



Department of Economic and Social Affairs (DESA)

Development Account Project 121C “ROA-207”: Strengthening National Capacities to Manage Water Scarcity and Drought in West Asia and North Africa

Technical Report on

**The Way to the Implementation of a Drought Management Plan in Morocco:
Review of the Past Activities and Planned Activities for 2015**

National Consultancy Assignment

Technical Advisory Service for Developing and Implementing Mitigation and Preparedness Drought Management Plans in Pilot Project Countries

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Morocco

December, 2014

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Acronym List

ABH	Agence de Bassin Hydraulique
ADA	Agency for Agricultural Development
ANAFIDE	Association Nationale des Améliorations Foncières, de l'Irrigation, du Drainage et de l'Environnement
ANDZOA	Agence Nationale pour le développement des Zones Oasiennes et de l'Arganier
CAM	Crédit Agricole MAROC
COMADER	Confédération Marocaine de l'Agriculture et du Développement Rural
CRTS	Royal Centre of Spatial Remote Sensing/Centre Royal de Télédétection Spatiale.
DDFP	Direction des filières de Production
DEWFORA	Drought Early warning and Forecasting to Strengthen Drought Preparedness In Africa
DF	Direction Financière
DMN	National Direction of Meteorology/Direction de la Météorologie Nationale.
DSS	Direction de la Stratégie et des Statistiques
DRA	Direction Régionale de l'Agriculture
DRPE	Direction of Research and Water Planning
ENA	Ecole Nationale d'Agriculture
FAO	Food and Agriculture Organization
HCEFLCD	the High Commissariat for water and Forests and Fight against Desertification
HCP	Haut Commissariat au Plan
INRA	National Institute for the Agricultural Research/Institut National de la Recherche Agronomique.
IAMZ-CIHEAM	Mediterranean Agronomic Institute of Zaragoza
IAV Hassan II	Hassan II Agronomic and Veterinary Institute/Institut Agronomique et Vétérinaire Hassan II.
MAMDA	Mutuelle Agricole Marocaine d'Assurances
MAPM	Ministry of Agriculture and Maritime Fisheries/Ministère de l'agriculture et de la Pêche Maritime
ONEE	Office National de l'Eau et de l'Electricité

ORMVA	Office Régional de Mise en Valeur Agricole
PPP	Partenariat Public Privé
SMAS	Système Maghébin d'Alerte à la Sécheresse
SSWE	State Secretary to Water and Environment
MEDROPLAN	Mediterranean Drought Preparedness and Mitigation Planning
NDMC	National Drought Mitigation Center
NGOs	Non-Governmental Organizations.
UN	United Nations
UNDP	United Nations Development Program
UN-DESA	United Nations Department of Economic and Social Affairs
UNECA	United Nations Economic Commission for Africa

A- Project Activities During 2014

I. Rationale and Background

Drought is one of the world's major natural hazards. Indeed, droughts may considerably and dramatically affect nations and livelihoods through a vast array of impacts on the environment, rural livelihoods, food security and agricultural production, urban and economic development. Cost projections from drought are hard to pin down but the World Economic Forum (WEF) says that drought across the globe costs \$US 6-8 billion a year from losses in agriculture and related business. The WEF also reported that since 1900, global droughts have affected two billion people, leading to more than 11 million deaths.

Drought occurs worldwide and has always been considered as a natural cyclical event. However, during the last decades, the increasing frequencies and severity of drought periods threatens the future of water and food supplies and the global economy. Drought prone areas are also expanding. Indeed, they have risen from 10-15% to more than 30 percent from the early 1970s to the early 2000s (Dai et al., 2004)¹. At the same time, the demography rate reveals that by 2025, 13-20% of the projected global population will live in water scarce countries, with Africa and parts of Western Asia being very vulnerable to the increasing water scarcity (WMO, 2012)².

It is therefore essential for drought prone countries to develop and enhance their drought management capabilities, particularly through the building of national capacities. Indeed, regarding drought management, most drought prone countries have implemented crisis management strategies focusing on recovery from drought impacts but still lack advanced planning by political leaders and integrated risk-based national drought policies that can contribute to reduce the social vulnerability to droughts by focusing on drought preparedness and mitigation measures.

Therefore, in 2012, the RIO +20 United-Nations Conference on Sustainable Development called for:

- Urgent action to address desertification, land degradation, drought and water scarcity
- Disaster risk reduction through in particular building communities capacities and resilience

¹Dai, A., K.E. Trenberth, and T. Qian (2004). A global set of Palmer Drought Severity Index for 1870-2002: Relationship with soil moisture and effects of surface warming. *Journal of Hydrometeorology*, No. 5, pp. 1117-1125.

²World Meteorological Organization (2012). Drought. Available from <http://www.wmo.int/pages/prog/hwrp/drought.html> Accessed 19 November 2012.

In addition, the RIO+20 main outcome document “the Future We Want” called for the development of:

- Methods and indicators for desertification, drought, and land degradation monitoring and impact assessment
- The cooperation in climate data sharing and implementing desertification, drought and land degradation early warning systems

Thus, as a response to these calls and the needs for effectively moving from a drought crisis management approach to a risk management strategies, the Department of Economic and Social affairs of the United Nations (UN-DESA) in partnership with the United Nations Economic and Social Commission for Western Asia (ESCWA) and in cooperation with the United Nations partners including UNEP, UNCCD, WMO, FAO, UNISDR and UNDP have implemented a capacity development project aiming at “*Strengthening the Capacities of National Planners, Policy Makers and Stakeholders in Water Scarce Countries of West-Asia and North-Africa*”. The inception meeting took place in Beirut, Lebanon on June 24-25, 2013 and, although Morocco was not represented in that meeting, discussions began in order to have it as a pilot country, along with Tunisia, Palestine, Jordan and Yemen. The discussions also emphasized the need to build on the NDMC 10-step planning process and on the Mediterranean Drought Preparedness and Mitigation Planning Guidelines (MEDROPLAN) and its partner countries’ experiences, including Morocco.

To this aim, Mr. Nikhil Seth, Director of the Division for Sustainable Development at UN-DESA addressed an official invitation to Mr. Sadiki, General Secretary of the Ministry of Agriculture and Maritime Fisheries, asking in supporting the project through the involvement of Morocco as a project partner and the designation of a national drought management coordinator.

Thus, later on, thanks to the effective coordination of Mr. Mohamed Sadiki and the continuous efforts of Mr. Sami Areikat, Project Coordinator, Morocco was designated as a pilot country and Mr. M’Hamed Belghiti (Ingénieur Général à la Direction de l’Irrigation et de l’Aménagement de l’Espace Agricole) as the National Coordinator of the project. The project was officially launched during the visit of the UN-DESA representative, Mr. Sami Areikat during April 14-17, 2014.

II. Research and Studies

In terms of research and studies, project activities during 2014 have led to valuable information, which can be summarized in the following points:

- Discussion of MEDROPLAN and University of Nebraska Guidelines and their adaptation to Moroccan context
- Mapping of existing knowledge and practices in mitigation and preparedness drought management planning
- Identifying the critical gaps and the needed actions

i. Discussion of MEDROPLAN and University of Nebraska Guidelines and their adaptation to the Moroccan context

As a partner of MEDROPLAN project, Morocco has contributed to the development of the guidelines and tested their applicability in the Oum Er Rbia basin. Then it gathered stakeholders from the main institutions involved in drought management within a national workshop to collect their feedback. In general, the guidelines were welcomed and accepted, although the necessity to develop a legal framework for water management under drought conditions was highlighted. However, the lack of a sustainable coordination among the targeted institutions and a weak diffusion and communication has limited their use. Currently, we can note two successful examples of application: the agricultural insurance, implemented by the Ministry of Agriculture, and the ongoing strategy of developing River Basin Drought plans, by the Ministry of Water.

The NDMC has also participated in several assessments of drought management activities in Morocco, leading to a report outlining the next steps in the country's efforts for proactive drought risk management. It contributed to the creation in 2001 of the National Drought Observatory, which is unfortunately currently weakly operational.

The UN-DESA project has been therefore welcomed as a great opportunity to fill the drought management gaps in Morocco.

ii. Mapping of Existing Knowledge and Practices in Mitigation and Preparedness Drought Management Planning

Within this project component, a comprehensive review on the national drought context, its history and impact, as well as the history of drought management plan, was performed.

In a second point, the current national drought management was assessed. The following assessments were developed:

- The institutional frameworks for drought management
- The drought monitoring capabilities
- The forecasting capabilities
- The drought warning experiences
- The drought mitigation practices and strategies
- The drought adaptation practices and strategies

The above actions were duly developed. The stakeholders discussed and analyzed the reactive actions that were implemented during the droughts of the 1980's, in the form of funds and subsidies to assist rural populations for livestock protection, drinking water, creating jobs and restructuring farmers' bank debt.

The relative national switch to more proactive actions was also underlined. Indeed, the subsequent developments of the droughts occurred more frequently during the 1990's and the growing awareness from the scientific community and civil society led the policy makers to adopt a more pro-active approach. Thus, in 1995, preliminary guidelines for a new approach, based on risk management principles provided the basis for a more proactive drought management approach in the country.

Emphasis was also made on the 1995 Water Law, the creation of the basin agencies, the national water and agriculture strategies as well as the drought insurance. The best practices in preparedness and mitigation drought management were illustrated and the national gap assessed.

iii. Identifying the Critical Gaps and Needed Actions

The developed report showed that Morocco has achieved very important advances in drought management in terms of drought monitoring, and performing institutional and technical capacities in specific domains as the meteorology, the remote-sensing and the forecasting.

However, the gap analysis conducted in reference to the best practices in drought preparedness and management showed that:

- The country still lacks an operational drought early warning system.
- Information related to drought on-set, when it does exist on an occasional basis, is often too technical, limiting its use by decision makers and farmers. Drought thresholds are not well defined.
- Delivery systems for disseminating data to users in a timely manner are not well developed or inexistent, limiting their usefulness for decision support.
- Impact and vulnerability assessment methodologies, a critical part of drought monitoring and early warning systems, are not standardized or widely available, hindering impact estimates and the adoption of regionally appropriate mitigation responses.
- There are weak synergies between the different institutional involved in drought management and data sharing remain very limited.
- Drought management strategies remain sectorial and are not integrated in a national drought management policy. Indeed, the key ministerial departments have their own specific roadmaps for drought management but the country still lack national or regional drought management plans, as described in the literature.
- There is no institution or ministerial department specifically dedicated to drought.

Therefore, in order to move forward and overcome these gaps, it is recommended to:

- Improve the synergy, cooperation and coordination between the institutions involved in drought management and capitalize on the successful experiences of coordination like the fight against forest fires or the locus control
- Capitalize also on the former experience of the National Drought Observatory, its strengths and weaknesses
- Conduct effective drought impact and vulnerability assessment studies
- Write, on the basis of the Nebraska and MEDROPLAN guidelines, drought management plans (either regional or national) that would be ready to use in case of emerging drought and would clearly define each single step and action to undertake
- Develop Capacity building for the consolidation of education, training and diffusion of best practices in drought response, preparedness and mitigation.

III. Planning and Coordination Process and Involvement of National Stakeholders

Enhancing and improving institutional collaboration, cooperation and coordination represent the main challenges to drought management in Morocco. In this context, the UN-DESA project will assist the country in filling the identified gaps through the development and implementation of a drought management plan. This process will rely on both the University of Nebraska³ and MEDROPLAN drought management Guidelines⁴ that provide a thorough framework for the development of drought management plans and both emphasize the involvement of stakeholders through a participatory approach and the appointment of a drought management task force. During the first year of the project, the carried activities focused on the two first steps of the planning process, which are the stakeholders' identification and involvement and the identification of the drought task force.

i. Stakeholder Identification and Involvement

Stakeholder identification and analysis are critical first steps in any participatory planning approach. This is particularly true in the case of the drought planning process, where specific management issues need to be addressed and where stakeholder identification and analysis provide a basic understanding of the social and institutional context. In the context of the UN-DESA project and in the first steps to the implementation of a drought plan, the stakeholder identification processes in Morocco were based on:

³ Wilhite, Donald A., Michael J. Hayes, and Cody L. Knutson. "Drought Preparedness Planning: Building Institutional Capacity." Ed. Donald A. Wilhite. Boca Raton, FL: Taylor & Francis Group, 2005. 94-135.

⁴ Cancelliere, A., D. Gabina, A. Lopez-Francos, M. Moneo, and G. Rossi (eds). *Drought Management Guidelines*. European Commission, MEDA Water, and MEDROPLAN

- Consultations with the national coordinator
- Consultations and meetings with representatives of the Ministries of Agriculture (MAPM), Water (SEEE), Environment, the Royal Center for Remote Sensing (CRTS), the High Commissariat for Water, Forests and Fight against Desertification (HCEFLCD), the Ministry of Statistics (Haut-Commissariat au Plan, HCP), the National Directorate of Meteorology (DMN), Research and Education Institutions (INRA, IAV Hassan II)
- The outcomes and learning from previous drought projects: MEDROPLAN, SMAS, DEWFORA, XEROCHORE, AQUATRESS.
- The guidance of the operational component of the MEDROPLAN guidelines
- The personal experience of the national consultant

On these bases, the institutions and ministerial departments listed in Table 1 represent the main stakeholders that should be involved in the drought planning process.

Table 1. List of the Main Stakeholders to be Included in the Drought Planning Process

Institution / Organisation	Responsibility
I. Ministry of Agriculture and Maritime Fisheries (MAPM)	
Direction of Irrigation and Territorial Planning	Planning and realization of all projects related to irrigation and drainage
Financial Direction (FD)	Subvention and development of drought insurance
Direction des filières de Production (DDFP)	Implementation of drought relief programs
Direction of Strategy and Statistics (DSS)	Monitoring of the agricultural campaign
Regional Direction of Agriculture (DRA) (Agriculture/ livestock Pastures)	Agricultural and pastoral development of rain-fed areas
Regional offices for agricultural development (ORMVAs)	Assessment of agricultural development plans for irrigation perimeters, monitoring and management of the infrastructures.
Agency for agricultural development (ADA)	Implementation of the national strategy for agricultural development
ANDZOA	National Agency for the Development of Oasis and Argan trees
II. State Secretary in charge of Water and Environment (SEEE)	
<u>Department of Water:</u>	
Direction of research and water planning (DRPE)	policy formulation and implementation in planning, mobilizing, managing and protecting quality of water resources
River Basin Agencies (ABH)	Key actors in regional water management, Maintenance and management of the public hydraulic infrastructure

<u>Department of Environment</u>	Elaboration and implementation of the national strategy for the preservation of the environment and the sustainable development
National Direction of Meteorology (DMN)	Climate monitoring and forecasting
National Office for drinking water and Electricity (ONEE)	Planning of urban water supply in the Kingdom Assessment, implementation and management of drinking water abstractions throughout the country, Management of water supply and sewerage services in cities where this service cannot be provided by local authorities
III. Royal Center for Remote-Sensing (CRTS)	Use, promotion and development of remote-sensing
IV. High Commissariat for Water, Forests and Fight against desertification (HCEFLCD)	Natural environment, forestry, wetlands, fresh water bodies conservation Reforestation, preventing desertification,
V. Ministry of Economy and Finance	Drought programs budget
VI. Haut-Commissariat au Plan (HCP)	In charge of the production and monitoring of statistical, economic, demographic and social data and parameters
VII. Ministry of Interior/Direction of Rural Affairs	In charge of local collectivities
VIII. Research and Education: Institut Agronomique et Vétérinaire Hassan II (IAV Hassan II), Institut National de la Recherche Agronomique (INRA) Ecole nationale D'agriculture de Meknès	Universities and Research Centres
IX. United-Nations representatives FAO UNECA PNUD	Technical support and funding, involvement in several development projects
X. NGOs and Associations	
XI. Bank and Insurance Companies	
Mutuelle Agricole Marocaine d'Assurances (MAMDA)	Implementation of the multi-risk agricultural insurance
Crédit Agricole Maroc (CAM)	Leading bank company in charge of the development of the agricultural sector, supports the national strategy of agricultural development

ii. Drought Management Task Force

After the completion of the previous step that allowed to identify and confirm all the stakeholders involved in drought management in Morocco, the next essential step for the project implementation is the identification of a drought task force whose objectives and missions as a drought management body would be to be responsible of monitoring drought conditions and assessing drought risks, oversee inter-governmental coordination and disseminate information. According to the MEDROPLAN guidelines, the competencies and mode of operation, both during drought and non-drought periods of the drought task force should be clearly defined. It should also be interdisciplinary and composed of both policy and technical experts. Thus, on the basis of:

- The previous considerations;
- The former experience of the implementation of the national Drought Observatory with the support and the guidance of the US National Drought Mitigation Center (NDMC);
- The consultations with the national coordinator; and
- The outcomes of the consultative meeting held on July 16th with representatives of the main institutions and ministerial departments involved in drought management,

It was proposed that the drought task force for Morocco should be composed of representatives of the following institutions:

- The Ministry of Agriculture (MAPM)
- The State Secretary in charge of Water and Environment (SEEE)
- The National Directorate of Meteorology (DMN)
- The High Commissariat for Water, Forests and Fight Against Desertification (HCEFLCD)
- The Ministry of Interior
- The Royal Center for Remote Sensing (CRTS)
- The National Institute for Agronomic Research (INRA)
- Hassan II Institute for Agronomy and Veterinary Medicine (IAV Hassan II)

Participants of the July 16th meeting expressed their initial engagement and commitments to the project, but also underlined that the coordination process and the implementation of the Steering Committee should further be discussed.

During the meeting, the national coordinator of the project also underscored the fact that if the responsibility for the national coordination of the project falls under the Ministry of Agriculture, the coordination of the drought Steering Committee and its official implementation is a key element that should be discussed at the highest governmental level.

IV. Training of Trainers Workshop in Zaragoza

i. Preparation of the TOT Workshop

The National Capacity Development Training of Trainers (TOTs) Workshop and Field visits were organized by UN-DESA in partnership with Mediterranean Agronomic Institute of Zaragoza (IAMZ-CIHEAM) and United Nations Office to Support the International Decade for Action (IDfA): “Water for Life” 2005-2015, and held at the premises of IAMZ-CIHEAM in Zaragoza, Spain from May 6-9, 2014.

ii. Workshop Outcomes

The four-day workshop was organized around three main components:

- A two-day training session in the premises of the IAMZ
- A one-day field trip to the EBRO river basin authority, irrigation organizations and irrigators’ communities
- A visit to the Ministry of Agriculture in Madrid

In general, the achievements of the workshop can be summarized as follows:

- It raised the understanding of the participants in terms of the needs and strategies for national drought policies and preparedness plans that place emphasis on risk management instead of crisis management;
- The visit to the Ebro River Basin Authority, irrigation organizations and irrigator communities and the visit to the Ministry of Agriculture allowed participants to benefit and learn from the successful Spanish experiences in terms of integrated water resources management, drought planning and agricultural drought insurance. Regarding Moroccan participation, this was particularly fruitful regarding the current ongoing national experiences and strategies related to agricultural insurance and the development of river basin drought plans.
- The workshop enabled the participants from the 5 pilot countries to get to know each other, share experiences and promote national and regional networks of stakeholders working in various ministries including agriculture, environment and meteorology.
- The 5 pilot countries involved in this project presented the drought management practices and strategies currently implemented in their countries. Through these presentations, it appeared that the participant countries present various levels of achievements in the field of drought management. Thus, Morocco and Tunisia, in particular, realized important progresses in the implementation of drought monitoring and management structures; various programs and important financial means are also devoted to drought management. Other countries may therefore

capitalize on their experiences. The workshop also helped to identify some of the capacity and knowledge gaps in implementing proactive drought management strategies. Indeed, it appeared from the countries presentations that they all lack, at either national or regional levels, drought management plans that clearly present the step-by-step process that should be implemented in the case of an emerging drought and would minimize the risk of missing any part in the management process. They also lack very important components of successful drought management plans such as effective and comprehensive drought early warning systems, appropriate drought thresholds and need overall specific guidelines on how to develop such plans and enhance drought preparedness and planning.

V. National Workshop Outcomes and Recommendations

Two meetings and a large workshop were organized in the framework of UN-DESA project in Morocco during 2014:

- The first meeting took place on April 16th during the visit of the UN Project Coordinator to Morocco and represents the official launching of the project. It gathered representatives of all the institutions involved in drought management at national but also local levels and saw the participation of UN agencies' representatives in Morocco.
- The second meeting took place on July 16th. It was restricted to representatives of the main institutions and ministerial departments involved in drought management. It was the occasion for the national consultant to inform them about the outcomes of the TOT workshop held in Zaragoza from May 5-10, 2014. The objectives and tentative agenda of a forthcoming national workshop, to be organized in the fall, were also discussed during this second meeting.
- The large workshop took place over two days: the first day was devoted to presentations and discussions at the Farah Golden Tulip Hotel in Rabat (October 21st). The second day was reserved for field studies and tours (October 22nd).

The main objective of the last workshop, which was attended by 35 participants, was to bring together all national stakeholders to discuss the strengths and weaknesses of drought management in the country. 30 participants from local administrations, universities and research institutes, local representations of UN organizations, farmers associations, bank and insurance companies, were among audience and shared their opinion about the undertaken actions by the government.

Twelve lectures were presented by the main institutions and ministerial departments. They have been followed, during the afternoon, by an organization around three sessions (i) opening and project overview, (ii) Sectorial strategies: water and agriculture, and (iii) national and international experiences. Interactive discussion took place, testimonies from farmers and end users have been recorded.

National media coverage and a well-illustrated article were assured (El Maghareb Weekly Newspaper, October 10-20 edition)

During the field study, participants were taken to the region of Chouia-Ouardigha, located southeast of Casablanca and had the opportunity to get acquainted with “Al Himmer” dam, the “Berrechid” aquifer artificial recharge, the waste water treatment station of “Settat” and the Dry Land Farming center of the National Institute for Agronomic Research (INRA).

The workshop yielded valuable outcomes and recommendations focused on the necessity to:

- Strengthen communication and cooperation between all the institutions and stakeholders including the civil society;
- Assess the vulnerability to drought;
- Perform early warning systems;
- Develop a set of indicators for drought management;
- Combine all sectorial drought management plans and to establish a National one,
- Apply MEDROPLAN guidelines;
- Create a central platform coordinating all the institutions and gathering all the results;
- Enhance awareness and capacity building; and
- Learn from unsuccessful experiences (Ex. National drought Observatory) and successful ones (Ex. drought insurance).

B. Recommended Activities under UN-DESA Project during 2015

PREAMBLE:

It is important to underline that if, during the first year of the project, all the national institutions involved in the drought management process expressed their strong commitments to participate in the project, the composition of the drought task force were identified but not fully implemented with a clear mandate because these type of decision should be taken at a higher political level.

We would need more support at a higher political level to have a full engagement of other ministerial departments at their highest levels (besides the Ministry of Agriculture) and the effective implementation of the drought task force and the achievement of the subsequent activities recommended in the second year of the project.

The present document is therefore a study from a consultant presenting his own vision of how to develop a drought management plan and its components. The components were shared with colleagues and some persons from ministries staff but it still represents a scientific document.

However, it is our hope that the identified task force will continue to use the resources developed to support the initiative through an effective collaboration. The present document may facilitate that process.

In this second part of the report, we will highlight the main activities that should be implemented in the framework of the UN-DESA project in order to achieve its ultimate goal which is the development of a drought management plan. Before that, we will provide further momentum for the project's implementation in the country by linking it to the national strategies to achieve food and water security, which represent respectively the Sustainable Development Goals 2 and 6.

I. Providing Further Momentum to UN-DESA's Project Implementation in the Country: Links with National Strategies

In the context of global change (climate, energy, demography, etc.), particularly in a context of growing water scarcity and increasing drought severity and frequencies, ensuring food security represents without a doubt the biggest challenge we will face in the coming decades. Therefore, this huge challenge will require food and water security to go hand in hand and the relationship between natural resource management and food security has increasing importance in the international political agenda.

In the section we will therefore analyze how Moroccan national strategies and plans for achieving both food and water security, and in particular the Green Morocco Plan (GMP) and the new Water Plan are linked together and how they are and may be connected to our project.

i. Food Security and the Green Morocco Plan

In Morocco, the agricultural sector plays a major strategic, economic and social role. Indeed, on average, agriculture contributed to 18% of total GDP in the period extending from 1980 to 2010. Agriculture is also the main labor employer with nearly 50% of the Moroccan population living in rural areas. Most of them are small subsistence farmers whose production, mainly based on cereal production, relies almost entirely on rainfall. The national agricultural GDP is consequently highly dependent on the weather. As a result, and considering the importance of the agricultural sector, any shortage or excess rainfall has an immediate effect on the economy as a whole and threatens the livelihoods of those small farmers that are very vulnerable to climate risks.

In this context, the issue of food security has always represented a major concern in the development of national agricultural strategies, and will be more challenging in the near future with the increase of water scarcity and drought frequencies and intensities. In that sense, in the framework of the new national agricultural vision adopted in 2008 and named Green Morocco Plan (GMP), specific programs have been implemented to improve productivity and food security under climate change (and increasing drought frequencies and water scarcity). These are mainly:

- **The National Program for Irrigation Water Conservation (PNEI):** 77% of Morocco's irrigated lands still receive water through surface irrigation methods. This program aims at conserving irrigation water by switching from surface to drip

irrigation over a land area of approximately 550,000 hectares [1.36 million acres] by 2020.

- **The integration of climate change into the Green Morocco Plan:** The Green Morocco Plan has launched a variety of programs in order to adapt to climate change. The program aims at integrating climate change into the implementation of the plan (2011-2015) to improve overall adaptation to climate change in five regions of Morocco. The key technologies to be adopted on a wide scale include soil-protection measures, such as no-till farming, the use of authorized high-yield drought-resistant crops and crop rotation through the planting of leguminous or oilseed crops after each grain harvest.
- **The program to shift from grains to fruit trees:** the aim of this program is to plant 1.1 million hectares [2.7 million acres] of land unsuited for grain crops with fruit trees, particularly olive trees.
- **Agricultural insurance:** Multiple risk weather insurance was launched in 2011 to replace the 1996 program to insure against drought. It provides coverage for grains and legumes across the entire country in case of droughts, hailstorms, heavy frost, flooding, violent winds and sandstorms. MAMDA acts as the insurer, but the government subsidizes the premiums, with a decreasing premium rate as surface area increases.

These types of programs show that the country is deeply aware that lessening climate risk on already rare productive resources (water and land) should be at the heart of food security policies. As another example, before the launching of the new multi-risk insurance scheme mentioned in the previous point, Morocco has launched a strategic study on “*Risk Management and Setting Up of an Agricultural Insurance System in 2011 under the Green Morocco Plan*” which reached the conclusion that agricultural risk currently accounted for 26% of overall production and was 50% concentrated in cereals and 30% in fruit and vegetables. Thus, risk management was assessed as a key lever that could secure over 12 billion Dirhams.

ii. The New Water Plan

The New National Water Plan (NWP) is the fruit of a long process of consultation and coordination between the different ministerial departments and institutions members of the Superior Council for Water and Climate (CSEC). The final version of the plan was approved during the 6th meeting of the permanent Committee of the CSEC and will soon be adopted. The NWP is a concrete answer to the major constraints of the Moroccan water sector. This document assesses the current situation and presents the major orientations by the horizon 2030.

The Water Plan was elaborated in close cooperation with the agriculture department, which accounts for 80-90% of total water usage in Morocco. The plan aims to address an expected rise in the national water deficit from 3 billion to 5 billion cubic meters in 2030. Its cost, which represents almost twice the total public investment budgeted for 2014, will rely mostly

for financing on long-term concessions open to private operators and the investment will maintain Morocco's annual average for water availability at its current 700 cubic meters per capita as the population increases.

The main components of this plan are:

1. Water demand management and valuing of water resources
2. Management and development of water offer
3. Preservation and protection of water resources, natural habitats and fragile areas
4. Reduce vulnerability to natural water risk and adaptation to climate change, through
 - Improved protection against floods; and
 - Implementation of proactive plans to mitigate drought through the development of regional drought plans (at river basin scales) and the establishment of financial mechanisms to support these plans
5. Continuation of the legislative and institutional reforms
6. Upgrading information systems and capacity building and skills

In this sense, the Ministry of Water (DRPE) has recently commissioned an expert mission for the elaboration of a water resources management plan in the event of a water shortage. This study is actually ongoing and aims at drought characterization, identification and development of monitoring indices, the implementation of structural actions and the formulation of a drought plan, the identification of legal, institutional and financial mechanisms for drought management.

This study is divided in three missions:

Mission I: Assessment of the current situation of drought management in Morocco, international benchmarking

Mission II: Formulation of a drought management plan, reflections on the legal, institutional and financial mechanisms for drought management

Mission III: Application of the drought management plan to the Oum Er Rbia basin

During the first national workshop held last October, the representative of the Ministry of Water presented the current achievements of this study, with the achievements of the first and second missions being under completion.

iii. Links of the UN-DESA Project with These National Strategies

The two previous points demonstrated how the national strategies for achieving SDG 2 and SDG 6, as well as water security, are linked together and integrate climate change mitigation and adaptation among their main objectives. Indeed, the resilience and sustainability of agricultural systems and water resources inevitably and certainly demand efforts in research on varieties and technology, innovation and training, on water demand and offer management but not only. This also requires putting in place suitable policies and instruments for risk management and the enhancement of national capacities. In that sense, the drought management plan which represents the ultimate goal of the UN-DESA project is a key tool

that will also contribute to lessen climate risk, contribute to increase the country resilience to drought and support its strategies to achieve food and water security.

II. Continuing the Planning and Coordination Process

Although the constitution of an official task force and committee for drought planning needs a national engagement coming from high political ranks, the first year of the project made a great breakthrough by ensuring the identification of this task force members. This has been done thanks to a collaborative effort of the General Secretary of the Ministry of Agriculture and Maritime Fisheries, the UN project coordinator and the national consultant. The national workshop gathered representatives of all the national bodies designed as task force drivers.

The involved persons and the participants in the workshop stressed that establishing a National Drought Plan is a challenge that must be addressed using the appropriate methods and tools and starting from a state will and decision. Thus, in the present paper, we will use the term of task force in reference to the representatives who supported the work during 2014 and/or those who may support the coming work during 2015. It does not yet have an official national connotation.

The main achievements of the national UN-DESA project towards the initiation of the drought planning process are presented in the first section of the current report. In order to continue the initiated process and the coordination work, we suggest the following tasks, with the ultimate goal of the development of a drought management plan.

The objective of a drought management plan is to anticipate drought situations and to plan solutions to satisfy water demands, protect and enhance livelihoods of vulnerable people and protect also the environment. They are based on a deep knowledge of water resources and their capacity to be stressed under water scarcity situations, a catalogue of measures to reduce drought impacts for each drought condition and an adequate administrative framework for the implementation of measures, allowing for the coordination of the administrative units involved. In addition, a plan for public participation needs to be implemented to guarantee cooperation of all users involved and to disseminate important information.

The NDMC categorizes drought plans as mitigation plans or response plans. Drought mitigation refers to actions taken in advance of a drought that reduce potential drought-related impacts when the event occurs. Drought response planning addresses actions that should be taken in response to emerging and ongoing drought. Ideally, drought plans should incorporate both mitigation and response and in the Moroccan context, this is the type of plan (Drought Response and Mitigation plans, DRMP) that should be adopted since both types of actions and strategies already exist and are both essential.

The process for the development of Drought Response and Mitigation Plans (DRMPs) includes:

- Preparatory actions, such as an international benchmarking, the definition of the drought plan's purpose and objectives and the development of the organizational structures to support the drought definition and risk assessment activities;
- The DRMP drafting with the integration of science and policy aspects;
- The publication of the draft DRMP and stakeholder consultation processes;
- The DRMP implementation; and
- The development of public awareness programs and post-drought evaluation processes.

This section of the report will therefore describe the different steps that will be taken in order to draft a drought management plan and the different components of the plan.

i. International Benchmarking

Although a national drought management plan may not be transferable to another country, institutional analysis to identify possible alternatives that have worked elsewhere, might be useful. Thus, a state of the art study, including countries who have adopted the Nebraska Plan and/or the MEDROPLAN Guidelines and/or any other model, should be gathered, reviewed and analyzed. This state of the art study should focus on the benchmarking of similar regions and countries, but it will also be appropriate to examine the existing compendium of best practices in this domain as well as to highlight case studies and success stories from others' experiences. Finally, institutional analysis to identify possible alternatives that have worked elsewhere and that might be useful in Morocco will be investigated. The national strengths and weaknesses in this domain may therefore be better identified and the gap more precisely assessed.

ii. Defining the Plan Purposes and Objectives

The drought management plan needs to answer the following key questions:

- How will drought affect us?
- How will we recognize the next drought in its early stages?
- How can we protect ourselves from the next drought?

The overall purpose of the plan is therefore to reduce the impacts of drought by identifying the principal activities, groups, or regions most at risk and developing mitigation actions and programs that alter these vulnerabilities. Therefore, the objectives of the Drought Plan should be defined in the early stages, taking into account issues such as:

- Purpose and role of State government in drought mitigation and response efforts;
- Scope of the plan;
- Identification of the most drought-prone areas;
- Historical impacts of drought in the respective regions;

- Historical response to drought in the respective regions;
- Most vulnerable economic and social sectors;
- Role of the plan in resolving conflict between water users and other vulnerable groups during periods of water shortage;
- Current trends (e.g., land and water use, population growth) that may increase/decrease vulnerability and conflicts in the future;
- Resources (human and economic) that the state is willing to commit to the planning process;
- Legal and social implications of the plan; and
- Principal environmental concerns caused by drought.

At this stage, the objectives of the Drought Management Plan should be clearly defined so as to allow:

- Collecting and analyzing drought-related information in a timely and systematic manner;
- Establishing criteria for declaring drought emergencies and triggering various mitigation and response activities;
- Providing an organizational structure and delivery system that assures information;
- Flow between and within levels of government;
- Defining the duties and responsibilities of all agencies with respect to drought;
- Maintaining a current inventory of programs and plans already in place for assessing and responding to drought emergencies;
- Identifying drought-prone areas and vulnerable economic sectors, individuals, or environments;
- Identifying mitigation actions aiming to address vulnerabilities and reduce drought impacts;
- Identifying and providing mechanisms to ensure timely and accurate assessment of drought's impacts on agriculture, industry, municipalities, wildlife, tourism and recreation, health, and other areas;
- Providing information to the public on current conditions and response actions (e.g. Press, Media and the Internet);
- Establishing a strategy to overcome obstacles related to the equitable allocation of water during shortages and establishing requirements or providing incentives to encourage water conservation;
- Establishing a set of procedures for the continuous revision and impact evaluation of the Drought Management Plan.

iii. Constitution of the Drought Mitigation and Response Plan Committees (DMRPC)

The elaboration of a drought response and mitigation plan (DRMP) is the result of a complex process in which user participation should be encouraged and simulated. According to the

planning process described by Wilhite et al. (2005a)⁵ and in the NDMC's website⁶, the first steps needed after the identification of the drought task force is to establish Drought Mitigation and Response Plan Committees (DMRPC) to oversee the plan development. These DMRPCs should include members of the drought task force (Drought Management) body. Since the drought plan should have three primary components (previously listed), the three groups that need to be involved should be comprised of:

- Climatologists, hydrologists and other scientists and practitioners who monitor how much water is available now and in the foreseeable future → **Monitoring Committee**
- Natural resource managers and others who determine how lack of water is affecting various interests, such as agriculture, environment, rural areas, municipal supplies, etc. → **Risk, Vulnerability and Impact Assessment Committee**
- High-level decision makers, often elected and appointed officials, who have the authority to act on information they receive about water availability and drought's effects. → **Drought Task Force**

It is recommended that a committee be established to focus on the first two of these needs while the drought task force can in most instances carry out the mitigation and response function. Each group should undertake their own tasks and goals in preparation of the plan while ensuring communication and information flow among them and with the actors involved. It is also one of drought planning's biggest challenges to get these groups to communicate effectively with one another.



Figure 1. Drought Response and Planning Committees and Their Inter-Relations
Source: Wilhite et al., 2005

⁵ D.A. Wilhite, V. Botterill, and K. Monnik. 2005. National drought policy: lessons learned from Australia, South Africa, and the United States.

D.A. Wilhite (Ed.), Drought and Water Crises: Science, Technology, and Management Issues, CRC Press, Boca Raton, Florida (2005), pp. 137–172 (Chapter 6)

⁶ <http://drought.unl.edu/planning>

In addition, the most active ministries in drought issues are the Ministry of Agriculture and the Ministry of Water who may lead the national drought management plan. For the present project, the national coordinator being from the Ministry of Agriculture may take the lead in identifying stakeholders and inviting the constitution of the technical committees (Monitoring and Vulnerability assessments) to be formed for the coming year of the project. Indeed, successful integration of local and state planning efforts begins with stakeholder engagement.

Ideally, a Streaming Committee, including members from policy expertise, should be considered for a sustainable and comprehensive drought management plan. This, however, will require State engagement. Therefore, we will focus on the constitution of these technical committees.

The design of the technical committees should consider representatives from all the involved departments, which will be able to provide cross and multidisciplinary vision. Ideally, a permanent technical drought committee must be formed in order to define roles and responsibilities and to ensure who is supposed to do what and when. In the framework of this project, they will be involved in the establishment of the plan components through their participation in the national workshop and through a mailing correspondence and meetings when needed with the national coordinator and consultant.

It is also appropriate to consider, in this committee, the inclusion of key drought experts from universities and research institutions, as well as farmers and professional associations. In the case of Morocco, discussions oriented towards the constitution of a drought task force during the first year of the projects and in particular during the first national workshop emphasized the need to include the main institutions and ministerial departments involved in drought management:

- The Ministry of Agriculture (MAPM)
- The Ministry of Water and Environment (SEEE):
 - The Division of Water Resources and Planning (DRPE)
 - The National Direction of Meteorology (DMN)
 - The Department of Environment
- The Ministry of Interior
 - The High Commissariat for Water, Forests and Fight Against Desertification (HCEFLCD)
 - The High Commissariat for Planning (Statistics Ministry)
 - The Royal Center for Remote Sensing (CRTS)
 - Research and Education Institutes (INRA, IAV Hassan II, ENA, EHTP, ...)
 - The Civil society

Therefore, since most of these institutions (through different direction of services and at different levels) are involved in the monitoring, impact assessment and decision making

processes, it should be recommended to initially identify the constitution and suggested members of each committee. The integration of science in the planning process is very important and representatives of research institutions should be included in each committee.

A rough approach that still needs to be refined through discussions and consultations with stakeholders would suggest for instance to include in the:

- **Monitoring Committee:** the National Direction of Meteorology, the Division of Water Resources and Planning and the river basin agencies, the Department of Environment, the Direction of Crop Chain values, the Regional directions and ORMVAS at the Ministry of Agriculture, the Direction of the fight against desertification and nature protection at the High Commissariat for Water, Forests and Fight against desertification (HCEFLCD), the Royal Center for Remote Sensing (CRTS) and Research Institutions (IAV Hassan II, INRA, ENA....)
- **Risk and Impact Assessment Committee:** the financial direction and the Direction of strategy and statistics of the Ministry of Agriculture, the High Commissariat for Planning (HCP), Research Institutions (IAV Hassan II, INRA, ENA....), the Division of water resources and planning and the river basin agencies, the Department of Environment.

iv. Drafting the Drought Plan through a Participatory Approach

The national consultant, in full agreement with the national coordinator, will establish a proposition for the plan components according to the national context, but also to the international benchmarking outcomes. To tailor a suitable and sustainable plan, these suggestions should be duly discussed and shared with, and given serious consideration by the policy-makers. However, the coming work will ensure the integration of the task force and the designated committee opinions.

The design of components will capitalize on the outputs and achievements of 2014 work and follow as well as possible the Nebraska and/or MEDROPLAN steps. Moreover, the recent Moroccan policies, as the Green Morocco Plan (Section I.i) and the new Water Plan (Section I.ii) represent national strategies which have to be taken into consideration.

Each component will be subjected to discussion and agreement among the reached committee and task force members and a consensus has to be getting for each suggested component. To help advance the work, especially in-between meetings, this step should rely on electronic communications.

A first template of these components is proposed in section IV of the current report. Other key elements needed for the plan and developed in section III.iv should be integrated in the process of discussion and validation with the stakeholders. They are mainly the drought triggers which may give different schemes and orientations to the

plan. Indeed, indices and thresholds are important to detect the onset of drought, to monitor and measure drought events, and to quantify the hazard.

The project outcomes in that sense may be very important because there is still need to clarify drought triggers in Morocco; discussion with stakeholders may help to do so. Thus, at this step of work, the determined thresholds are crucial for continuing the work reflection, because drought management depends on indices to detect drought conditions, but also thresholds to activate the appropriate drought responses.

v. *National Workshop Organization and Potential Organization of a Regional Workshop*

This part of the project will focus on the preparation and the organization of a national workshop to present and discuss the plan. Indeed, the primary objective of this national workshop will be to expand communication among drought professionals, by engaging them in discussions around the suggested drought planning components and by considering their feed-back to review and readjust the plan. Thus, the plan components will be not only shared, but also improved.

The workshop attendees should be not only the committee and the traditional stakeholders, but also those that are experiencing drought considering farmers from the most vulnerable regions. The workshop should include 3 sessions: i) lectures and presentations, ii) working groups, and iii) discussion and recommendations. The working groups, in concordance with the 3 designed subcommittees, will document and review each one of the plan components: monitoring, vulnerability and mitigation strategies.

It will be also possible that Morocco hosts the regional workshop gathering the five involved countries in the UN-DESA project. It will represent a great opportunity of enhancing collaboration between countries, sharing their points of view and achievements on drought plan building. It will be also the occasion to bring together all relevant stakeholders, engage them in discussions of the issues that each country faces.

vi. *Finalizing the Drought Plan*

Developing strategies for implementing a drought management plan is a major concern among drought professionals. A national drought plan should establish a clear set of principles and components to govern the management of drought and its impacts.

However, for an effective and sustainable plan, the implemented strategies should include both the decision-makers' engagement and the scientific and technical issues. In this project, we will be able to suggest a scientific report which will mirror the point of view of several stakeholders and drought professionals. The knowledge and the experience will be included through a multidisciplinary working committee and workshop expected attendees.

The drafted plan will include all the detailed activities in the current document and will integrate the relevant recommendations and outcomes of the scheduled workshops. The selected plan components will be well developed and oriented through a realistic vision, possible to achieve. Moreover, Morocco has developed several sectorial strategies as drought adaptation and mitigation actions. These strategies need to be assembled in a drought management plan. The drafted plan will suggest different orientations and components according to the thresholds of drought. In addition, the drafted plan may present a basis work for decision-makers if they decide to set-up an official one.

vii. Proposed Work Plan

The following work plan is a tentative schedule for achieving the previously mentioned tasks and activities. It may be reviewed according to the project's orientations and timeline.

Implementation Plan for MOROCCO, 2015		2015								
		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9
Activities	Tasks									
Kick-off	Agreement and launching of the project									
Activity 1 : Project platform : Objectives definition, International benchmarking, committee constitution	Objectives									
	International benchmarking review									
	Constitution of the committee									
	Reporting: Deliverable 1					1				
Activity 2: Assessment and analysis of the monitoring component	data and information gathering and sharing									
	Reporting: Deliverable 2					2				
Activity 3 : Assessment and analysis of Vulnerability component	data and information gathering and sharing									
	Reporting: Deliverable 3						3			
Activity 4 : Assessment and analysis of Mitigation strategies component	data and information gathering and sharing									
	Reporting: Deliverable 4							4		
Activity 5 : National workshop organization	Stakeholders contact and feed-back from them									
	Preparation of workshop modalities									
	Regional workshop									
	Reporting: Deliverable 5									5
Activity 6 : Potential organization of the Regional Workshop	Stakeholders contact and feed-back from them									
	Preparation of workshop modalities									
	Regional workshop									
	Reporting: Deliverable 6									

III. Investigating Drought Monitoring, Risk, and Management Options in Morocco

The ultimate goal and final output of this second year of the project is a national drought management plan that should include the three following core elements:

- Drought Monitoring and Early Warning
- Vulnerability and Impacts Assessment
- Emergency Relief and Response

Morocco has a long history of drought management and has achieved much progress towards moving from crisis to risk management. Thus, each of the key institutions and ministerial departments involved in drought managements has developed an array of monitoring systems and mitigation and adaptation strategies that “are ready to use” and can already be incorporated in the plan through a process that can be assimilated to a “puzzle construction”, with most of the pieces already existing and a few still needing to be added.

Therefore, in the following section, we will investigate the drought monitoring, risk and managements options in Morocco taking into account the existing and what still needs to be set. They can also be analyzed with regards to the desired elements of the compendium in a national drought policy developed by Sivakumar et al. (2011)⁷. This compendium gathers the desirable elements in a national drought policy from which countries could adopt the most appropriated elements to their local circumstances and national priorities.

I. Drought Monitoring and Early Warning

According to Sivakumar et al. (2011), the first element to consider is the evaluation of the availability of comprehensive, integrated drought monitoring systems. Therefore, in Morocco, the following existing and functional systems fully described in the technical report on existing drought management capabilities in Morocco should be considered:

- The seasonal forecasting system of the National Direction of Meteorology (DMN)
- CGMS-Morocco: The Moroccan national system for crop monitoring and yield prediction developed by the DMN, INRA and the DSS of the Ministry of Agriculture.

In addition to these currently functioning systems, the experience of the SMAS project that implemented a drought early warning system for the Maghreb region is also a good example of integrated EWS (although it does not function anymore). The Royal Center for Remote Sensing (CRTS) is also currently implementing a GEF-funded project and in collaboration with the Ministry of Water a new EWS called LDAS-Maroc.

⁷ Sivakumar, Mannava V.K., Roger Pulwarty, Donald A. Wilhite, and Justin Ginnett (2011). Proposed Elements in the Compendium on National Drought Policy. pp. 128-135.

Regarding drought monitoring, the DRPE (Ministry of Water) has recently commissioned an expert mission for the elaboration of a water resources management plan in the event of a water shortage. This study is currently ongoing and aims at drought characterization, identification and development of monitoring indices, the implementation of structural actions, the formulation of a drought plan and the identification of legal, institutional and financial mechanisms for drought management. The preliminary results of this study presented during the first national workshop in October 2014 recommended, as advised by the WMO, the use of the SPI as a drought indicator and set 4 different alert thresholds according to the SPI values (normal, early warning, warning and emergency).

Several other drought monitoring indices such as rainfall indexes, vegetation indexes, agricultural and forest indicators, piezo metric levels, flows of rivers, reservoirs levels are available and presented in the technical report on existing drought management capabilities in Morocco. The main issue here is therefore to select a set of indices and indicators and define their corresponding alert thresholds.

As a second element of “the compendium of the desirable elements in a national drought policy”, Sivakumar et al. (2011) recall the importance of the assessment of the adequacy of meteorological and hydrological networks and data quality. Until very recently, The DMN was managing 43 synoptic weather stations, most of which are located at airports. A big effort was achieved towards the extension of the network and the DMN has now about 200 operational synoptic stations offering good coverage of the country and high quality data. 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. In addition, each river basin agency (9 in total) has developed its own hydrological network offering therefore an adequate hydrological status monitoring.

The third and fourth elements cited by Sivakumar et al. (2011) represent the main challenges since they deal with the current procedures for coordinating the collection and analysis of meteorological and hydrological data and for data sharing, which we know that they currently represent the main impediment to drought management in Morocco.

Finally, a key element to consider is to design appropriate (in time and content) data and information dissemination systems

II. Vulnerability and Impacts Assessment

Generally, making an effective transition from crisis to risk management is difficult because little is done to understand and address the vulnerability, risks and impacts associated with drought. Indeed, vulnerability refers to the characteristics of a group of actors in terms of their capacity to anticipate, cope with, resist and recover from the impacts of drought. The objective of the vulnerability assessment is therefore to identify the underlying causes of risks that stem from inadequate management structures and technologies, or from economic, environmental, and social factors and provide decision

makers and water resources managers with decision tools allowing for efficient mitigation actions, tailored to the needs and specificities of each drought-prone community.

In Morocco, data about the percentage of rainfed agriculture, cereal production and imports in dry years are usually used to characterize the drought vulnerability of the agricultural sector. However, vulnerability cannot be directly observed or quantified on its own. Rather, it is a relative term comprised of many dimensions. As a result, it is necessary to identify proxy variables or indicators that can be used to assess vulnerability.

Several previous attempts have been made to create a quantitative index of vulnerability. Yohe and Tol (2002)⁸ proposed a method for developing indicators for the social and economic coping capacity in the context of climate change. Later, a simple index to quantify adaptive capacity was used by Ionescu *et al.* (2007)⁹ including only GDP, literacy rate, and the labor participation rate of women. Examples of this type of index have been proposed by O'Brien *et al.* (2004)¹⁰, Moss *et al.* (2001)¹¹, and Vincent (2004)¹². Iglesias *et al.* (2007)¹³ developed an Adaptive Capacity index (AC index) with three major components that characterize the economic capacity, human and civic resources, and agricultural innovation.

A similar approach has been taken in the context of drought (Moneo, 2007)¹⁴ and aimed to develop a drought vulnerability index (DVI). The DVI was computed at African level (Naumann *et al.*, 2013)¹⁵ proving to be a robust indicator and able of representing the complex processes that lead to drought vulnerability across the African continent.

⁸ Yohe, G. W. and R. S. J. Tol (2002), 'Indicators for Social and Economic Coping Capacity—Moving Towards a Working Definition of Adaptive Capacity', *Global Environmental Change*, 12 (1), 25–40

⁹ Ionescu, C., Klein, R.J.T., Hinkel, J., Kumar, K.S.K. and Klein, R. (2007). Towards a formal framework of vulnerability to climate change. *Environmental Modeling and Assessment*

¹⁰ O'Brien, K., Leichenko, R., Kelkar, U., Venema, H., Aandahl, G., Tompkins, H., Javed, A., Bhadwal, S., Barg, S., Nygaard, L. and West, J.: 2004, 'Mapping vulnerability to multiple stressors: climate change and globalization in India', *Global Environmental Change* 14, 303-313.

¹¹ Moss, R.H., Brenkert, A.L. and Malone, E.L.: 2001, 'Vulnerability to Climate Change: A Quantitative Approach', Pacific Northwest National Laboratory, p. 88

¹² Vincent, K. (2004). "Creating an index of social vulnerability to climate change for Africa." Norwich, UK, Tyndall Centre for Climate Change Research.

Available at: http://www.tyndall.ac.uk/publications/working_papers/wp56.pdf

¹³ Iglesias, A., Garrote, L., Flores, F., & Moneo, M. (2007). Challenges to manage the risk of water scarcity and climate change in the Mediterranean. *Water Resources Management*, 21, 775-788

¹⁴ Moneo, M. (2007). Agricultural vulnerability of drought: A comparative study in Morocco and Spain. MSc Thesis, IAMZ-CIHEAM, Zaragoza.

¹⁵ Naumann, G., Barbosa, P., Garrote, L., Iglesias, A., and Vogt, J.: Exploring drought vulnerability in Africa: an indicator based analysis to inform early warning systems, *Hydrol. Earth Syst. Sci. Discuss.*, 10, 12217-12254, doi: 10.5194/hessd-10-12217-2013, 2013.

When analyzing drought management in Morocco, it appears that certain elements are fragmented. Drought vulnerability assessment and mapping in rain fed agricultural systems of the Oum er Rbia basin were achieved following the methodology described by Wilhelmi and Wilhite (2002)¹⁶ in the framework of the MEDROPLAN project.

Kusunose (2011)¹⁷ measured the vulnerability of Moroccan dry land farms using the ex-ante likelihood of poverty based on estimates of incomes fluctuations combined with assumptions on savings behavior and the identification of ex-post vulnerable households after a severe drought. A recent research conducted in the framework of the DEWFORA project used the approach and methodology developed by Iglesias *et al.* (2007) and Moneo (2007) to assess and map drought vulnerability in the Oum er Rbia basin (Imani *et al.*, 2014)¹⁸.

The vulnerability assessment should be both quantitative and qualitative. It should include a review of national and local drought hazards, an extensive literature review, and interviews with individuals knowledgeable about particular sectors or assets. It identifies risks and impacts as well as adaptive capacities to improve the management of future incidents. The assessment also includes an economic valuation of the impacts, estimating potential losses to each sector. This information can be used to compile an ongoing record of drought impacts in order to better define future drought vulnerability.

Regarding impact assessments, data about droughts socio-economic impacts are available but they should be approached in a more systematic way. The different steps of drought impact assessment and a checklist of historical, current, and potential drought impacts are available as a guide to government entities involved in this plan development process at the following address: (<http://drought.unl.edu/planning>).

Carrying these processes is fundamental to decide on the specific mitigation actions that can be taken to reduce short and long-term drought risks and further studies on these issues are strongly recommended for the implementation of the national drought plan and as a component of the drought planning process.

III. Response and Mitigation

Morocco has developed and implemented a large array of measures aiming to prepare for and respond to climatic risks. They include structural measures (dams, irrigation systems, land use strategies and others) as well as non-structural measures (drought damage insurance, solidarity funds, drought relief measures).

¹⁶ Wilhelmi, O. V. and D. A. Wilhite (2002). "Assessing vulnerability to agricultural drought: A Nebraska case study." *Natural Hazards* 25 (1): 37-58.

¹⁷ Kusunose Y. 2011. Measuring Ex Ante and Ex Post Drought Vulnerability of Moroccan Dryland Farms. <http://gaton.uky.edu/faculty/minier/kusunose.pdf>

¹⁸ Imani Y., O. Lahlou, S. B. Alaoui, G. Naumann, P. Barbosa, and J. Vogt (2014). Drought vulnerability assessment and mapping in Morocco. *Geophysical Research Abstracts* Vol. 16, EGU2014-276, 2014. EGU General Assembly 2014

They can be summarized as follows:

- Protecting upstream water resources
- Water resources mobilization
- The expansion of irrigated areas
- The improvement of irrigation water efficiency
- The improvement of crop yields through the development of agricultural inputs (grains and approved fertilizers)
- The development of dry-land farming techniques
- The development of non-conventional water sources
- The adaptation to climate change through the use of water conservation technologies
- The development of a multi-risk agricultural insurance scheme

Most of these measures are parts of sectorial strategies (water, agriculture, environment...) that still need to be assembled together in a national drought management plan. In addition, options for drought management need to be completed by mitigation actions that can reduce drought vulnerability at the short term and enhance drought preparedness.

Knutson et al. (1998)¹⁹ proposed a tentative list of actions and management options to reduce drought risk and a three-step process for selecting the most appropriate mitigation measures:

- Analysis of the underlying causes of vulnerability to drought;
- Identification of the necessary actions for reducing drought risk; and
- Selection of actions using the following criteria: feasibility, effectiveness, cost, and equity.

Response and recovery actions and strategies should also be taken into account as a part of the drought management plan.

IV. Development/Adoption of Appropriate Drought Thresholds and Triggers

After researching impacts, monitoring and management options, it is essential to define appropriate triggers to phase in response actions according to the severity level of drought. Drought decision points, or triggers, are the threshold values of an indicator that distinguish a level of drought and potentially determine when management actions and/or government intervention should begin and end. Ideally, they should specify the value, time period, spatial scale, drought level, and whether conditions are progressing or receding (Sims et al. 2009)²⁰.

¹⁹ Knutson C., Hayes M., Phillips T., 1998, How to reduce drought risk, Preparedness and Mitigation. Working Group, Western Drought Coordination Council.

²⁰ Sims, J., Walcott, J., Gray, J., Krijnen, T., Laughlin, G., Miller, M., Nicholson, M. and Platzen, D. 2009. Alternative Methodologies for Assessing Drought Decision Points, Bureau of Rural Sciences,.

To be effective, the triggers should ideally meet a number of criteria, although there may be trade-offs between them:

- Be applicable at appropriate levels, cost-efficient and easy to administer
- Be credible, the measures are scientifically and technically adequate, satisfy valid sampling, statistical and consistency methodologies, have historical data available for identifying trends and have accessible and accurate data
- Be simple. Ensure that stakeholders' values are unbiased, fair and relatively simple for public understanding of outputs

For instance, the US National Drought Policy has an entry threshold of fifth percentile rainfall (that is, rainfall in the lowest 5% of the historic record), combined with a scientific and economic assessment of the production conditions within the region. Then, an important and sometimes neglected aspect of the drought declaration framework is to specify when the declaration should finish. In principle, decision points should specify thresholds for both entering and exiting drought declarations, which may be quite different. Exit decision points should be designed to accommodate the desired management outcome. The current EC guidelines use an exit threshold based on whether or not producers have begun to carry out typical farm practices.

In the case of Spanish river basin drought management plans, measures are grouped according to different severity levels (i.e., pre-alert, alert, and emergency). The severity levels are determined by established thresholds of indicators that trigger groups of measures in response to the objective of each level (Table 1). In the emergency level, the main priority is to satisfy drinking water demands and all structural and non-structural measures of high economic, social, or environmental cost are designed and taken in order to minimize water restrictions for urban demand.

In China, when a drought is expected to occur or strengthen, early warning should be issued with a rank estimated according to the severity and trend of the drought. There are three warning ranks for the meteorological drought. The drought warning usually consists of the rank, the start time, domain likely to be impacted, caution notes, and prevention and mitigation measure to be taken. Detailed measures and working regulations are worked out by the relevant government departments in line with the specialized plans and their respective responsibilities.

These key elements of any drought management planning process still need further development in the Moroccan case, through discussions with the main stakeholders involved in drought monitoring. It should also be one of the main tasks of the Monitoring Committee. In addition, since defining drought levels require exhaustive data, this is a very challenging process and we recommend therefore to be as simple as possible in choosing the adequate drought indicators and their respective thresholds for the drought phasing.

IV. Drafting the Drought Plan

As previously mentioned, the core of the DRMP should include three major points: monitoring, vulnerability, and mitigation and response. The content of each of these sections has been discussed in the previous point of the report. They should be reported in detail and presented to the DRMPC committees for discussion and validation. Then, they can be integrated in the whole document. In Box 1, we present in Box a template of the table of contents for the drought plan:

I. Introduction: Understanding the National Drought Context

- 1.1 Historical droughts and climate change
- 1.2 Drought management history and gaps
- 1.3 Objective and purpose of the drought management plan

II. Drought Planning Process Overview

- 2.1 Description of the plan preparation process
- 2.2 Constitution of the Drought task force and the Drought management plan Committees
- 2.3 Stakeholder's involvement

III. Drought Risk

- 3.1 Characterization of the drought hazard
- 3.2 Drought vulnerability assessment
- 3.3 drought impacts assessments

IV. Pre-Drought Actions: Longer-term actions, implemented before a drought, for the purposes of preparedness, monitoring and mitigation

- 4.1 Drought monitoring
 - 4.1.1 Drought indices and indicators
 - 4.1.2 Drought early warning
 - 4.1.3 Drought triggers
- 4.2 Drought forecasts
 - 4.2.1 Medium range forecasts
 - 4.2.2 Seasonal range forecasts
- 4.3 Sectorial actions
 - 4.3.1 Agricultural sector
 - 4.3.2 Water sector
 - 4.3.3 Environment
 - 4.3.4 Other sectors

V. Drought Response: Short-term actions, implemented during a drought, according to the level of drought severity:

- 5.1 Agricultural sector
- 5.2 Water sector
- 5.3 Environment
- 5.4 Other sectors

VI. Communication and Education

VII. Plan Revision Process

V. Recommendations for the National Drought Management Policy in Building Public Awareness and Consensus

Another key component of the plan that should be highlighted and developed here is how to publicize the plan and build public awareness.

The drought plan should be publicized and presented to the stakeholders and to the public in a way that gives maximum visibility to the program and credit to the agencies and organizations that have a leadership or supporting role in its operation. For purposes of gaining publicity and attention, it may be a good idea to announce and implement the plan just before the most drought-sensitive season. In an agricultural setting, this would be in advance of planting or at some other critical time during the growing season. Where municipal water supplies are the primary concern, the peak water use season would be the best time for an announcement.

All or a portion of the system should be tested under simulated drought conditions before it is implemented. In addition, the best plans can be undermined if there is a lack of experience in implementing them. One way to gain experience prior is to use simulation exercises that can help ensure smoother implementation of drought measures when the time comes.

In a case of emerging or installed drought situation, it is necessary to develop a special communication plan that will ensure that the right messages reach key stakeholders, end-users, the civil society and the media as quickly and as effectively as possible. The key objectives of the communications plan should therefore be to:

- Publicize the drought situation, explain why it has happened and provide regular updates;
- Ensure local communities and end-users receive clear messages regarding water efficiency;
- Engage key stakeholders in the management of the drought;
- Teach civil society about drought; and
- Heighten public awareness of drought, water conservation, and the ways in which individual citizens and industry can help to mitigate impacts in the short run.

Hands-on training and technical assistance programs can help stakeholders formulate and implement plans that incorporate drought planning and mitigation processes. Such programs can help farmers decide whether to include drought-resistant crops, on-farm wells, crop insurance, conservation systems, and other important factors into farming practices and drought management strategies. These measures can also help farmers implement water management practices and gain a better understanding of the soils and climate conditions in their areas and the types of crops and plants suitable to mitigating adverse changing conditions.

Government agencies and stakeholders may need training and technical assistance in gathering drought related information and preparing public education and involvement campaigns to develop appropriate solutions. Researchers in university drought-related programs are potential sources for training assistance.

Partnerships with private entities and NGO's can also support and augment government outreach activities and may help to access different target audiences.

The cooperation of the media is also essential to publicizing the plan. They must be informed fully of the rationale for the plan as well as its purpose, objectives, assessment and response procedures, and organizational framework. A wide range of media tools can be used to deliver key messages to specific stakeholders and also to the civil society. This may include media and press briefings and radio advertising. Regarding the social society awareness, full use can be made of the internet to post information on a dedicated drought page and email bulletins will also be issued on a regular basis. Social networking sites could also be used.

A key element of successful drought preparedness is public education. Educational programs such as workshops, newsletters, public service announcements, press releases, community meetings, and interactive participatory decision-making processes can increase awareness of the value of preparing and planning for droughts. A more informed public will be more likely to be active participants in developing successful strategies to prepare for and respond to droughts.

Other actions may include the development of:

- An ongoing public awareness program that provides the public with basic information on the source of their water, the importance of using water efficiently and how to conserve water in the home;
- School programs to promote drought and water conservation awareness and develop educational exercises; and
- Drought-related short movies that educate the public about the “science” of drought development, drought impacts and the importance of drought preparedness.