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Amjad Kallel · Mohamed Ksibi Hamed Ben Dhia · Nabil Khélifi *Editors*

Recent Advances in Environmental Science from the Euro-Mediterranean and Surrounding Regions

Proceedings of Euro-Mediterranean Conference for Environmental Integration (EMCEI-1), Tunisia 2017





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Volume I and Volume II



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Preface

Highlights

- Springer, in collaboration with the Editorial Office of the Euro-Mediterranean Journal for Environmental Integration in Sfax, Tunisia, launched the First Euro-Mediterranean Conference for Environmental Integration (EMCEI: www.emcei.net) in November 2017.
- The conference gathered new research contributions from all disciplines of the environmental sciences by Euro-Mediterranean scientists with diverse backgrounds, in particular from the geo- and bio-environmental sciences and engineering.
- More than 800 short contributed papers were received from authors based in 50 countries. The evaluation process was managed by the Editors of this proceedings volume, who invited the members of the conference scientific committee and other international experts to review the papers. Ultimately, roughly 550 short papers were accepted.
- Papers are published in this proceedings volume, which is divided into 10 major sections representing the tracks (topics) of the conference. They cover a broad range of environmental research fields, mainly from the Euro-Mediterranean region, but also from surrounding regions and some other parts of the world that show similar case studies on environmental integration in general.
- Springer invited the Editors of the Euro-Mediterranean Journal for Environmental Integration and other distinguished scientists and experts to contribute to the conference in the form of keynote lectures and workshops.
- Authors of the best papers from this proceedings volume will be invited after evaluating their presentations during the conference to submit extended versions of their papers for evaluation before publication in a number of special issues in selected Springer journals.
- This conference proceedings volume gathers these new studies, which demonstrate how science and knowledge can help to promote a more sustainable environment for the Euro-Mediterranean region.

Summary

The Euro-Mediterranean region is currently facing not only political, economic, and social challenges but also an ever-growing environmental degradation—aspects that have made environmental and resource protection an increasingly important issue. These aspects have also rekindled the debate on revitalizing the Euro-Mediterranean integration process by means of concrete cooperative projects in various sectors, especially those related to environmental awareness, assessment, and improvement. This integration process is mainly intended to reduce the development gap between the northern and southern shores of the Mediterranean

and to create new and closer political, economic, social, cultural, and most importantly scientific ties between the two on the basis of common concerns.

In this context, and precisely in order to promote the Euro-Mediterranean scientific partnership so as to develop and integrate environmental research in the region, under the auspices of Springer a group of Euro-Mediterranean scientists recently launched the Euro-Mediterranean Journal for Environmental Integration (EMJEI). The journal, supported and hosted by the University of Sfax, Tunisia and its Association University & Environment (AUE), offers a scientific platform for showcasing and discussing the latest research advances concerning emerging environmental issues and challenges in the Euro-Mediterranean region.

To further strengthen Euro-Mediterranean environmental research, the Editors of the Euro-Mediterranean Journal for Environmental Integration launched, in close collaboration with Springer, the First Euro-Mediterranean Conference for Environmental Integration (EMCEI). This first installment of EMCEI, held in Sousse, Tunisia in November 2017, aims at gathering new research contributions from all disciplines of the environmental sciences by Euro-Mediterranean scientists with diverse backgrounds, in particular from the geo- and bio-environmental sciences and engineering, and thus makes an essential contribution to ensuring that science and knowledge can help to promote a more sustainable environment for the Euro-Mediterranean region.

Once the conference's call for papers had begun, the global relevance of EMCEI-2017 was demonstrated by the more than 800 contributed papers submitted by authors from 50 different countries. Following peer review, about 560 papers were ultimately accepted.

The papers gathered in this book offer a general and brief overview of current research on emerging environmental issues and challenges, and of related applications to a variety of problems in the Euro-Mediterranean region in particular, but also in surrounding regions and other parts of the world. They are arranged in 10 major sections, reflecting the main topics addressed at the conference, namely:

- 1. Innovative approaches and methods for environmental sustainability;
- 2. Environmental risk assessment, bioremediation, ecotoxicology, and environmental safety;
- 3. Water resources assessment, planning, protection, and management;
- 4. Environmental engineering and management;
- 5. Natural resources: characterization, assessment, management, and valorization;
- 6. Intelligent techniques in renewable energy (biomass, wind, waste, and solar);
- 7. Sustainable management of marine environments and coastal areas;
- 8. Remote sensing and GIS for geo-environmental investigations;
- Environmental impacts of geo/natural hazards (earthquakes, landslides, volcanic, and marine hazards); and
- 10. Environmental health sciences (natural and social impacts on human health).

Presenting a broad range of topics and results, EMCEI-2017 offered a valuable opportunity for researchers and students to learn more about new advances in environmental research initiatives in view of the ever-growing environmental degradation in the Euro-Mediterranean region, which has made environmental and resource protection an increasingly important issue with regard to sustainable development and social welfare.

In addition to the several oral and poster sessions, participants enjoyed revealing keynote lectures by distinguished scientists and accompanying workshops. Keynote lectures highlighted the latest research results obtained in the Euro-Mediterranean region on topics including the following: clean energy production; wastewater treatment and energy production; novel approaches to contaminant removal in water; tracing pollution in aquatic systems; ecological risk assessment of plant protection products; environmental risk in connection with chemicals in soils; collecting and processing geodata for environmental and sustainable spatial planning; assessment of coastal morphological changes and the impact of sea level rise on

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shorelines; long-term sustainability of coastal zones and their adaptation to climate change; urban agriculture and green infrastructures; seismic hazard assessment; new solutions for energy, biomedical, and environmental applications; and several other interesting case studies, all of which are included in the first section of this proceedings volume: "keynote lecturers and workshops". The workshops were also an opportunity to discuss in round tables several regional issues hindering sustainable development in the Euro-Mediterranean community, updating and summarizing the latest advances in connection with ongoing cooperation projects between scientists based on the northern and southern shores of the Mediterranean. Lastly, they highlighted important case studies related to the environmental health sciences and integrated approaches to achieving a better environment, as well as training sessions on scientific writing and publishing techniques.

This first Springer EMCEI gave younger scientists, in particular, the opportunity to present their findings—and the outcomes astonished and delighted us. We hope that the ideas in this book can stimulate further work on environmental integration and sustainable development.

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Sfax, Tunisia Sfax, Tunisia Sfax, Tunisia Heidelberg, Germany November 2017 Amjad Kallel Mohamed Ksibi Hamed Ben Dhia Nabil Khélifi

Assessment of Citizens' Virtual Water Footprint

Mahdi Kolahi, Saeideh Heydari, Mina Ansari, and Farzaneh Nouraei

Keywords

Water footprint • Mashhad • Water conservation • Water policy • Water sociology

1 Introduction

Water scarcity is very important because of its influence on all human activities in different communities and nations (Hoekstra et al. 2011), and there is a direct ratio between population and water use amount. Urban population may rise to double by 2050 and subsequently rate of water use is going to be increased (Corcoran 2010). Based on records, water is mostly used in agriculture section, sometimes counting for about 70–90% (Morera et al 2016). Recently population growth is combined with water scarcity and have severely affected sustainability urban development and environment.

Water footprint (WF) is an indicator of freshwater use and includes virtual and direct water use of a consumer or producer (Hoekstra et al 2011). It refers to total volume of freshwater used for produced goods and provided services

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by an individual, community or business (Hoekstra and Hung 2002). Families, as the smallest units making up a community, can use water in two major ways: directly, as water used for sanitation purposes, or indirectly, as water used for cultivation of crops that are consumed by family members. The latter is termed virtual water and the amount of water used in this manner is referred to Virtual Water Footprint (VWF) of a family.

This research studies families' VWF in the city of Mashhad, the second biggest and most populated city in Iran. It is essential for the city to direct attention to water consumption because of scarcity, climate change, drought, and increasing population. It is hypothesized that individual's VWF is higher when female, older, married, higher education, higher income, higher home area, owning a property, having a professional occupation, and living in an improved quarter. The findings can be very useful in better management of water resources in every household.

2 Materials and Methods

The city of Mashhad, Iran, consists of 13 districts, 44 areas, and 156 quarters (city census 2010). A pre-test questionnaire was conducted to distinguish three main quarters based on income classes, namely higher, middle, and low-income levels. Then systematically random sampling was applied using geographical software, and 116 samples were selected. The Water Footprint Personal Extended Calculator (https://goo.gl/z0zL6S) was used, where questions regarding food consumption, domestic water use, and industrial goods consumption were asked. Collected data was analyzed, VWF was calculated, and coordination among parameters were determined.

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		Gender	Income	Quarter	Property	Area	Age	Education	Occupation
VWF	Correlation coefficient	0.175*	0.288**	0.270**	0.137	0.103	0.173**	0.149*	-0.133
	Sig. (2-tailed)	0.022	0.000	0.000	0.074	0.107	0.006	0.040	0.068

 Table 1. Correlations among VWF and variables (Kendall's tau_b Test)

3 Results and Discussion

The Table 1 shows results of correlations among VWF and variables. Furthermore, Fig. 1 highlights relationships between VWF and income.

62 and 38% of respondents were female and male, respectively. The proportion of respondents who were 19-20 years old was 3; 19% were between 21 and 30; 16% between 31 and 40; 22% between 41 and 50; 16% between 51 and 60: 16% between 61 and 70, 7% between 71 and 80, and 3% were over 81. The youngest and the oldest responders were 19 and 90 years old, respectively. 11 and 86% of respondents were single and married, respectively. Interviewers were or worked at government Section (6%), private Section (3%), self-employed (16%), retired (12%), student (3%), unemployed (3%), or housewife (51%). About 5% of responders were illiterate, 50% did not complete high school, 20% completed high school, 17% had bachelor degrees, and 8% had the master degrees. The proportion of respondents who earn less than 10 million Rials per month was 45%; 16% between 10 and 15; 11% between 15 and 20; 14% between 20 and 30; 3% between 30 and 40; 4% between 40 and 50; 1% between 50 and 60; 2% between 60 and 70; and 3% over 70 million Rials per month. 71% were landlords and 29% were tenants. Area of home was less than 50 square meters for 5% of respondents; 50-100 m2 for 33%; 100-150 m2 for 23%; 150-200 m2 for 12%; 200-250 m2 for 13%; 250-300 m2 for 4%; 300-350 m2 for 5%; and between 400-500 m2 for 7%.

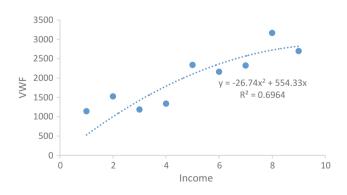


Fig. 1. Correlation of VWF and Income (incomes in nine categories: 1 = less than 285\$, 2 = 285\$-428\$, 3 = 429\$-571\$, 4 = 571\$-857, 5 = 857\$-1142\$, 6 = 1142\$-1428\$, 7 = 1428\$-1714\$, 8 = 1714\$-2000\$, 9 = more than 2000)

Most interviewed people have higher family size, educated, unemployed, low income, eating meat a lot, food with average oil, less fruits, more cup of tea, and like sweats. The findings support the idea that as a family becomes more affluent, it expends more resources (Fig. 1). It means higher income causes higher VWF. However, Quarter 2 has higher VWF than other quarters, which it can be because of the pre-test investment, and people had different ideas about incomes in different quarters. According to the findings, families' level of Income, Gender, Age, Quarter, Education are the main variables exhibiting a statistically significant correlation with VWF (Table 1). They show a correlation between VWF and Income, Quarter, and Age at 1% level, and also a correlation between VWF and Gender and Education at 5% level. In addition, a significant correlation between VWP and quarter represents that people have been affected by their living areas. A positive relationship between VWF and education means higher education has a direct influence in consumption of virtual water. Nevertheless, other variables such as Property, Area, and Occupation are irrelevant with VWF.

The research highlights that individual's VWF is higher when male, older, higher education, higher income, and living in an improved quarter. These findings are partly different with some reports (Neumark-Sztainer et al. 1999; Auld et al. 2002; Bowman et al. 2004; Hanson et al. 2005; Fan et al. 2014).

4 Conclusion

More food consumption, domestic water use, and industrial goods consumption equal to more VWF. The pattern of life style has affected water resources. Furthermore, greenhouse emissions from husbandry and agriculture have significant effect on global warming and resources. For example, "producing a single kilogram of beef generates as much CO2 as driving 250 km in an average European car or using a 100-watt bulb continuously for twenty days" (Carolan 2013). However, animal products generally have a larger WF than crop products (http://waterfootprint.org). Additionally, vegetables' WF varies within different irrigation plans and even in different regions (Nyambo and Wakindiki 2015). Currently water is a key factor in virtual water trade to produce water-intensive products, and countries can save their water resources due to using virtual water trade, and allocate it in other sections (Azam et al. 2012). Therefore,

the evaluation of water footprint makes important insights into the food-energy-water relation at the urban scale, creating opportunities for understanding water and energy savings and efficiency (Chini et al. 2017).

The research reveals that almost all people need to redesign their life style to have healthy food and to pay more attention to their waters consumption patterns. It is also necessary to mention that positive relationship between VWF and education levels presents less or no importance of education towards environmental concerns. Furthermore, it notes a big problem in educational sectors in lacking socializing water and environmental issues (Kolahi et al. 2012; Kolahi et al. 2013; Kolahi 2013; Kolahi et al. 2014a; Kolahi 2014; Kolahi et al. 2014b). For that, a four-step conceptual framework is presented on how to find, research and socialize water problems, including water philosophy, water sociology, water strategy, and water proactivity, respectively and interactively (Kolahi et al. 2016).

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References

- Auld G, Boushey CJ, Bock MA, et al. Perspectives on intake of calcium-rich foods among Asian, Hispanic, and white preadolescent and adolescent females. J Nutr Educ Behav. 2002;34:242–51.
- Azam A, Amin A, Yaser VR, et al. Agricultural water foot print and virtual water budget in iran related to the consumption of crop products by conserving irrigation efficiency. J Water Resour Prot. 2012;4(5):318.
- Bowman SA, Gortmaker SL, Ebbeling CB, et al. Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. Pediatrics. 2004;113:112–8.
- Carolan MS. Reclaiming food security. Routledge; 2013.
- Chini CM, Konar M, Stillwell AS. Direct and indirect urban water footprints of the United States. Water Resour Res. 2017;53:316– 327. doi:10.1002/2016WR0194373.

- Corcoran E. Sick water?: the central role of wastewater management in sustainable development: a rapid response assessment. UNEP/Earthprint; 2010.
- Fan L, Wang F, Liu G, et al. Public perception of water consumption and its effects on water conservation behavior. Water. 2014;6:1771– 84. doi:10.3390/w6061771.
- Hanson NI, Neumark-Sztainer D, Eisenberg ME. Associations between parental report of the home food environment and adolescent intakes of fruits, vegetables and dairy foods. Public Health Nutr. 2005;8:77–85.
- Hoekstra AY, Hung PQ. Virtual water trade: a quantification of virtual water flows between nations in relation to international crop trade. Value water Res Rep Ser. 2002;11:166.
- Hoekstra AY, Chapagain AK, Aldaya MM, Mekonnen MM. The water footprint assessment manual: setting the global standard. London, UK: Earthscan; 2011.
- Kolahi M, Protected areas management and environmental sociology in Iran. Scholars' Press; 2014.
- Kolahi M, Bajestani Moghadam G, Jafari Sayadi MH. Socialization of Water Problems. Int. Conf. Water Environ. New Millenium Educ. Capacit. Dev. University of Tehran, German Academic Exchange Service (DAAD), University of Duisburg-Essen, and UNESCO-IHE, Tehran; 2016, p. 91–95.
- Kolahi, M. Synergisms for the intricate system of biodiversity and society in the conservation management of Iran. Kyoto University; 2013.
- Kolahi M, Sakai T, Moriya K, Makhdoum MF. Challenges to the future development of Iran's protected areas system. Environ Manage. 2012;50:750–65.
- Kolahi M, Sakai T, Moriya K. Assessment of the effectiveness of protected areas management in Iran: case study in Khojir National Park. Environ Manage. 2013;52:514–30.
- Kolahi M, Moriya K, Sakai T, et al. Introduction of participatory Conservation in Iran: case study of the rural communities' perspectives in Khojir National Park. Int J Environ Res. 2014a;8:913–30.
- Kolahi M, Sakai T, Moriya K, et al. Visitors' Characteristics and Attitudes towards Iran's National Parks and participatory conservation. Parks. 2014b;20:49–62.
- Morera S, Corominas L, Poch M, et al. Water footprint assessment in wastewater treatment plants. J Clean Prod. 2016;112:4741–8. doi:10.1016/j.jclepro.2015.05.102.
- Neumark-Sztainer D, Story M, Perry C, Casey MA. Factors influencing food choices of adolescents: findings from focus-group discussions with adolescents. J Am Diet Assoc. 1999;99:929–37.
- Nyambo P, Wakindiki IIC. Water footprint of growing vegetables in selected smallholder irrigation schemes in South Africa. Water SA. 2015;41:571–8.