Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 162 (2016) 476 – 485

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Efficient & Sustainable Water Systems Management toward Worth Living Development, 2nd EWaS 2016

Estimating the water resources vulnerability index in the Adriatic Sea region

Vasilis Kanakoudis[a], Stavroula Tsitsifli[a,*], Anastasia Papadopoulou[a], Barbara Cencur Curk[b], Barbara Karleusa[c]

[a]Civil Engineering Department, University of Thessaly, Pedion Areos, Volos, GR38334, Greece
[b]Faculty of Natural Sciences and Engneering, University of Ljubljana, Aškerčeva c. 12, 1000 Ljubljana, Slovenia
[c]Faculty of Civil Engineering, University of Rijeka, Radmile Matejčić 3, 51000 Rijeka, Croatia

Abstract

The Adriatic Sea countries face significant problems regarding cross-border water resources management. DRINKADRIA project aims at developing a common methodological framework, for efficient and effective cross border water supply and resources management, taking into consideration different resources types (surface and ground water) emphasizing in drinking water supply intake. The common methodology is based in four pillars: climate characteristics and the climate change, water resources availability, water resources quality and finally water resources management. The present paper assesses both present and future vulnerability of water resources based on a common methodology and estimates the integrated vulnerability index for the Adriatic Sea region and the Corfu test area.

Keywords: Water resources; vulnerability; water availability; water quality; climate change

* Corresponding author. Tel.: +30-24210-74156; fax: +30-24210-74135.
E-mail address: tsitsifli@uth.gr

doi:10.1016/j.proeng.2016.11.091

1. Introduction

Water supply and resources management within the borders of a country is an extremely complicated process, that policy makers and experts are called to address. There are many variables that need to be analyzed such as water quantity and quality, available resources, temperature, water pressure, asset ageing, fluctuating demand, operation and maintenance risks, leakages, accidental pollutions, pipe bursts, soil instability, pricing policies and supply standards. Things get more complicated when cross-border water supply is involved, especially when there are no standard and common methodologies, procedures and technics to address this issue.

Globally, around 748 million people do not have access nowadays to an improved source of drinking water. Additionally, water demand for manufacturing is expected to increase by 400% between 2000 and 2050 in a global level. Improving policy coherence within the borders of country and across borders will be one of the top priorities in the water sector, for the next time period [1,2].

Cross-border water resources management is one of the main tasks involved in DRINKADRIA project including: the analysis and development of climate and climate change database for the Adriatic region; the identification of present and future risks for water resources availability with emphasis in drinking water; the determination of present and future water quality risks and the causes for drinking water quality deterioration and; the development of guidelines and protocols for the protection and management of cross-border water resources.

2. Cross-border water resources management: the methodology

2.1. Climate characteristics and climate change

It is stated that changes in physical processes, in the global hydrological cycle, over the past 50 years may be linked to climate change. Climate characteristics and climate change are the first variables studied in the Adriatic region, forming a database of climate characteristics and climate change for the past. These data were simulated also for the future, until the year 2050, using SRES (Special Report on Emissions Scenarios) scenarios [3]. Nine test areas were selected by the partner countries (Italy, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Serbia, Albania and Greece), including different water types of resources (Fig. 1). Using different climate simulation models and scenarios (Aladin, Promes, RegCM3) observed data are explained and climate change trends in the future period(s) are described.

2.2. Water resources availability

Water resources availability with emphasis to drinking water, is the second step implemented in DRINKADRIA project. The analysis included both total and drinking water use. Water resources availability took into consideration climate change impacts, the renewable water resources and the water demand. The impact of climate change to water resources availability is also analyzed. Temperature and precipitation results were input data for calculating water availability change in the test areas for the future period (2021-2050). The Water Exploitation Index (WEI) is estimated for all test areas for the present and the future state. WEI is the ratio of the water demand (WD) and renewable water resources (WR). Three water demand scenarios are analyzed: present state (scenario WD0), present water demand increase by 25% (future scenario WD1) and present water demand decrease by 25% (future scenario WD2) [5]. Finally, four WEI indices are calculated: WEI1 = WD0 / WR1961 – 1990; WEI2 = WD0 / WR2021 – 2050; WEI3 = WD1 / WR2021 – 2050; WEI4 = WD2 / WR2021 – 2050. The WEI threshold values used to classify the vulnerability or risk have been used in CC-WaterS project [6]. WEI values below 0.5 indicate low risk; WEI values ranging from 0.51 to 0.70 indicate possible problems; WEI values ranging from 0.71 to 1.00 indicate strong risk; and WEI values above 1.00 indicate that water resources availability is not sustainable [7].

Conclusions on water availability indicate that climate change will have an impact in the future (2021-2050) on water resources availability causing water resources quantities decrease [7]. There is a difference in water resources availability trends in Southern and Northern Adriatic (lower changes). Different climate models provide different estimates of the intensity of climate change impacts [8].