preseason months of the analogue years.

The data set used to determine analogue years includes Pacific sea surface temperature anomalies (SSTA) of the equatorial Pacific Ocean, the Southern Oscillation Index (SOI), the surface charts, daily mean sea level pressure charts (ECMWF), 500 hpa chart, 200 hpa chart, tropical cyclone frequency over the southwestern Indian Ocean, and the preseason and seasonal rainfall. Finally, an analogue year which closely resembles the current year would be chosen, based on the results of the above comparison and analysis. Then, the coming season would be anticipated to be under the categories of Above Normal, Normal, or Below Normal rainfall, based on the observed rainfall of the analogue year. Similarly, the onset and cessation of the rains will be projected.

- **Trend method**

Using this method, the trends of the major synoptic systems are analyzed in the preseason period, and the result is compared with the ideal situation. In some other cases, depending on the type of ENSO information available, the trend of SSTs over the central equatorial Pacific and the SOI are analyzed carefully to determine the status of an ENSO event.

A good example to show how ENSO information could be used (with the trend method) is the 1990 Kiremt seasonal forecast. It was stated as follows: "...From [Climate Diagnostics Bulletin and Climate Monitoring Bulletin], one can see that there has been a surface warming over the central equatorial Pacific Ocean since December 1989. If the warming continues, it will likely develop into an El Niño situation. Hence, previous years which have shown the same trend were selected" (NMSA, 1990). In the above statement of the forecast, the information about the trend of the central equatorial Pacific SSTs is used to anticipate the trend of the major synoptic systems, assuming that the coming season will be affected by an El Niño event. This is one example of the application in Ethiopia of applying ENSO information using this method. On the other hand, once a forecast about the status of ENSO is at hand, it can be used in the trend analysis of the major synoptic systems to anticipate ahead of time (i.e., forecast) their intensity, magnitude, position, etc.

- **Statistical method**

This is an objective method of forecasting, based on a statistical examination of the past behavior of the atmosphere using regression formulas, probabilities, and other statistical measures (WMO, 1992). The use of ENSO information under this method is based on the results of previous studies by different investigators on SOI and El Niño and their effects on Ethiopia's seasonal rainfall.

- **Tele-connections**

Oceanic and atmospheric events at great distances from the central and eastern equatorial Pacific Ocean (i.e., the field of action), observed to occur in association with ENSO events, are considered subject to being forecast with some degree of reliability.

The effect of ENSO events on the global atmospheric circulation in general, and on the east-west overturning of the Walker Cell in particular, alters rain-bearing synoptic systems which influence the seasonal rainfall distribution of Ethiopia. Normally the ascending limb of the Walker Cell is over Africa. During the occurrence of ENSO, the descending limb replaces it (WMO, 1985).

13.5 ID: DM NEA 05 - FACTSHEET 44: CONTINGENCY PLANNING AND FINANCING

13.5.1 General information

In recent years, particularly since 2002, country-wide contingency plans have been prepared. Contingency planning is found to be an effective and useful tool for improving emergency response in Ethiopia. Especially in 2002 and 2003, national level contingency planning has facilitated early and more comprehensive action by the Government, donors, UN agencies and NGOs. Also in 2003/04 contingency scenario and resource planning at national level has been worked out. Most probable and worst case scenarios are developed; regional food security outlook was analyzed; food requirements are estimated; non-food requirements (for water sanitation, health, agriculture, livestock) are calculated; and response strategies and main issues are discussed.

13.5.2 Description of how system/network/forum functions

Currently two contingency planning that would involve food and non-food sectors, consider the effects of food crises like increased incidence of diseases, and that would consider mitigation and recovery interventions to ensure the continued development of a more robust emergency response system is in process. Some agencies working in Ethiopia have contingency plans for their own operations. For example Oxfam international has a drafted contingency plan for humanitarian operation in Ethiopia. There are also contingency plans of agencies for specific areas like the contingency plan for Somali Region that was initiated by a multi-agency team working in the Region and supported by UNDP in 1997.

13.5.3 Information available from the system/network/forum

The lack of effective contingency planning and funding mechanisms during the drought of 2005–2006 was one of the critical elements behind the delay in the response. Unlike in Kenya, Ethiopia has no national preparedness plan. However, a plethora of different contingency planning processes and funds exist both at the local and federal level. They are not coordinated and there is no common approach to developing and resourcing these plans. The following contingency plans were established:

- The National Disaster Prevention and Preparedness Fund, 2000

- The Pastoral Community Development Project
- The Pastoral Livelihoods Initiative
- The Pastoral Productive Safety Nets

Other contingency funds

The Humanitarian Response Fund, March 2006

In addition to addressing the relief food requirements for 2000, the annual DPPC relief appeal launched on January 21 also highlighted various non-food assistance requirements requiring a total of approximately US $31 million. Important highlights are as follows:

- Water tanks and construction/rehabilitation of water sources - $4.6 million
- Purchase and delivery of 216 emergency health kits - $2.6 million
- Purchase and delivery of urgent veterinary medicines - $9.5 million
- Support for the Non-Food Contingency Stock - $3.26 million
- Support for the Disaster Prevention and Preparedness Fund - $9.0 million
- Establishment of a strategic national water tank fleet - $2.25 million

13.5.4 Who uses the system/network/forum?

A number of other logistics-related special operations are under preparation to be included under the contingencies plans for different sectors:

Non-Food Sectors: In its own appeal launched on January 28, the UN Country Team placed a similar emphasis on priority interventions in the non-food sectors. The various interventions proposed by the UN agencies have since been reviewed in the light of the worsening humanitarian situation. The following sections summarize the indicative needs within each specific sector:

Health; A range of urgent interventions are needed in the health sector, targeting drought-affected areas in Somali, Amhara and Oromiya regions. Emphasis is on support for basic health care services, measles vaccination, disease surveillance and reporting, capacity building and provision of essential drugs and medical supplies. In this regard, a total of around US $10.2 million is currently required to support the following priority interventions:

Assistance to improve the coverage of measles vaccination and Vitamin A.

- Provision of measles vaccines, needles and syringes, cold chain equipment.
- Capacity building of health workers and provision of operational support.
- Strengthening national capacities to combat selected priority diseases.
- Strengthening epidemiological surveillance and outbreak control mechanisms.
- Provision of essential drugs and medical supplies.
- Coordination and management of the emergency health response.

- Laboratory reagents and supplies (including HIV testing kits).
- Support for safe motherhood and reproductive health services.
- Psychosocial support.

Water Supplies: In many seriously drought affected areas of the country, especially in the lowlands of Somali region and Borena Zone of Oromiya region, there is little alternative to the emergency tankering of water from permanent sources of water to where people have congregated. Tankering operations need to be supported with the provision of storage and delivery systems. The repair and rehabilitation of boreholes is feasible in some areas and also needs support. Total priority needs in this sector are currently estimated at US $2.5 million.

Agricultural Sector Support, including Livestock

For drought affected farmers in the central highlands of Ethiopia assistance is needed in the form of seeds. In some areas small-scale irrigation can be supported through the provision of pumps. Lowland farmers in the Somali region, especially those living along the permanent rivers (in Gode, Liben and Afder zones) also need help with seeds, farm tools and irrigation pumps. Total resources required in this regard have been estimated at around US $4.5 million. Livestock and pastoralists in the drought-affected lowlands of Somali region, the Borena zone of Oromiya and South Omo Zone of the SNNP region are also being targeted for special emergency assistance. The provision of feed for animals, the provision of adequate veterinary services in the drought affected areas, and the establishment of slaughter facilities for the preparation of dried meat are all elements of the planned programme that has been budgeted at US $ 11.5 Million.

Migration and Population Tracking; A mechanism for tracking and monitoring migratory movements in order to understand the determinants to displacement is urgently needed. The data and findings thus generated can be applied to design interventions and to optimize the allocation of resources to areas with urgent needs. Funding in the order of $500,000 is required to commence work on establishing such a project.

Emergency Education: Three years of poor rains have placed a serious economic burden on many poor rural families. In drought-affected areas, school attendance has been low and drop-out rates have been accelerating. To assist children whose parents might not otherwise be able to afford to send their children to school, a total of US $ 2 million is required.

Special Protection Needs of Women and Children; the severe drought in the Somali region, in particular, has led to the migration of at least 10,000 people in the Gode area. The most vulnerable segments of the displaced population, especially women and children, have a greater need for special help under such circumstances. At least US $100,000 is needed to support various interventions in this respect.

Shelter and Logistics Requirements: The migration of communities in search of water and food significantly increases the risks associated with exposure to wind, sun and rain. To mitigate the effects of exposure, and to provide some basic household requirements to the most vulnerable families, donor assistance amounting to US $600,000 is urgently required

13.5.5 A conceptual description of how the system/network/forum functions

Components of the contingency plans slightly differ, but the principles are similar. Looking into the contents of the Somali Region Contingency Plan for example, it discusses scenarios and assumptions for activating the plan. It describes the overall policy objectives (priorities and goals). It deals in length with sector objectives, strategic options, activities and resources. Under this main body water, relief food, health and nutrition, livestock, agro-pastoralists, refuges, logistics, management and coordination and capacity are addressed. For each of the above sectors situation analysis of the sector, objective of the sectoral contingency plan, strategic options, activities and tasks (also defining the responsible agencies and time frame) and resources required for the identified tasks of the sector are discussed. Moreover, the contingency plan also deals with concerns and possible solutions, monitoring and follow-up, existing agencies/structures in the region and their possible roles, standby resources that could be accessed. It also deals with early warning indicators that signal imminent disaster.

The responsibility for activating the plan rests on the Regional Disaster Prevention and Preparedness Bureau. Information is not available whether this contingency plan is being updated or not.

13.6 ID: DM NEA 06: FACTSHEET 45- SUDAN METEREOLOGICAL AUTHORITY

13.6.1 General information

The SMA start when first monitoring station in 1890 was established at City of Suakin on the Red Sea coast, and in 1891 opened the station and Wadi Halfa, and that was under the supervision of the Egyptian army. By 1900 there were seven stations in operation, and their number increased to sixteen station in 1920. Services was expanded the network of stations for monitoring and the number of stations reach to seventy station in 1950, including thirteen major works over twenty-four hours. The meteorological belonging to the Postal and Telegraph authority until 1966 when the decision was issued by the Council of Ministers to set up an independent department under the Ministry of Transportation and remained so until 1971, when followed to the Ministry of Defence, since 1976, became a body affiliated to the presidency of the Council of Ministers as providing services to many of the facilities of the State. There is great development over the past years as the expanded network of stations and stations supported by the most advanced electronic devices. There are around 34 weather stations and 300 rainfall gauges all over the country by 2010. The SMA provide information, data and services for many sectors includes Agriculture, Transportation (air, Maritime, Land), tourism, public health, environmental pollution, Research and studies.

13.6.2 A conceptual description of how the system/network/forum functions

The SMA has three units 1) Research unit (Numerical and statistical models)
2) Agro-Meteorology (Sudan Agri-Meteorology Information System (SAMIS); and
3) Monitoring and forecast unit

Self-finance and Fund from WFP and FAO through Sudan institutional capacity program: food security information for action.

13.6.3 Who uses the system/network/forum?

The system used by policy makers at Ministries of Agriculture, Defense, Irrigation and Water Resources, Environmental and Physical development and also for researches, students and public.

For Agri-Meteorology Information System (SAMIS) project the partners are

- SMA: providing the meteorological data, technical team and hosting the system.
- FAO: provide NDVI data and technical support.
- TAMSAT TEAM, CCD Data
- Federal Ministry of Agriculture, Provide Crops data there is no partners

All the ministries and bodies mentioned below use the output data from SMA for monitoring and warning action, and for development purposes.

13.6.4 Description of how system/network/forum functions

The SAM activities involve recording and monitoring the weather parameters from different stations and analysis this data. The rainfall data from the stations and gauges point was used to forecast and predict the rainy season by using static and numerical models. Then the output information and data become available for policy makers and public.

The information and data flow via the radio communication facilities and internet. For SAMIS project the diagram below (fig 29) shows the flow of information.

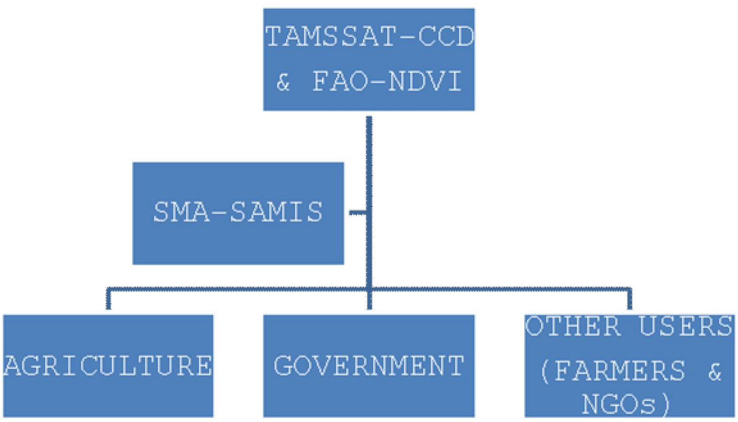


Fig 29: Information Flow

13.7 ID: DM NEA 07: FACTSHEET 46- DESERT RESEARCH INSTITUTE (DRI)

13.7.1 General information

In 1992 the national center for research (NCR) was established Desert and Development Research department (DDRD) as one of the departments of the Environmental and Natural Research Institute (ENRRI). The great cooperation of Khartoum state facilitated the transfer of Rawakeeb Rural Development project, which was severely affected by drought and desertification during 1980s, to NCR. The project facilities were used to establish Rawakeeb Dry land Research Institute (RDRS). In a later development DDRD was upgraded into Desertification Research Institute (DRI) in the year 2002. The objectives of DRI are:

1. Undertake basic and applied research in the fields of desertification and dry land considering the human life and ecological problems.
2. Initiate cooperative local, regional and international research programmes.
3. Provide scientific research fields for the interested investigators at local, regional and global levels.
4. Provide models for research in the desertified and dry lands which can be compared with and transferred to similar areas.
5. Adopt and transfer advanced and recent technologies.
6. Initiate reserved games and protected areas in order to conserve the natural desert environment and desert wildlife and vegetation for scientific purpose.
7. Train personnel and disseminate relevant knowledge.

13.7.2 A conceptual description of how the system/network/forum functions

- Conduct research on technologies appropriate for development in areas where water and nutrients are scarce and expensive.
- Conduct research on biological, physical and socio-economic problems of arid and semi arid regions and advise on possible curative measures.
- Study rain water harvesting and spreading and modern irrigation systems.
- Harness renewable energy sources and develop technologies useful in desertified environment.
- Provide data on climate conditions which may help to forecast the onset of drought cycles, their magnitude and duration.
- Search on methods to enhance existing crop varieties so as to increase production and make them more resistant to drought and diseases.
- Disseminate results and technologies obtained from the research activities.

Governmental fund through the Ministry of Science and Technology, Annual budget to run the DRI is around 20000 SDG.

13.7.3 Who uses the system/network/forum?

The system is used by ministry of Agriculture; policy makers as it provide needed information and data.

13.7.4 Description of the Inputs to system/network/forum

The parameters or data that are used as input are: Climate parameters, fauna, flora, soils, and annual discharge of wadis, crops, forestry, and data about vegetation cover

The source of data (satellite, in-situ, other)

- In-situ and satellite data from different sensors

The quality control processes applied to the input data: Manual check

The frequency for each parameter/data is on demand (according to research needs)

13.7.5 Description of the methods/techniques/models and outputs

The frequency of delivering outputs: According to needs for the running research projects

13.7.6 Procedures for developing and interpreting indicators

The procedures followed in developing the indicators: Plant breeding to select best varieties that had resistance criteria to drought and disease, experimental studies to select best techniques for water harvesting.

Use of Indicators: The produce varieties become available for farmers and private and governmental sector

13.7.7 Information available from the system/network/forum

The provided information: Data and information about the crops varieties that resist the drought and also early mature varieties, water harvesting techniques

Data can be achieved by: Personal contact and via website of the DRI

The information is disseminated in: Workshop, conferences, scientific paper in journals, annual reports

13.8 ID: DM NEA 08: FACTSHEET 47: INSTITUTE OF ENVIRONMENTAL STUDIES

13.8.1 General information

The IES was established in 1978, when the University of Khartoum entered into an associate relationship with UNU with the agreement to encompass both training and research activities. As a result the first idea of IES offering both diploma and MSc in environmental studies emerged. The link with the outside world was then perused. It purposes a programme that blends 1) graduate education; 2) short term training; 3) graduate and consultation; and 4) environmental awareness. The objectives of the IES are:

1. To encourage and promote inter-and multidisciplinary research projects in the realm of environment.
2. To offer post-graduate degree in environmental sciences.
3. To organize training courses and to develop skill aiming to solving environmental problems.
4. To assist and advise in introducing environmental education at the school and university levels.
5. To promote a wider understanding of environmental problems both within the university and among the general public, through publications, conferences, workshops and public lectures.
6. To undertake consultancy studies on environmental problems for the government and private sector. Currently, the IES offers the following degrees:
    - M.Sc. in Environmental Sciences (by courses)
    - M.Sc. in Environmental Sciences (by research)

- M.Sc. in Meteorological Sciences (by course and complementary research)
- Ph.D. in Environmental Sciences (by research)

The number of students enrolled in the above four programmes for the year 2004- 2005 is over 200.

13.8.2 A conceptual description of how the system/network/forum functions

The IES, as an institute and via its staff members – all of them active members of national and internal NGOs dedicated to the environment cause, has urged and supported the establishment of governmental bodies such as the Ministry of Environment and the Higher Council for Environment and Natural Resources. The former is the custodian of the environment and natural resources in the country and the latter is its technical arm. The IES also participated in the formulation of the first Environment Conservation Act 2001. The IES is administered via: Director; Program coordinators; The Registrar; The Academic Committee; The Governing Board.

Owner, funding and budget: The IES has governmental funding as an institute at university of Khartoum and also from Post-graduate students, Consultancies, Activities of the IES (short training courses, E. learning etc), Governmental contribution, and Charity donation. Annual budget average is about 6,000 SDG.

13.8.3 Who uses the system/network/forum?

The users are: Students, governmental agencies, private sector, and NGOs.

13.8.4 Description of how system/network/forum functions

The information about the researches and advises can be obtain only by contact the IES personally or through the email of the director.

13.8.5 Description of the Inputs to system/network/forum

The input data used by IES are Meteorological data, animal production data, data about water resources, vegetation and forestry (wide range of data according to type of the research).
There is an Enclosures area at Kassala state (east Sudan), study areas in western part of the country

The source of data

- In-situ and satellite data

The quality control processes applied to the input data: Most of the time they used secondary data (already checked).

13.8.6 Information available from the system/network/forum

The provided information: The users access the system through direct contact with IES

The information is disseminated thought: Conferences, Workshops and public lectures, Monographs, newsletters.

13.9 ID: DM EAC 01: GEOGRAPHIC INSTITUTE OF BURUNDI "IGEBU"

13.9.1 General information

In Burundi, the Geographic Institute of Burundi "IGEBU" is the key institute in drought management. It is located in Gitega City at 100 km from Bujumbura, the capital of Burundi. This includes two departments: Hydrometeorology and Agro meteorology.

Burundi National Meteorological and Hydrological Services (NMHS) started as a section in the Directorate of Civil Aviation in 1927. Thereafter the NMHS has been under the Ministry of Environment, Land management and Public Works. It is one of the departments of the Institut Géographique du Burundi (IGEBU) along with the department of Surveying and Mapping since the creation of that institution in 1980.

The National Hydrological and Meteorological Service deals with the planning, development, coordination, maintenance and control of hydro meteorological stations network. The NHMS is also charged of data collection, quality control, analysis conservation, diffusion and publication of hydro meteorological information. It has also in charge of monitoring, forecasting and the meteorological assistance to the aerial navigation of aircraft, flight thereby contributing to reducing the risk of disasters from natural hazards. The NMHS in Burundi is able to implement and maintain reliable and effective routine forecasting and severe weather warning programmes through enhanced use of NWP (Numerical Weather Prediction model) products and delivery of timely and authoritative forecasts and early warnings.

The funding of the institution comes from the government budget and through different projects funded by UNDP, FAO. In the previous years, the annual budget to run the institution was around 30.000000 FBU, about 24,000 US dollars.

13.9.2 Who uses the system/network/forum?

The main partners are the following:

- Ministry of transport, post and telecommunication to assist and secure the aerial navigation during departure and arrival of flights
- Disaster Management and Civil Protection Authority for disaster prevention and mitigation for rapid intervention in case of existence of extreme weather conditions that can lead to disaster.
- Media for disseminating and communicating information to general public and socio – economic sectors. The following list provides the users of the services provided by Burundi National Meteorological and Hydrological Services.

- Ministry of agriculture and livestock
- Ministry of healthy to use the products from forecast to protect the population of diseases originating from excess or tress of rainfall;
- Ministry of Water, Environment, Land and Urban Management to protect the water from pollution, the environment from floods and drought, land from soil degradation
- Ministry of interior, Local Administration to protect the population and infrastructure from disasters
- Other infrastructure companies;
- Utility Companies (Electricity, water/sewerage);
- Transport Authorities ;
- Fire/Rescue Service;
- Police Department;
- NGOs
- General Public via media
- Civil Protection Authority
- Local Banks, etc.

13.9.3 Description of how system/network/forum functions

This institute is serving in terms of both monitoring and forecasting meteorological drought at national wide. In IGEBU very short and short range weather forecasting are provided (from 24 hours to 3 days). With the use of INTERNET sites, additional meteorological products are gathered from Global Centres such as Germany Meteorological Service (DWD), NOAA/NCEP, ECMWF and EUMETSAT (MSG Satellite Images).

13.10 ID: DM EAC 09: RWANDA METEOROLOGICAL SERVICE

13.10.1 General information

The Rwanda Meteorological service is the key institution in drought management especially in collecting, processing and providing meteorological data. This service is under the Ministry of Infrastructure and is based in Kigali city, the capital of Rwanda. Rwanda Meteorological Service was established in 1962 and registered in 1963 under the Directorate General of Aeronautic with the main objective to help the aviation navigation but, some data collection was started well before. In fact, the first rain gauge station started early in 1906 by catholic missionaries at Save church in south of Rwanda and the systematic rain gauge and temperature station started in 1930. After the creation of the RMS in 1962, a synoptic station network followed in 1967. With a support from WMO, a network of observing meteorological stations was established in 1988, allowing an edition of ten days agro-meteorological bulletin (EAC, 2008).

Before the war 1990-1994 Rwanda had a reliable network comprising more than 150 observing stations including 5 synoptic stations, 6 agro-meteorological stations while others were used for climatology (rainfall and temperature). About 60 meteorological staff was mobilized in observation (data collection), analysis, weather forecasting and meteorological application that assisted in aviation. The war 1990-1994 and the Genocide against Tutsis in 1994 destroyed important infrastructure and personnel were victims (EAC, 2008).

As stated above, Rwanda Meteorological Service suffered from the war 1990-1994 in terms of its infrastructure and in its personnel. Currently, the Rwanda Meteorological Service repaired 14 synoptic and agro meteorological stations and 35 climatological stations. Rain gauging stations are also about 79 making a total of about 127 stations. By the end of 2011, it is planned to have 225 observing stations including four subsystems (synoptic, agro-meteorology, climatology and automatic) which means that, for the first time since the war in 1990-1994, Rwanda will have in near future the minimum meteorological network restored. Wecan note that additional stations (climatological and automatic) have been established by partner ministries mainly the Ministry of Agriculture and the Ministry of Health and the resulting data are shared among partners. The NUR is also running a GIS centre covering all regions.

About human resources, 33 (against 60 before the genocide against Tutsis) meteorologists are working for meteorological services including management, observation, data quality control, Archiving, processing, forecasting and dissemination. These staffs are working under three units as presented above: Observation / Station Network unit, Climatology/Monitoring unit and the Forecast unit.

RMS is under the Ministry of Infrastructure end its budget is fully provided by the government of Rwanda. The detailed information on the annual budget was not available when we visited the service, given that the Director General was in a mission.

13.10.2 Who uses the system/network/forum?

The main users of the RMS can be grouped into the following categories:

- Disaster managers
- Agriculture and food security
- Water resources developers
- Health sector
- Energy sector, etc.
- Land and Forest Resources Agencies

13.10.3 Description of how system/network/forum functions

The main partners of Rwanda Meteorological Service include, among others, Kenya Meteorological Department (Regional Centre for ten Countries); Word Meteorological Department, ICPAC (Intergovernmental Authority for Development, Climate Prediction and

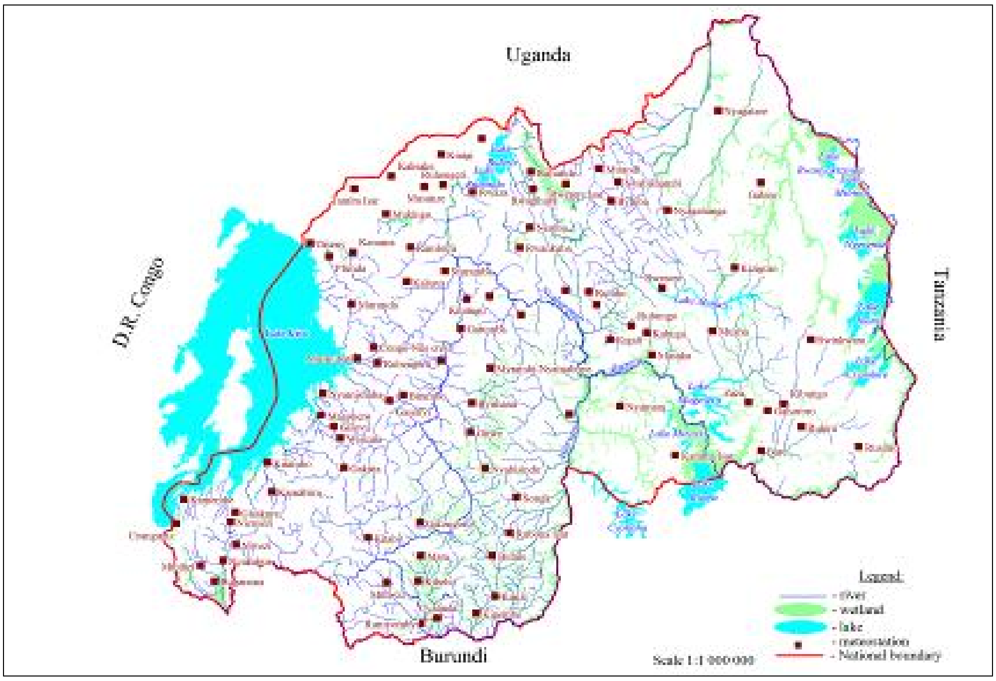
Application Centre); Drought Monitoring Centre, Nairobi (DMCN), NOAA, etc. The main role of these partners is in link with data sharing and in capacity building. At local level, the main partners include various ministries and their projects; research Institutes, Universities, UN Agencies, NGOs, etc.

13.10.4 Description of the Inputs to system/network/forum

These data locally collected comprise mainly: wind (speed and direction at 10 m height and 2 m height), temperature (maximum temperature, minimum temperature, temperature on glass, wet bulb temperature, soil temperature at 100cm, 50cm, 20cm and 10cm underground), number of sunshine hours, cloudiness (cloud cover and type of cloud), evaporation (in shelter and on evaporation pan), atmospheric pressure (measured on the site and reduced to sea level), relative humidity, vapour pressure, rainfall duration (diurnal, nocturne), rainfall quantity (diurnal, nocturne, total of the day), maximum hourly rainfall quantity.

The measurement frequencies are hourly (synoptic stations), three-hourly (agro-meteorological station) and daily (climatological stations). From these data, decadal (ten days), monthly, seasonal and annual data are calculated (EAC, 2008).

A map is included in this section to show the active stations as published in 2010. This map needs to be updated as there has been a change in the number of stations. Locally, data are collected from various stations around the country and additional data are obtained from satellite (METEOSAT Second Generation) and internet.



Location of meteorological stations, Rwanda (NBCBN, 2010)

13.10.5 Description of the methods/techniques/models and outputs

The country is divided into five zones and the Meteorological Division publishes seasonal forecasts for rainfall, indicating regions for which quantities are likely to be below, normal or above normal rainfall throughout the two rainy seasons March-to-May and September –to-November. When the values are below normal, the region risks to be affected by the drought, among others linked to ENSO (El Nino / la Nina) events.

13.10.6 Information available from the system/network/forum

Rwanda Meteorological service provides information before and after analysis. For researchers who want to treat and analyze the data, they can source the necessary information from the archive (databank) resulted from various records of temperature (maxima, minima and averages), precipitations, water level, wind, humidity, evapotranspiration, etc.

In addition, Rwanda Meteorological service uses the collected data and provided data (from satellite and partners) to forecast weather on daily basis, weekly basis and three months basis (seasonal forecast). This forecasting is disseminated using broadcasting on national radio and TV, bulletins, and by inviting journalist who receive the predicted weather to follow in 3 months later. This campaign insists on the two rainy seasons from September to December (SNOD) and from March to May (MAM). Generally, RMS provides raw data, processed data (means, frequencies etc.), graphics and maps depending on request of users, available expertise, and available data.

14 DETAILED DESCRIPTIONS OF NATIONAL DROUGHT MONITORING AND FORECASTING SYSTEMS/NETWORKS/ INSTITUTIONS:SOUTHERN AFRICA

14.1 ID: DM NSA 02: FACTSHEET 49: TANZANIA FORECAST OFFICE (CFO)

14.1.1 General information

The central forecasts office (CFO) was established in 1999 during the establishment of the Tanzania Meteorological Agency (TMA) from the so called Directorate of Meteorology (DoM). The DoM was established following the split of the East African Community (EAC) in 1977. The CFO issues weather forecasts that include daily 24 hours forecasts and tailored forecasts for public weather services, aviation, warning of hazards as weather and climate conditions such as tropical cyclones, droughts and floods. Ten day (decadal) bulletins, monthly, seasonal weather outlooks and advisories are also issued routinely. The system also prepares meteorological products and impact assessment in collaboration with other sections (i.e. agro-meteorology, environment and research, and hydrology for the purpose of distribution to customer and users)

The CFO through its national telecommunication center collects and exchange observational data at national, regional and International level by using the Global Telecommunication System (GTS) and Aeronautical Fixed Telecommunication Network (AFTN). The center is equipped with the African Meteorological Environmental Diagnostic Integrated System (AMEDIS), which is integrated with the Satellite Distribution System (SADIS) and the Meteorological Data Distribution (MDD). The AMEDIS links CFO with Zanzibar, Kilimanjaro and Mwanza meteorological offices. The system is owned by Tanzania Meteorological Agency. The funding mechanisms are through government subsidies, data cost sharing and International organizations such as WMO.

14.1.2 Who uses the system/network/forum?

Stakes: Modeling and verification department with the role of developing forecast models and their verification; Marine meteorological services with the role of collecting marine data; Aeronautical meteorological service with the role of collecting data from airports; Public weather services with the role of information publication and communication with the public on weather and disasters; PMO/DMD with the role of overseeing and coordinating the activities of government on matters related to prevention, preparedness and response to all disaster management in the country; FEWS with the role of early warning and teaming in matters relating to food security; WMO with the role of linking with other International meteorological or forecasting offices.

The system is used through media; electronic data transfer; hardcopy information; face to face meetings

14.1.3 Description of how system/network/forum functions

The CFO has a Primary Data User Station (PDUS) for reception of cloud imagery information. There is also a Meteorological Data Distribution System (MDD), which is used to receive from Satellite data and Numerical Weather Prediction (NWP) products from other world centers such as the Met. Office-UK; Toulouse-France and European Centre for Medium range Weather Forecasts (ECMWF)-Reading, UK. The following diagram Fig. 17 showing the flow of information between partners:

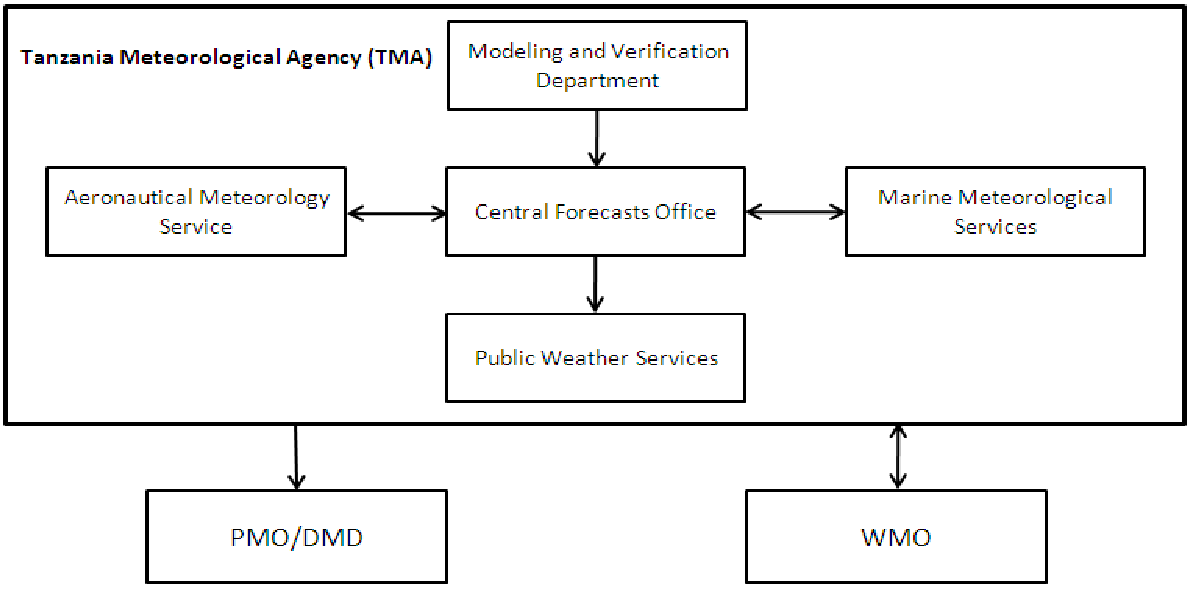


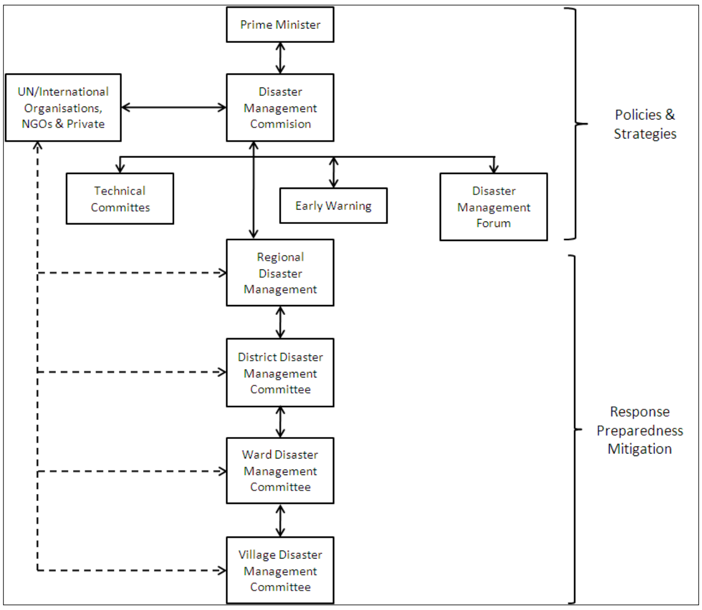
Fig. 17 showing the flow of information between partners:

Note: One direction arrows means one way flow of information and two direction arrows means two way flow of information.

14.2 ID: DM NSA 03: FACTSHEET 50- DISASTER MANAGEMENT DEPARTMENT

14.2.1 General information

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 Minister's Office. The funding mechanisms are through the government.



Conceptual description of the system functioning:

14.2.2 Who uses the system/network/forum?

Stakes: (i) TMA with roles of weather and drought forecasting (ii) MoAFS with roles of contingency planning, food situation assessment, stockpiling of food and seeds, and early warning (iii) 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 (iv) MoW with roles of response actions in the areas of emergency water supply (v) 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 (vi) 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 (vii) 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 (viii) FEWS with roles of providing famine early warning system

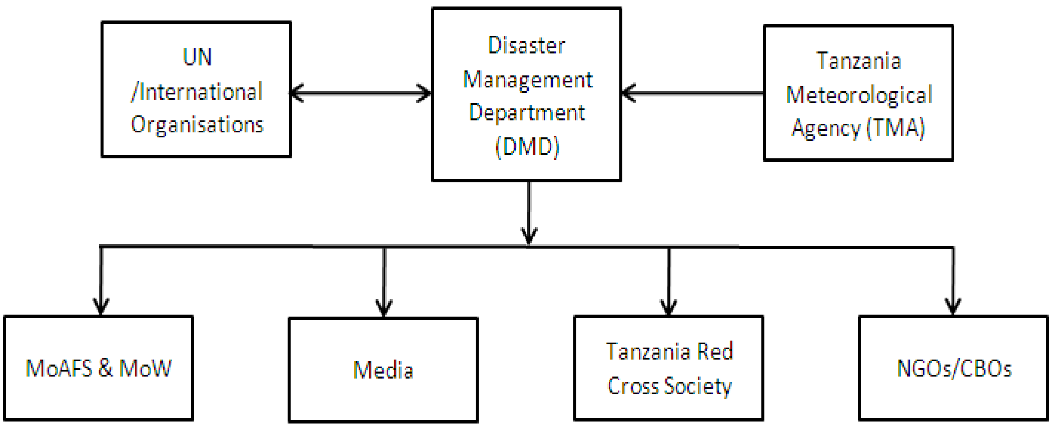
List of users and their contact details are in their respective administrative units:

- Regional Disaster Management Committee
- District Disaster Management Committee
- Ward Disaster Management Committee
- Village Disaster Management Committee.

The system is used at the units/levels as follows: Be a channel for information and resources, and be a link between national objectives and district priorities at the region; At district level: continuously monitor the hazards, risks, and disaster threats and the conditions of vulnerable population within the district; in the event of a disaster/emergency, in the affected district will take operational control of the situation to ensure support is delivered promptly to the affected communities; establishing the response team and civil protection system for disaster; At ward and village levels: Taking operational control in the event of a disaster or emergency so as to ensure that support is provided to the affected households; Identifying and mapping of all hazards in their respective location and conduct risk and vulnerability analysis.

14.2.3 Description of how system/network/forum functions

The DMD system function involves planning, coordinating, controlling, implementation and evaluation of a set of activities that entails four main elements. These include prevention or mitigation, preparedness, response and recovery, which form a cycle of activities. This continuous process is always embedded in implementation of activities in these elements stage by stage. The first stage is mitigation and preparedness, which is regarded as development activities followed by response and ending with recovery, which is a last element comprising rehabilitation and reconstruction activities. Post disaster review is an additional element that is not part of the disaster cycle that should be given attention. Like other program activities, the review of disaster operations is important. The following diagram shows the flow of information between partners:

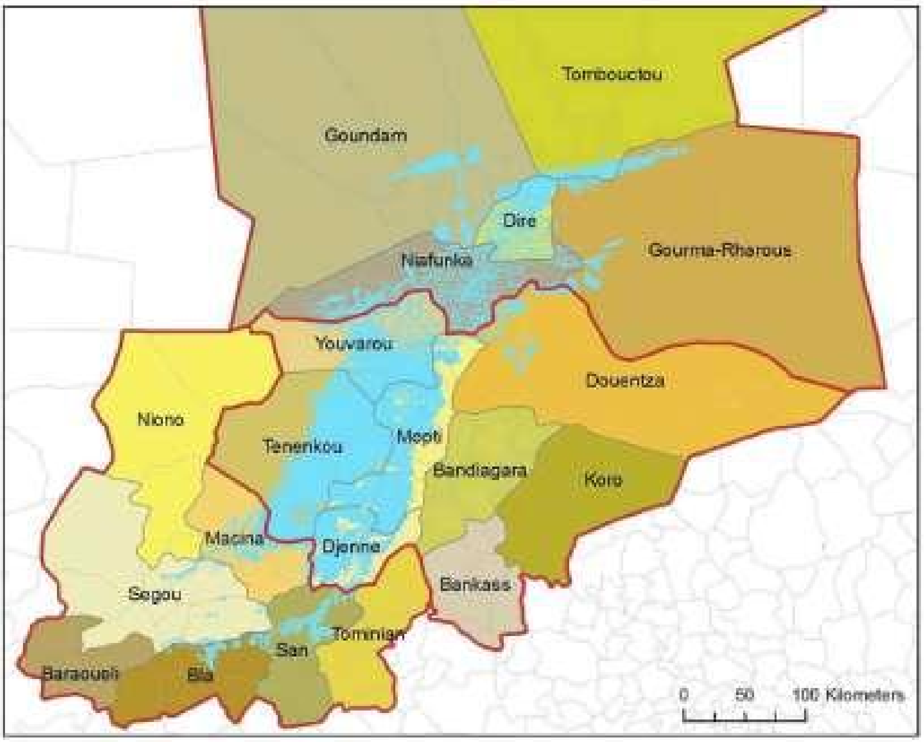


Flow of information between partners:

Note: One direction arrows means one way flow of information and two direction arrows means two way flow of information.

15 DETAILED DESCRIPTIONS OF DROUGHT MONITORING AND FORECASTING SYSTEMS/ NETWORKS/ INSTITUTIONS IN THE WESTERN AFRICA REGION

The Inner Niger Delta (IND) is a densely populated area, with many socio-economic activities (agriculture, livestock, fisheries, picking of fruits, handicraft, navigation, tourism and trade) and inhabited by 1.5 million people who depend on the Delta resources and ecosystem. The combined effect of continued drought and socio-economic pressure by the population has led to the following: significant reduction of the rivers and water table supply, a reduction of flooded areas in the Delta, a reduction of fish production and catch, deterioration of the vegetation cover, leading to soil erosion and silting of the river beds, exodus and concentration of the population and animals in the Delta, continued degradation of natural resources with the disappearance of certain species, and lastly increase in the number of conflicts, etc.Climate changes have significantly affected one of the main sub basin of the Niger river basin in Mali, the Bani river. Between 1950-1980, the cumulative effects of the climate change have been respectively -80% and -30% on the river discharge and rainfall. -50 and -30% decrease has been observed during the same period respectively on the Niger River discharge and rainfall. The size of the IND has been reduced about 6000 km² because of climate change impacts and another 1000 km² by the Selingue and Markala dams located upstream.



Map of the communes covered by the flooding of the Inner Niger Delta

General information

Three quarters of the IND population lives below the poverty level. In 2004, the Delta, which covers 30 000 km² was classified as a Ramsar Site. It is a major biodiversity centre with the two largest known bird nest colonies in Africa; furthermore, it forms a vital part of the eco-regional network, with 3 to 4 million resident or migratory water birds from almost all parts of the world, in particular Europe and Asia. It is a refuge for fauna and specific flora. The Delta, with its many river arms, ponds and lakes, is a good area for fish production (nearly 100 000 tons during high waters and 50 000 tons during low rainfall). The Delta is an area of culture, and immense tourist and economic potential. Many historic cities such as Hamdallahi (former capital of Dina), Djenné and Bandiagara are major tourist centers. These last two towns have been included in UNESCO World Cultural and Natural Heritage list since 1989. The tourism sector welcomed about 100 000 tourists and represented a market of 76224509 Euros in 2001.

15.1 ID: DM NWA 01: FACTSHEET 51: EARLY WARNING SYSTEM (SAP)

15.1.1 General information

The SAP was introduced in 1986. Initially, SAP covered the north regions of Mali considered as risk areas and in 2004 it covered the whole country.

SAP is a continuous monitoring system, timely and effective for food and nutrition security. Access to reliable data in real time to prepare and enable for faster responses and more efficiency to food insecurity. The SAP is responsible for responding to a set of questions about the status of food security: What are the areas and populations likely to experience a food and nutrition crisis?

- At what time and for how long it will last?
- What are the estimated needs related to the population number?

The SAP is a hydro-economic model that analyzes the food and nutrition situation of population. SAP information is collected from administrative and technical services from government, local elected officials, civil society, municipalities, prefectures, regions and Bamako district levels.

SAP is funded by the Restructuring Program of Crop Market (PRMC) and the Government of Mali. The budget is estimated about 609 849 €.

The SAP is headed by the National Directorate of Statistics and under the supervision of the Food Security Commission(CSA).

SAP is working in partnership with many actors, both for information sharing and the implementation of surveys. At national level, there are many collaborations with many governmental institutions.

The SAP is also working with national and international NGO such as NGO “Action against Hunger, Spain”.

SAP presents its results as a monthly newsletter. The SAP is not a physical structure but a tool, animated by technical institutions of the state and NGOs, who meet monthly to discuss and validate the results of last month. At the national, regional, prefecture and sub prefecture levels the chair is provided respectively by the National Director of Statistics, the Governor of the region, the Prefect and the Sub-prefect. All regional reports are sent to the national level. These results are popularized at the community level on national television and by the technical staff of the structures of the Government and NGOs .

15.1.2 Description of how SAP functions

The SAP is based on ongoing data collection related to food and nutrition situation of populations. These data cover a variety of areas such as rainfall, flooding of rivers, pests, crop production, livestock and fishery production, market prices of crops, migration of populations, their habits and food reserves, and health. This information are collected from administrative and technical services from government, local elected officials, and civil society, municipalities, Sub prefecture, Prefecture, Regions and Bamako district levels.

In each of the eight capital regions of Mali, the regional team responsible for the collection of information is supported by the Regional Directorate of Planning, Statistics, Information Technology, Physical Planning and Population (DRPSIAP). Before being transmitted collected information as regional monthly report to Bamako, it is reviewed by the working group of the SAP Regional Development Committee which meets monthly and brings together the structures involved in food security issues under the chairmanship of Advisor Economic and Financial Affairs to the Governor.

At Bamako, regional reports, survey results and information collected are analyzed and compiled into a monthly national report, which is reviewed and adopted by the SAP Working Group before being published and distributed as a national newsletter. The latter aims at national, regional, local and international agencies to enable them to take measures to prevent a food crisis. The areas where a deteriorating food situation is suspected, a team of health workers and social affairs investigate the socio-medical and nutritional depth to clarify the importance of suspected problems.

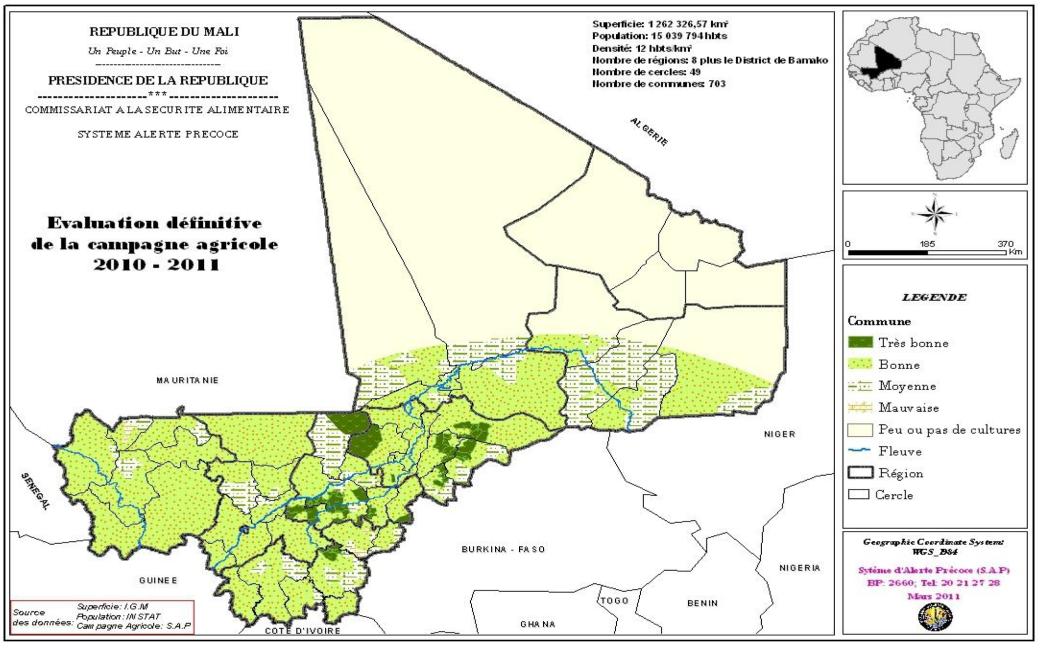
ORGANIGRAMME OF SAP

15.1.3 Assessment of spatial coverage

The SAP covers the entire Mali. The SAP is a state tool for fighting against poverty and promotes environmental management. In its operation there are shortcomings related to several factors. The National Directorate of Statistics, which directs operations is seeking ways to remedy the weaknesses in the national coverage.

15.1.4 Description of the inputs to SAP

- Rainfall and flood of rivers
- Pests
- Agriculture production http://sapmali.net/index.php/bulletins/bulletins-2007/synthese-par-indicateurs.html?start=4
- Live stock and fish production http://sapmali.net/index.php/bulletins/bulletins-2007/synthese-par-indicateurs.html?start=6
- Population migration
- Habits and food stocks
- Health status
- Crop prices on the markets



Intervention zones of SAP

Data are collected from the following institutions :

- National Directorate of Meteorology
- National Directorate of Hydrology
- National Directorate of Rural Equipment
- National Geographic Institute
- Ministry of Agriculture
- Ministry of Environment and NGOs

The data are reviewed by a working group of the SAP Regional Development Committee, which meets monthly and brings together the structures involved in food security issues under the chairmanship of Advisor to the Economic and Financial Affairs of the Governor. In Bamako, regional reports, survey results and information collected are analyzed and compiled into a monthly national report, which is reviewed and adopted by the working group SAP. The observation frequency is monthly

15.1.5 Description of the methods/techniques/models and outputs

1. Data entry input on the SAP is performed by the software CSPro.
2. The consolidated file is then transferred into an SPSS database.
3. The purification of socio-economic data is performed o nthe software SPSS.16.
4. The anthropometric data is performed on Epinut/Epi6fr.4.0, Anthro2005/OMS for data standardization (NCHS, WHO) and SPSS 16.
5. Excel for the output, frequency tables, crosstabs, charts, and Word for report writing.

Demographic characteristics, agricultural yields, morbidity and mortality of animals, food available per capita, the depth of water resources, the cost of products to the market, the amount of rainfall recorded, the flow of water river, etc.

PROCEDURES FOR DEVELOPING AND INTERPRETING INDICATORS

Rural observatories carry out annual surveys by using household questionnaires and monthly prices of crops in the market. The goal is to understand the profile of households: demographic composition, educational level, the structure of activity, income and expenditure. The investigations carried out on a panel, identifies the change in circumstances(following a crisis, for example) the resilience conditions and identifying the most vulnerable groups. One questionnaire is used for surveys at the municipal level which is complemented by a group of resource persons and communal discussion group(GDC), which functions as a focus group, using a participatory approach. Related to information on available socio-economic infrastructures and their conditions, the survey provides valuable data which will power a municipal information system essential in the context of decentralization. However, the method has limitations for the understanding of phenomena such as food vulnerability.

The early warning system performs a combination of quantitative data (rainfall, anthropometric measures, statements, etc.) but also qualitative, provided by resource persons. the method is adapted to each type of information sought. The data are integrated into a model (expert system) which allows an initial diagnosis of the food situation, then validated diagnostic or change by the resource persons on the ground.

15.1.6 Information available from the SAP

The SAP is a decision support tool for making available relevant information on food and nutrition situation of affected populations to decision makers(national and international. This information is used for recommendations to food aid (free or by selling intervention) and the publication of monthly newsletter, which corresponds to the primary objectives of the SAP.

The data are collected from people by investigators, with respect to rainfall and flood. Also data are collected successively from the AGRHYMET and the National Directorate of Hydraulics. The status report is published and distributed as a national newsletter, which is aimed at national, regional, local and international agencies to enable them to take measures to prevent a food crisis.

Publication of reports help to identify areas where degradation of the food situation is suspected, as a result, a team of health workers and social affairs will investigate on socio-medical and nutritional depth to clarify the importance of suspected problems.

The SAP is placed under the supervision of the Food Security Commission(CSA)
The data are adequate for the model use as the system provides monthly, quarterly and biannual newsletters to prevent risks in the future situation of food and nutrition crisis are done in real time in order to take appropriate solutions.

Problem faces are the poor filling of the survey forms by the investigators. Often the Prefects only complete the questionnaires without the support of technical services.

15.2 ID:DM NWA 02: FACTSHEET 52: WEST AFRICA SEED ALLIANCE (WASA)

15.2.1 General information

The alliance was formalized in October 2009with the signing of a memorandum of understanding among stakeholders that are AFSTA, AGRA, CEDEAO et USAID.

WASA is a multilateral program that brings together partners from the private and public sectors with the aim to establish a sustainable commercial seed industry capable of guaranteeing small producers access to timely, appropriate genetic material and at fair price.

WASA functions

Funded by USAID and AGRA in the beginning, the alliance of public and private sector will be executed in 5 years in association with ICRISAT and SSC-ISU and local partners. The alliance is committed to cooperate with the African Institutes for supporting the activities of the seed industry. The Alliance also supports capacity building of people in trade and market access. It enhances the prediction of food, agricultural research for development and support increased productivity in the long term.

15.2.2 Who uses the WASA?

The system WASA is managed by ICRISAT (International Crops Research Institute for the Semi-Arid Tropics).

Technical Partners:

- ICRISAT (International Crops Research Institute for the Semi-Arid Tropics).
- SSC-ISU (Seed Science Centre of Iowa Stade University): assistance for the implementation of seed policies and regional capacity building
- CNFA

Collaboration Partners:

- AGAGHAN
- Regional Directorate of Agriculture
- Office Riz Mopti
- HOBE.

Users use improved seeds and other required inputs to increase productivity and market acceptability. Users are: Producers and Consumers

Technical staff of agriculture popularized information on improved seeds to producers.

The WASA network provided seeds at their agencies. The seeds are sold to producers at a shared cost by the WASA system, that is to say that the system WASA buy seeds from the research institutes and to sell to producers at a reduced price.

15.2.3 Description of how WASA functions

WASA system works on the development of a new seed in West Africa based on seed varieties of high quality. These varieties of seed increase productivity and improve the conditions of farmers by undertaking making a number of new activities. These seeds will ensure the production of new seeds that will be used in the country of the alliance to produce commercial quality, high seed in the future, the production of certified seed.

15.2.4 Assessment of spatial coverage

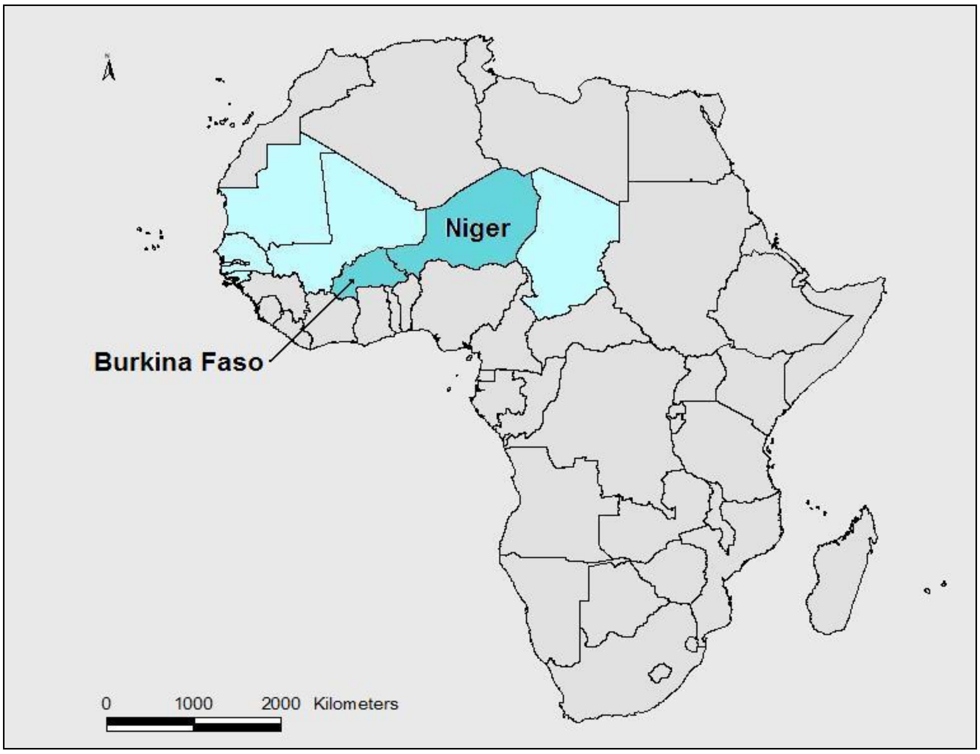
Burkina Faso, Ghana, Mali, Niger, Nigeria, Senegal

15.2.5 Description of the inputs to WASA

Parameters or data used as input to the WASA.

The seeds for the experimentare: Rice, Sorghum, Millet, Cowpea, Peanut, etc.

The plant breeders: Develop and purify improved varieties from the genetic resources available and introduced keep and maintain amounts of native seed varieties for the purpose of breeding and production of pre-basic seeds



WASA map of West Africa Alliance

15.2.6 Description of the methods/techniques/models and outputs

Commercial seed producers

Multiply basic seeds to obtain certified seeds to be sold by distributors in markets.
Certification to ensure consistent quality with improved seed origin.

Drought indicators that are produced (outputs)

Yields, resistance to disease and weevils

Procedures for developing and interpreting indicators

WASA system focuses on the interrelated issues of harmonization and implementation of seed policies and regional capacity building in the following areas:

- Harmonization variety systems, including the development and publication of a virtual catalog;
- control of seed quality and the certification / accreditation, and
- Identification according to a scientific approach to the list of quarantine pests

The interpretation of these indicators must create opportunities for plant breeders, seed companies, distributors of agricultural inputs, agricultural producers and consumers. Support for components of the value chain of the seed is a priority for action.

15.2.7 Information available from the WASA

WASA system provides information on seeds and educates people to use its seeds.The system is managed by WASA ICRISAT (International Crops Research Institute for the Semi-Arid Tropics).The system WASA purchases the seeds from researchers and makes it available to producers at shared cost, that is to say that the system makes a 50% reduction to producers of seeds and agricultural fertilizers. Then WASA supports certification by the regional Directorates of Agriculture. For demonstrations, the system WASA provides free seeds to farmers. Monitoring is supported by the system. The WASA system provides information about seeds that are adapted to current climate. These are being tested in demonstration to educate farmers to buy their seeds. Farmers are used to save seed or to trade with neighbours. WASA system with the support of officials of the Directorate of Agriculture make awareness sessions to use improved seeds.

Expertise involved in the network

International Crops Research Institute for the Semi-Arid Tropics ICRISAT, Seed Science centre of Lowa Stade University (SSS-ISU), CNFA, Regional Directorate of Agriculture and Seed Services.

Existing expertise involved in monitoring, forecasting, early warning and response

ICRISAT is responsible for its expertise

15.2.8 Is the input data is adequate for the methods/techniques/models used?

They are suitable for adaptation to climate change but with problems that farmers buy at high costs.

Lessons learnt

More and more farmers understand the advantage of using the seeds. Strong involvement of agricultural services in the extension of the seed.

Challenges that WASA is experiencing?

These challenges are:

- Decrease in seed prices
- How to make this activity profitable
- Establish a system for disposal of products

15.3 ID DM NWA 03: FACTSHEET 53: INFORMATION PREDICTION SYSTEM AND EARLY WARNING OF FLOODING (SPIAC)

15.3.1 General information

It was established in January 2006, The SPIAC is a tool for capturing and disseminating information to stakeholders of the IND.

15.3.2 Description of the system

The SPIAC is a hydrological model based on the flow of the Niger river at the Stations of Koulikoro and Moptiand. It did not take into account the Bani and its stations that also play an important role in the flooding of the Central IND.

15.3.3 Who uses the SPIAC?

Regional Directorate of Hydraulics and Energy manages the system

Partners and their roles/stakes.

- Institut d'Economique Rural
- Office Riz Mopti
- Opération Pêche Mopti
- Regional directorate of hydrology
- Regional Directorate of Agriculture

15.3.4 Description of how SPIAC functions

SPIAC is based on the discharge of the flood of the Niger at stations Koulikoro and Mopti . It did not take into account the Bani and stations that also play an important role in the flooding of the central IND.Consideration of these observations will lead to a new model that will integrate the Bani, its discharge and water heights.To make it an effective and efficient tool, it will be essential to develop it from simple data and information that can help the people of Delta to develop and adopt appropriate strategies.

Two types of information may serve them: climate data (rainfall, floods, inundation) and agricultural data (agriculture, livestock and fisheries).

15.3.5 Assessment of spatial coverage

The Inner Niger Delta

15.3.6 Description of the inputs to SPIAC

Parameters or data used as input to the SPIAC are the discharge and water heights. The source of data are landsat satellite images and other data come from the National Directorate of Hydraulics.

The transmission of information, interpretation and use will be different. At the level where information will be issued (hydro-meteorological stations located upstream of the Delta) to the level where they will be used, the information can undergo a series of transformations and interpretations without losing their essence and effect. The communication of information from its emission source can help to strengthen methods and tools used for transmission, but also to safeguard its nature, according to the needs and emergencies of the principal users. The observation frequency is daily.

15.3.7 Description of the methods/techniques/models and outputs

The transmission of information, interpretation and use will be different. At the level where information will be issued (hydro-meteorological stations located upstream of the Delta) to the level where they will be used, the information can undergo a series of transformations and interpretations without losing their essence and effect. The communication of information from its emission source can help to strengthen methods and tools used for transmission, but also to safeguard its nature, according to the needs and emergencies of the principal users.

Alert on the hydrological situation of a year. The water flow in the river, the degree of sedimentation. The frequency is monthly. But SPIAC had a lot of funding problems and because of these problems the tool is not operational.

Procedures for developing and interpreting indicators. Information about the flood on agricultural production, fisheries and livestock. The interpretation is done by studying a series of analysis with data over a period of 53 years on the amount of rainfall and flood levels.

15.3.8 Information available from the SPIAC

Information about the flood in the Inner Niger Delta and it comes from the AGRHYMET

Expertise involved in the network

- Institut Economique Rural (IER);
- Office Riz Mopti(ORM);
- Opération Pêche Mopti (OPM);
- Regional Directorate of Hydraulics (DRH);
- Regional Directorate of 'Agriculture (DRA);
- AGRHYMET.

Expertise involved in monitoring, forecasting, early warning and response (provide numbers and years of work experience) is the

National Directorate of Hydraulics and Energy is responsible for the tool.

Lessons learnt

- Taking a good decision on time, in developing a strategy to adapt to challenges and reducing their negative impact, promote research, diversify sources of income for farmers and strengthen their organizations;

- Promote intensification of production and thus ensuring better management;

- Incentives to preserve and restore the environment.

Challenges that the SPIAC is experiencing?

- The integration of Bani in the model;
- The use of water level in addition to flow;
- The gauging stations used: Koulikoro, Mopti and Douna

NB: Development of the tool has stopped at half way. The model is no longer operational.

15.4 ID:DM NWA 04: FACTSHEET 54: FLOOD PREDICTING TOOL OF THE INNER NIGER DELTA (OPIDIN)

15.4.1 General information

The system is for prediction of Flooding in the IND as part of adaptation to climate change.

15.4.2 Who uses the OPIDIN?

A steering committee composed of technical services and NGOs

Partners and their roles/stakes.

- A representative of the Agency of the River Niger (ABFN);
- A representative of the Regional Directorate of Agriculture;
- A representative of the Office Riz Mopti;
- A representative of the Regional Directorate of Hydraulics;
- A representative of the Regional Directorate of Fisheries;
- A representative of the Regional Production and Animal Industry;
- A representative of FODESA;
- A representative of the Coordination of Traditional Leaders DIORO;
- IUCN ;
- PROTOS ;
- WETLANDS International.

The operation of the steering committee is through exchange of information from e-mail regarding the collection of information and data. A monthly meeting is held to validate the information obtained.

Because the basic data on water level is the main source of OPIDIN, the water level are provided daily by the Regional Directorate of Hydraulics in the format of decadal frequency. The newsletter derived from these data is conveyed by e-mail to all members.

Because of the communication and dissemination of information require a cost it was considered necessary to combine OPIDIN information system to existing communication systems which are: the weekly magazine of the Regional Directorate of Fisheries, radio proximity of FODESA. Beyond these two aspects, the interventions of the City Council and Administration at the prefecture level can contribute to the dissemination of information in the database.

Local communities (pastoralists, fishers), Technical Services, NGOs, etc.

Because of the communication and dissemination of information require a cost it was considered necessary to combine OPIDIN information system to existing communication systems which are: the weekly magazine of the Regional Directorate of Fisheries, radio proximity of FODESA. Beyond these two aspects, the interventions of the City Council and Administration at the prefecture level can contribute to the dissemination of information in the database.

15.4.3 Description of how OPIDIN functions

A forecasting system based on the data collection (water level) upstream.

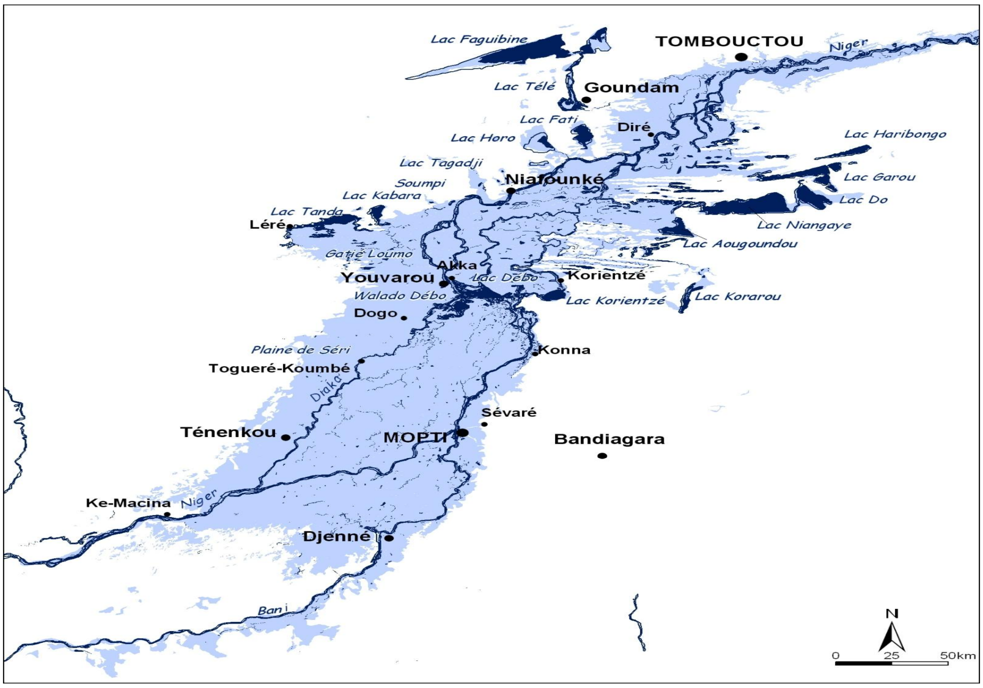
15.4.4 Assessment of spatial coverage

The spatial scale is about 110 km from upstream to downstream inside the IND

15.4.5 Description of the inputs to OPIDIN

Parameters or data used as input to the system/network/forum/institution.

Water depth, date of reading, satellite images.



15.4.6 Description of the methods/techniques/models and outputs

Input methods are based on spread-sheets (spreadsheet) and statistics are applied to the input data

Drought indicators that are produced (outputs)

Water levels, Flows, areas flooded, floodplain forests, the presence of breeding colonies of water birds, the size and catch fish, and the frequency is

Ten-day (3 times per month)

15.4.7 Information available from the OPIDIN

The system provides information on flood and flood recession

Details of each source of data/information.

National Directorate of Hydraulics, Wetlands International and Altenburg and Wymenga (Contact), Because of the communication and dissemination of information require a cost it was considered necessary to combine OPIDIN information system to existing communication systems which are: the weekly magazine of the Regional Directorate of Fisheries, radio proximity of FODESA. Beyond these two aspects, the interventions of the City Council and Administration at the prefecture level can contribute to the dissemination of information in the database.

Expertise involved in the network

At the national level, National Directorate of Hydraulics and at international level (Royal Haskoning and Altenburg & Wymenga).The reliability of indicators is good in terms of prediction . There is a confidence interval that provides the margin of certainty of the prediction. Lessons learnt are that this is unfavorable for agricultural forecasting, because the prediction is late (in August) when the seedlings are already in July, and the challenges are how to integrate the tool in the rainfall forecast for farmers.

15.5 ID:DM NWA 05: FACTSHEET 55: GEOGRAPHIC INFORMATION SYSTEM ON WATER RESOURCES IN MALI (SIGMA)

15.5.1 General information

The system was established in 2002, The SIGMA is a tool for guiding national government and donor communities on areas with limited access to drinking water supply. The SIGMA is a hydrogeological and geographical model and is funded by (German Cooperation (GTZ), Swiss Cooperation, French Cooperation)

15.5.2 Who uses the SIGMA?

National Directorate of Hydraulics and regional level Regional Directorate of Hydraulics, Hydrology Local Service, Documentation and Information Centre uses SIGMA. Users of the system and their contact details, NGOs, technical services, bilateral cooperation, projects, programs, etc. Access to SIGMA information is done by request from the Documentation and Information Centre of the National Directorate of Hydraulics

15.5.3 Description of how SIGMA functions

The SIGMA is a system that provides information on existing water infrastructures. It is installed at the Documentation and Information Centre of National Directorate of Hydraulics.

15.5.4 Assessment of spatial coverage

The SIGMA is applied in Mali. The tool is held by the National Directorate of Hydraulics.

15.5.5 Description of the inputs to SIGMA

Existing water infrastructures (wells, drinking water supply, Forage, pumping equipment, etc.)

Quality control processes applied to the input data.

Locally, the update controls are made by local leaders.

Nationally, the update is done by the Documentation and Information Centre of National Directorate of Hydraulics. Frequency is quarterly, each six months and annual.

15.5.6 Description of the methods/techniques/models and outputs

Characteristic of each carried out infrastructure put in place (Pedology, localiy, coordinates, Texture, etc.). Diagnostic study that identifies the areas not covered by an drinking water supply system, not equipped with drilling, etc.

Drought indicators that are produced (outputs) are number of water points per village / inhabitant. Frequency is quarter, each six months and annual

Procedures for developing and interpreting indicators

Cover rate, village without water infrastructure, population who have access to a system of drinking water supply, etc The interpretations are qualitative and quantitative and related to water resource.

15.5.7 Information available from the SIGMA

Cover rate, cartography of the locality, population, etc. Users access the SIGMA through the Documentation and Information Centre of National Directorate of Hydraulics. Information is disseminated through municipalities for better planning future activities in the water sector. Determine the existing expertise involved in monitoring, forecasting, early warning and challenges that the system/network/forum is experiencing are that there is no bridge between the SIGMA and other programs of the National Directorate of Hydraulics.

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