Water Scarcity Management: An Introduction

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Several decades ago water was perceived as a non-limited resource because water availability was enough to cover the requirements for the various sectors and the environment. Gradually due to increased water use, misuse of water resources, increased pollution and other natural and human induced changes, water has become scarce resource not only in arid and drought –prone areas but also in humid or subhumid zones of the globe.

The perception that water is increasingly scarce calls for initiatives to safeguard this precious resource. Sustainability, a household word nowadays, is widely accepted as the first priority when designing, constructing or operating water development projects but also in every human, economic or social activity related directly or indirectly to water. In other words, sustainable use of water implies resource conservation, environmental protection, economic viability, technological appropriateness and social acceptability of development issues.

Water Scarcity may be caused by either natural or human induced causes, or may result from the interaction of both. Table 1 presents the various types of water scarcity, their occurrence regime and their type of causes.

Table 1: Causes and Types of water scarcity

Causes / Regime	Natural	Human Induced
Permanent	Aridity	Desertification
Temporary	Drought	Water Shortage (1)

(1) water shortage is referred to as water scarcity in many publications

As known **Aridity** is a natural environment imbalance in the water availability characterizing the climatic conditions of a region. In contrast **Drought** is a natural but temporary imbalance of water availability caused mainly by low precipitation and thus resulting in lower availability of water resources.

Desertification and **Water Shortage** are mainly caused by human induced causes and they represent permanent and temporary imbalance in the water availability respectively. Desertification is widely known as the process of land degradation and deterioration of its productivity, including the damage caused to the ecosystems, whereas water shortage is mainly caused by inappropriate misuse of water resources or due to man made changes.

It is important to note that water scarcity is not only a quantitative concept but it affects and interacts with quality matters to a great extent. It has been observed that in most of the cases limited water availability means deterioration of water quality.

From the above it can be induced that water scarcity linked with aridity or desertification calls for engineering and management measures that produce conservation and augmentation of water resources. On the contrary water scarcity caused by droughts or water shortage requires the development and the implementation of preparedness and emergency plans.

Temporary water scarcity (that is drought and/or water shortage) is not generally dependent on the aridity regime of the area. However the perception of these situations in a dry area and the anticipated impacts are much more profound therefore resulting in more adverse consequences.

Using an "operational" definition of temporary water scarcity the critical term of **water availability** (falling below a certain threshold) should be defined and the characteristics of the phenomenon should be described by specifying the commencement, the termination, the intensity, the magnitude and its aerial extent. In fact it is useful to know the temporal and spatial evolvement of each episode of water scarcity.

Conventionally temporary water scarcity may be treated as a meteorological , hydrological, agricultural or socioeconomic event. In each of these cases the variable representing "water availability" and the selected threshold are different. For instance water scarcity may be determined by using the water volume stored in the reservoirs of a water supply system, or by the precipitation recorded in a number of meteorological stations in a watershed. It is therefore difficult to find common basis for assessing water scarcity. Furthermore water availability depends greatly on the demand placed upon the existing water resources. The "normal" or "average" water regime is not always the proper level to assess water scarcity.

Table 2 presents the most commonly used variables representing water availability in the various types of temporary water scarcity

Temporary Water Scarcity	**Water Availability**
meteorological	precipitation, precipitation & evapotranspiration
hydrological	streamflow, water storage, water levels in lakes, and groundwater
agricultural	Soil moisture budget, actual to potential evapotranspiration
socio-economic	demand & supply

To facilitate the assessment of water scarcity in an easy to understand way indices have been employed which represent the severity of each episode or period. A big variety of indices have been proposed and used with varying success in various parts of the world. A computer software named *PrintC (Drought Indices Calculator)* was recently developed in the framework of SEDMED II project. *PrintC* operated on Windows Platform and has been programmed in Visual Basic C.

Attention has been paid so far to the assessment of drought severity through the use of indices. The PDSI (Palmer Index), the Deciles and the SPI (Standard Precipitation Index) are among many others the most popular indices used for assessing the severity of meteorological drought. Recently a new index based on both precipitation and potential evapotranspiration called RDI (Reconnaissance Drought Index) was proposed in the framework of MEDROPLAN project. The new index was tested in a large number of watersheds in the Mediterranean region and although in some cases behaves in a similar manner as SPI in other cases deviates from SPI giving a more sound representation of drought condtions. The differences between SPI and RDI may be clearly illustrated when drought severity maps are produced. Since water scarcity is a regional phenomenon the spatial representation is also of importance. Illustrative pseudo – 3D maps, the method of runs or the "or more" cumulative severity-area curves have been successfully applied in the past.

Working with water scarcity one can easily understand that due to many different definitions, many different sectors of interest, different variables examined and even different severity indices used, it is rather a utopia to expect to devise a unique procedure for developing and implementing preparedness plans and emergency plans for all types of regions using the same tools. However what is most important in the development of such plans is to reach a common language and common presentation of data sets on which we will attempt to devise a procedural framework based on multiple approaches incorporating most of the situations in the Mediterranean Islands and Coastal areas.

It should be understood from the beginning that the cornerstone of this initiative is the fact that water scarcity is considered as a hazard and therefore the approach to be followed will be a risk management approach. This calls for assessing impacts caused by water scarcity and therefore attention should be given to systems vulnerability. In other words we will devise plans to face water scarcity by proactive planning instead of crisis management which is the conventional practice to face these phenomena for most countries and regions of the world. In this context due to significant uncertainties encountered when impacts are estimated innovative techniques to incorporate uncertainties should be also utilized.

Closing this short introduction I wish to stress the fact that the new project PRODIM should capitalize on the results of many other European and non European projects and attempt to address water scarcity as a water resources management problem as it will be faced by the managing authorities and perceived by the public. In this effort easy to understand and scientifically sound figures will be helpful if the outcome of the project is to be implemented and accepted by the users. I think our responsibility is to devise methodologies that are simple and powerful at the same time. It is a real challenge for all of us.