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

DEWFORA

A 7th Framework Programme Collaborative Research Project

Concept report describing the outline of a framework for drought warning and mitigation in Africa

WP5 – D5.1

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SUMMARY

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1. INTRODUCTION

The final aim of DEWFORA is to develop a framework for improving drought early warning, with more effective drought mitigation measures that addresses strengthening preparedness, increasing resilience, and enhancing adaptation to drought in Africa.

In WP5 drought risk and vulnerability (WP3) and forecasting (WP4) are combined and extended into a warning system based on appropriate and predictable indicators, related warning thresholds, and typical responses within the existing socio-political context in Africa. WP5 leads to the primary deliverable of DEWFORA: A framework to support drought early warning in Africa, responding to the technical and organisational structure of science and society. This framework is meant to support existing drought monitoring and warning institutions and agencies in the operation of DEWS.

D5.1 is a concept report describing the outline of a framework for drought warning and mitigation in Africa. This will be followed by D5.2 that will provide and organizational chart with required institutional responsibilities, and communication lines for drought responses from national to local levels, derived from case study experiences.

Early warning to drought conditions is a key element for reducing drought damage to society (UN ISDR 2004; Iglesias et al., 2009, Wilhite, 2005). Early warning relies on two main aspects that have to be linked: developing prediction tools of drought hazard and vulnerability that support a risk assessment and supporting timely implementation of drought mitigation measures. In DEWFORA we consider the well established concept of the monitoring, forecasting, warning and response. This Deliverable focuses on warming.

Iglesias et al. (2007, 2009) defined drought management guidelines to support drought management plans linking drought characterisation to risk management and operational actions in the context of each institutional setting. Here we extend this concept to support early warning systems for Africa. Through provision of early warning at sufficient lead time, drought mitigation planning can be implemented at an earlier stage. These plans can then be developed and implemented in a more proactive and effective manner, and at best the actual emergency situation due to a persistent drought can be avoided (see **¡Error! No se encuentra el origen de la referencia.**). On return to normal conditions post drought recovery plans can be implemented to facilitate return to normal conditions as soon as possible. Drought preparedness and education will facilitate such rapid recovery, and is an important aspect of the response link in the chain. DEWFORA will address drought

preparedness and education to drought, and propose approaches through which these can be enhanced. .

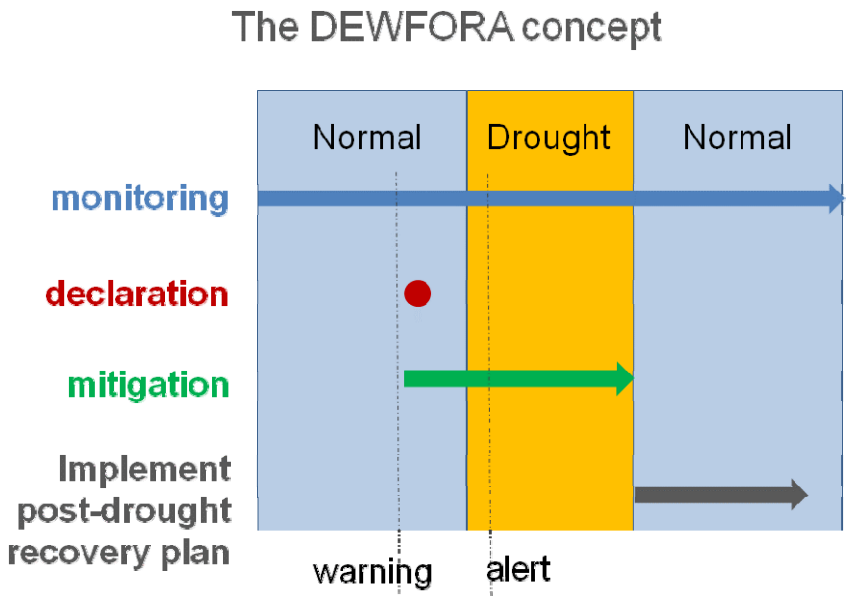

Figure 1 Sequential steps for implementing operational drought management actions combined with the provision of drought forecasting and warning

2. AN EVIDENCE-BASED FRAMEWORK FOR DROUGHT EARLY WARNING SYSTEMS

Early warning systems can make a substantial contribution to overall drought damage reduction objectives by enabling institutions and vulnerable groups to take timely action to mitigate loss and damage in advance of an impending hazard event. Existing early warning capabilities, however, are often limited due to limitations in the science and institutional and social aspects that enable the application of the science.

To define an evidence-based approach to policy development (Figure 2), the early warning system ideally should include four major phases, which are:

- What is the science available?, evaluating the detection of the signs of impending drought.
- What are the societal capacities?, evaluating the institutional framework that enables policy development.
- How ca science be translated into policy?, linking science indicators into definition of risk levels and analysing the signs of drought in an integrated vulnerability approach.
- How can society benefit from the forecast?, evaluating the provision of information to potentially affected groups.

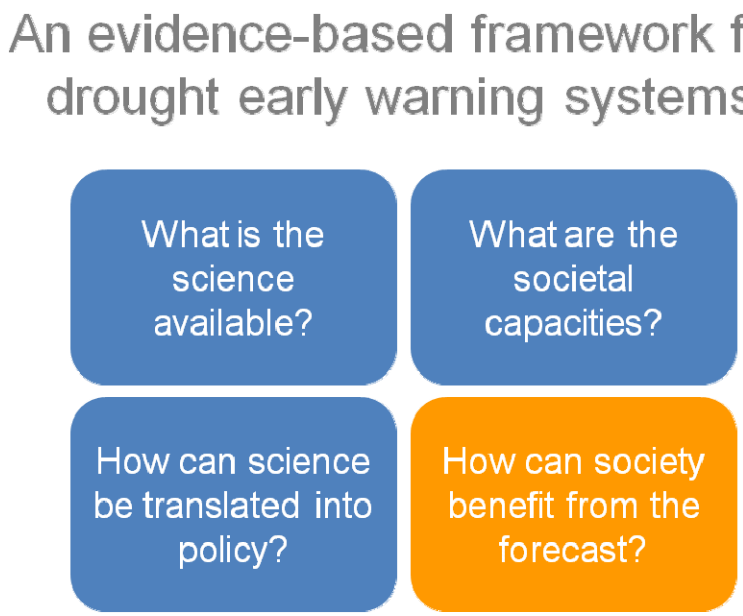

Figure 2 An evidence-based framework for policy development in drought early warning systems

3. WHAT IS THE SCIENCE AVAILABLE?

This phase evaluates the evaluating the detection of the signs of impending drought. The objective is to quantify the probability of damage in each drought situation and validate the results with the observed impacts.

In D3.1 and D3.2 and D4.x we have responded to the following questions:

- What are the useful drought indicators for monitoring and for forecast?
- What can we learn by analysing vulnerability?

It is important to recognise that indicators are sector/system specific, indicators should be calibrated with observed impacts, risk level, and vulnerability reducing targets; therefore multiple indicators are needed.

3.1 DETECTION OF THE SIGNS OF DROUGHT

The main problem for developing effective early warning systems is the lack of means to predict climate conditions with sufficient skill and lead- time. Nevertheless, there has been remarkable progress in the science of climate and climate prediction in the last few decades that permits to mainstream the climate variable into the development planning. This requires an understanding of how climate variability impacts on society in a country, region, or community.

Atmospheric scientists can now predict some of the medium-term features of our climate with a reasonable level of skill. This provides specific opportunities for incorporation of forecast information into water management strategies. While the forecast in many regions of Africa n is not expected to achieve a high level of seasonal forecast skill in the foreseeable future (see D4.x), research does suggest that sea-surface temperature forcing does yield some forecast skill for part of the rainy season, especially in the southern region where the latter part of the rainy season is correlated with the El Nino / Southern Oscillation.

3.2 PRESENTING THE RESULTS OF CLIMATE MONITORING AND FORECAST

The scientific knowledge to forecast potential drought impacts from atmospheric and hydrological conditions needs to be considered into future drought management plans, based on monitoring and prediction. The information should be presented to stakeholders as an "integrated monitoring" product and request their evaluation as an element of adaptation strategies. For example, an ideal integrated monitoring product for agriculture should incorporate the information about climate, soil, water supply, and potential agricultural yields. Ideally, information should be in the public domain, sufficient to gauge the level of risk and make informed decisions about the future.

An effective way of presenting the drought early warning is by maps, which show the variations in probability of drought events of a given level of severity (e.g., the probability of a 50 per cent reduction in annual rainfall).

The monitoring of rainfall, water levels in rivers and aquifers and the depth of snow (in areas where snowmelt is an important source of water) can give warning of imminent or developing droughts.

3.3 MONITORING CAPACITIES AND DROUGHT MITIGATION PRACTICES IN AFRICA

The results of WP2 show that many countries have functioning rainfall monitoring systems, though in some areas these may have become less effective as a result of lack of investment or conflict causing the breakdown of recording and reporting systems. The capabilities of the DEWFORA regions for analysing existing climate monitoring and prediction capabilities, and possibilities for incorporating the forecast and monitored information into drought management plans will be evaluated in D5.2.

4. WHAT ARE THE SOCIETAL CAPACITIES?

This component evaluates the institutional framework that enables policy development. To this end, it is necessary to have information about the major strengths and challenges (impediments and weaknesses) that stand against drought preparedness and the capacity to develop and carry out DEWS. Following the analysis, tentative recommendations as to what specific institutional or organisational changes would be needed to improve the current preparedness plans can be made. In some cases, specific identified changes may take place within the current political and administrative context in each country.

NOTE: Some of the information referred to in this section may be already planned or collected in WP2 and WP6.

Here we propose a method for evaluating institutional capacity that includes mapping the organizations and institutions relevant ro drought early warning systems (defined in WP2) and evaluating the process of DEWS development according to a mental model provided in here (Figure 3). The model includes the analysis data and information systems, legal framework, linkages among relevant institutions, organizations and stakeholders and summary of the proactive and reactive plans and actions. The model structure needs to be validated with participation of the stakeholders. The final output will be a discussion of the challenges and opportunities for improving current drought management plans.

The conclusions of the societal analysis should be concise and specific about the institutions' or organisations' performance (both based on past episodes and future contingencies) in relation to mitigation of drought impacts and anticipatory measures.

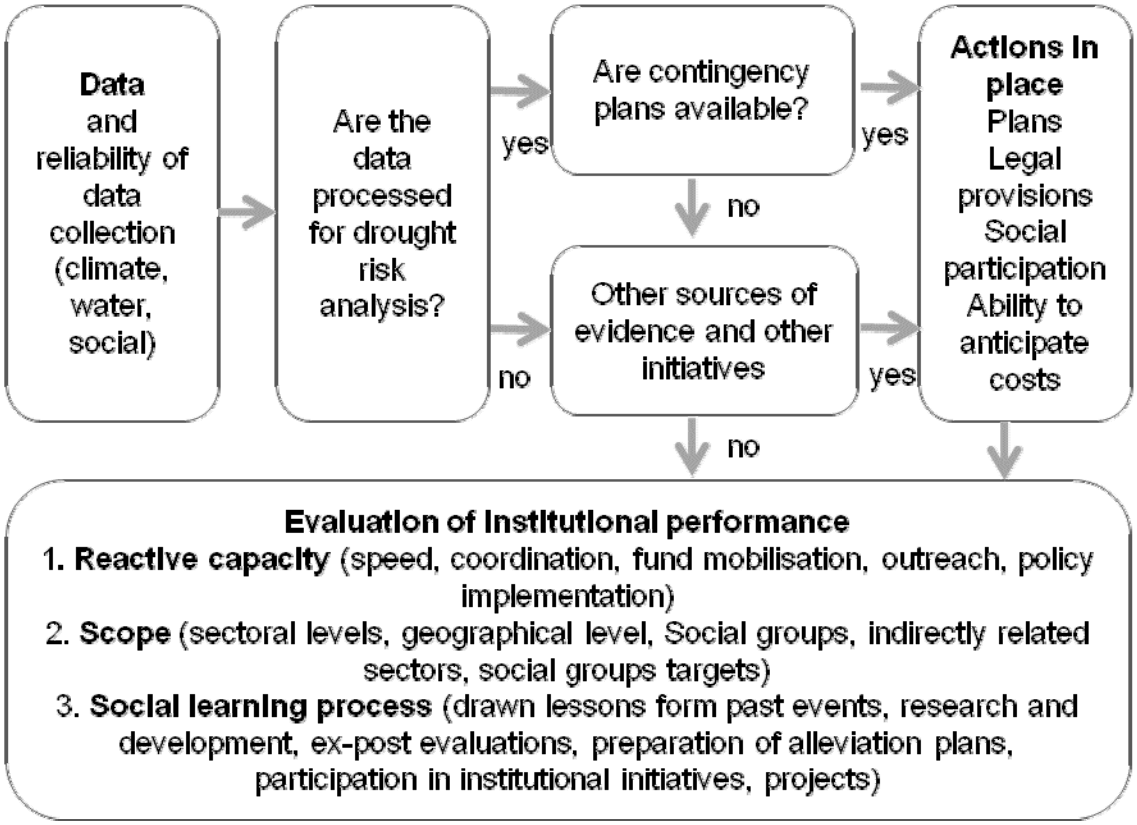

Figure 3 Overview of the institutional framework within which DEWS may be developed

Although the objectives of DEWFORA are not directly focused on the institutional Analysis per se, it is important to understand the concept, to identify them and map them to ensure the relevance of subsequent drought management analysis. The analysis aims to provide insights to the following key questions:

- Are the set of organisations and institutions that interact within a formal or an informal network?
- Are there networks to provide communication and hierarchical flows of command?
- Are the stakeholders included into the network?
- What is the degree of influence and dependence of the stakeholders' decisions on the institutions' core themes?

The Institutional Framework are all organizations and institutions related with the management of water resources. The institutions are classified into policy-level institutions, executive-level institutions, user-level institutions and the NGO's institutions, at national, regional, district and local levels.

A correct definition of the roles of the different levels of government in planning and co-ordination is a primary need in the preparedness and management processes. This component of the mental model includes a topology-type graph and a written description.

The organizations and institutions to be included are those within the formal framework of the political and government structures in each country (i.e., Ministries, General Directorates, Commissions, etc.) and the Official Institutes and Offices with relevant roles in drought preparedness and management, including water management organisations (e.g. municipal supply agencies, irrigation district consortia), institutions responsible of disaster's defence and ad-hoc drought emergency Committees or Offices. The analysis includes: a topology-type map and a description.

We propose that the institutional and organisational analysis also includes information on data collection, accessibility and reporting. Table 1 may be a guideline for the collection of information. .

Table 1 Types and characteristics of the institutional data relevant to drought early warning systems

Type of information	Description and variables to be included in the analysis
Data Types	Biophysical data: climate, soils, water, land, agriculture Socio-economic data: water and land uses supplies and demands, economic indicators (i.e., GDP), demographic indicators.
Data Suppliers	List the organisations and institutions that have the responsibility of data collection and processing, and describe the strategic mandates or policies that dictate the data collection policies.
Data Acquisition	Description of the instrumental base for data collection, processing, and recording. For example for climatic data, the information should include the number of weather stations, variables collected, length of the data series, etc.
Data Accessibility	Description of the accessibility conditions of data: costs, regularity, format. Documentation of the metadata, location, and publications.
Data Reporting	Mention the mandatory dependencies that exist with regards to data reporting among official organisations, stakeholders and NGOs.
Data Users	List the organisations and institutions that receive data on a regular basis

Finally, here we propose an evaluation of the institutions strengths and weaknesses for implementing or developing drought preparedness and management plans. The analysis may consider all aspects of the model; Table 2 may be a guideline for the major issues to be evaluated.

Table 2 Summary of the major issues to be evaluated in the analysis of the model structure

Topic	Relevant issues
Data and Information	Representation (spatial and temporal) Adequacy for risk analysis Appropriate for historical analysis Accuracy Handling Accessibility Legal data: Water right-holders records Updated registries Socio-economic data: Water users Sectorial distribution Demographics Other
Institutional Organization	Organisational set-up Legal set-up Personnel capacity and training Coordination among institutions Information flows and utilisation Units in charge of drought preparedness actions Bodies in charge of developing proactive and reactive management plans NGOs and stakeholders participation
Institutional Performance	Based on the most recent drought episode Based on the present state of approved contingency plans Based on the strategies developed as a response to recent drought episodes Based on the capacity to conduct risk analysis Based on the capacity to pool risks and ensure compensation mechanisms at the lowest cost
Conflict Resolution	Levels at which conflicts are faced and solved Means to solve conflicting issues Stakeholders and users participation Groups left unattended or disenfranchised

4.1 IMPROVING THE INSTITUTIONAL AND ORGANISATIONAL FRAMEWORK

In order to develop national and local capabilities for early warning systems, it is recommended that the institutions, national agencies and social organisations to incorporate an strategy that includes the following components:

- A vulnerability information system, which can enable drought management authorities to generate vulnerability scenarios. These should indicate the potential impact of an impending drought event on specific vulnerable groups and sectors of the society.

- A preparedness system, in which drought preparedness strategies are developed that indicate actions required to reduce the loss and damage expected from an impending drought event.
- A communication system, which allows the communication of timely information on impending drought events, potential risk scenarios and preparedness strategies to vulnerable groups, so that they may take appropriate measures.

5. HOW CAN SCIENCE BE TRANSLATED INTO POLICY?

A science-based approach for preparedness and early warning is the key for later operational management and determines the success of the overall DEWS. The following aspects need to be considered:

1. Definition of the actions to reduce social vulnerability (permanent measures).
2. Identification of the alert mechanisms based on thresholds of indicators that allow raking of risk levels in agriculture, ecosystems and water supply systems

We propose a science-based approach to identify alert mechanisms. For example, when probability of drought damage exceeds a minimum threshold, mitigation actions are taken and implemented (Figure 4)

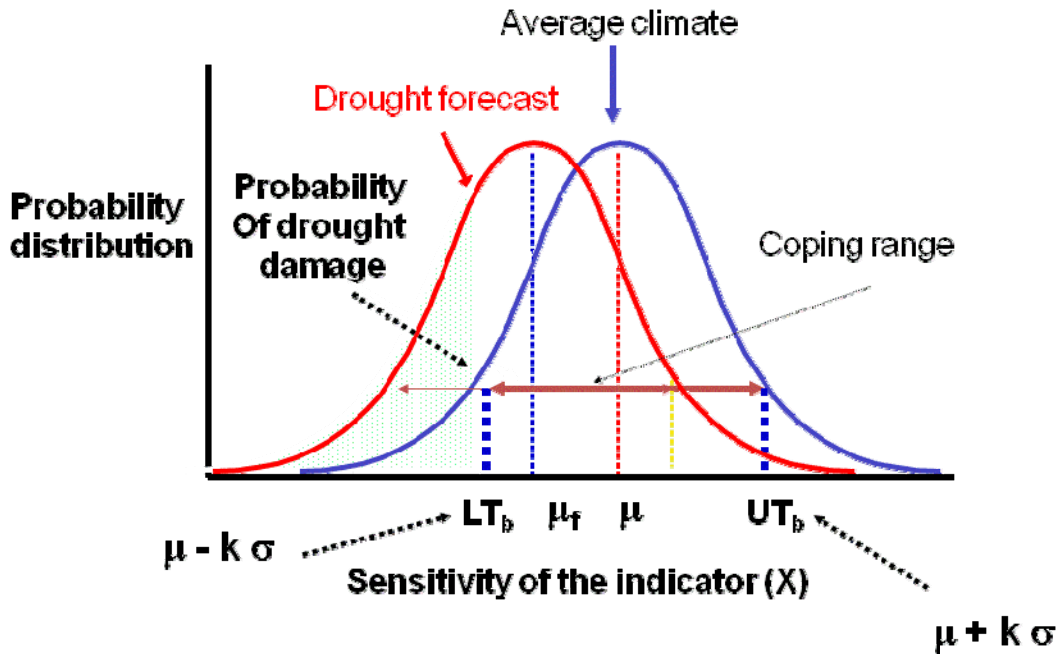

Figure 4 Example for definitions of thresholds to trigger drought alert

Communicating probabilities is a difficult task. From the academic point of view, the probability distribution functions (see example in Figure 5). Nevertheless, this is not effective for communication with some stakeholders groups and the work in WP2 and WP6 need to provide insights on how to communicate probabilities in the various levels of stakeholders involved in DEWS.

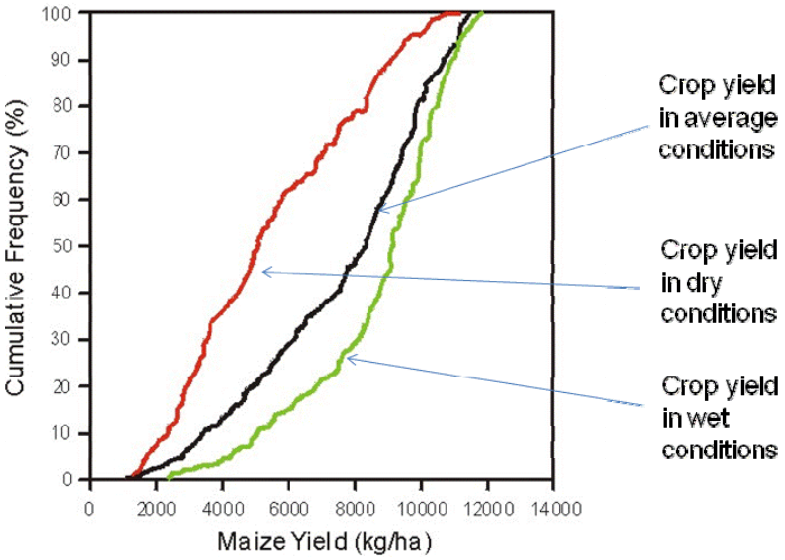

Figure 5 Example of probability distribution functions of crop damage during drought

The challenge is to ensure that complex models are transparent and provide insight to users. This will have to be analysed in the case studies.

6. HOW CAN SOCIETY BENEFIT FROM THE FORECAST?

The provision of information to potentially affected groups is the final step for effective DEWS; this includes the following aspects:

1. Define the actions to be taken upon drought, establishing priorities during water scarcity situations.
2. Evaluate the process to implement the actions, the political process, and the links between drought, water and development policies.
3. Define of the process to ensure communication.
4. Review process

6.1 PRIORITISING POTENTIAL ACTIONS

Potential actions have two components (Figure 6): (1) drought prevention, which concerns those measures aimed at preventing drought causing damage; and (2) drought preparedness, which concerns those measures which enable societies to respond rapidly to drought.

Drought mitigation actions may range from increasing the security of water supplies through water storage schemes (such as dams or micro-level water harvesting schemes), increasing the proportion of food production which is irrigated, increasing the efficiency with which available water sources are utilised, introducing or ensuring the retention of crop varieties which are drought-resistant, encouraging the greater use of adaptive strategies by farmers, to diversifying the sources of employment and income in an area into activities which are less vulnerable to the effects of drought.

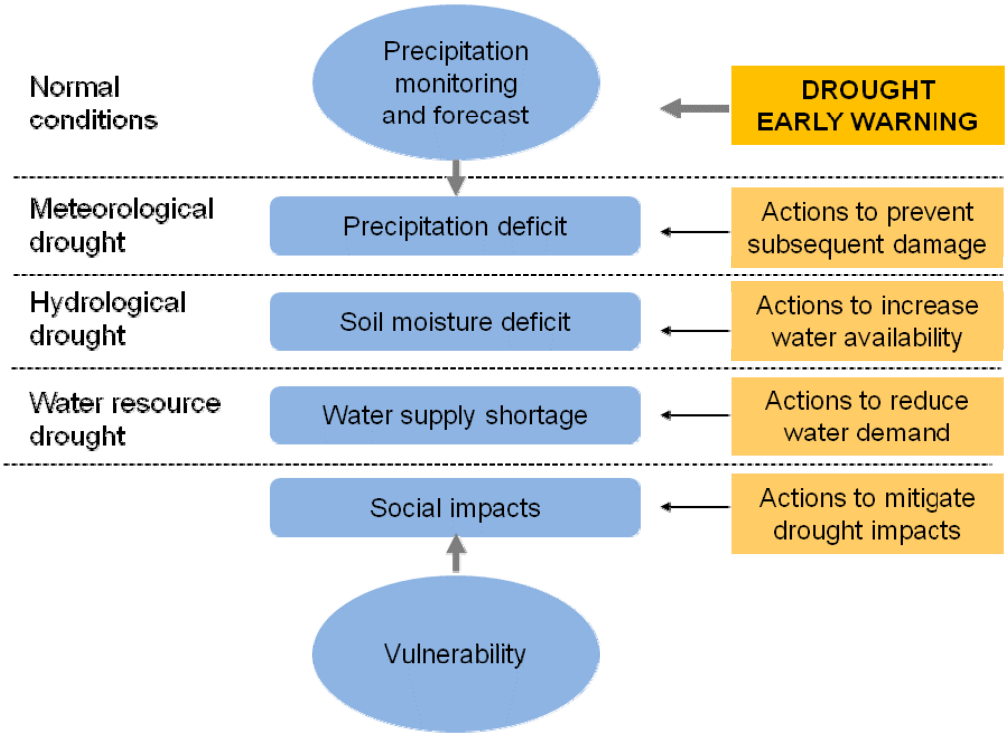

Figure 6 potential actions that may be included in a DEWS

Priorities may be established based in on such concerns as feasibility, effectiveness, cost, and equity. In choosing the appropriate actions, it might be helpful to ask some of the following questions:

- What are the cost/benefit ratios for the actions identified?
- Which actions does the general public deem feasible and appropriate?
- Which actions are sensitive to the local environment (i.e., sustainable practices)?
- Are your actions addressing the right combination of causes to adequately reduce the relevant impact?
- Are your actions addressing short-term and long-term solutions?
- Which actions would fairly represent the needs of affected individuals and groups?

6.2 PROCESS TO IMPLEMENT THE ACTIONS

The following aspects may be considered:

- Assess the availability of skilled human resources needed for drought preparedness planning
- Educate policy makers and the public on the need for improved drought preparedness as an integral part of water resources management
- Support creation of regional drought preparedness networks to enhance regional capacity in sharing lessons learned
- Enhance regional and international collaboration
- Recognize the role of WMO, ISDR, NMHSs, and regional/national institutions in drought early warning and preparedness

6.3 COMMUNICATION

Effective communication and public participation will increase the quality and acceptance of the DEWS, since this: (a) ensures acceptance of or trust in the science that feeds into the planning; and (b) provides essential information and insights about drought preparedness, since the relevant wisdom is not limited to scientific specialists and public officials.

Participatory methods, such as interactive approaches, or structured dialogues, are recommended.

6.4 REVIEW PROCESS

Developing DEWS is not and end-to-end process, but needs to be revised and reviewed in light of new science and evolving institutions and societies.

7. CONCLUSIONS

The framework for drought warning and mitigation in Africa proposed will assist in establishing policy priorities based on scientific evidence. Overall, a science-based approach is a useful guideline, but a number of challenges are recognized. Risk-based approaches to preparing for drought are focused on acquiring accurate probabilistic information about the events themselves. When this is not possible, the strategy fails. In contrast, understanding and reducing vulnerability does not demand accurate predictions of the incidence of extreme drought. Nevertheless, if may be politically difficult to justify drought vulnerability reduction on economic grounds.

8. NEXT STEPS

The next step to define the Early Warning System is to gather information from the Case Studies about priorities, management objectives, thresholds for alert, and definition of actions.