



# Vulnerability Assessment of **Freshwater** Resources to Climate Change:

Implications for Shared Water  
Resources in the **West Asia**  
Region



**Back cover photographs:**

**Insets, from top to bottom:**

Khaled Mubarak

UNEP 2012

Alen Ištoković/[www.panoramio.com](http://www.panoramio.com)

Bernard Gagnon/[commons.wikimedia.org](http://commons.wikimedia.org)

Tristan Schmurr/[www.flickr.com](http://www.flickr.com)

Tristan Schmurr/[www.flickr.com](http://www.flickr.com)

Khaled Mubarak

UNEP 2012

# Vulnerability Assessment of Freshwater Resources to Climate Change:

Implications for Shared Water  
Resources in the **West Asia**  
Region



First published by the United Nations Environment Programme in 2011

Copyright © 2012, United Nations Environment Programme

Publication: **Vulnerability Assessment of Freshwater Resources to Climate Change: Implications for Shared Water Resources in the West Asia Region**

Job number: **DEW/1580/BA**

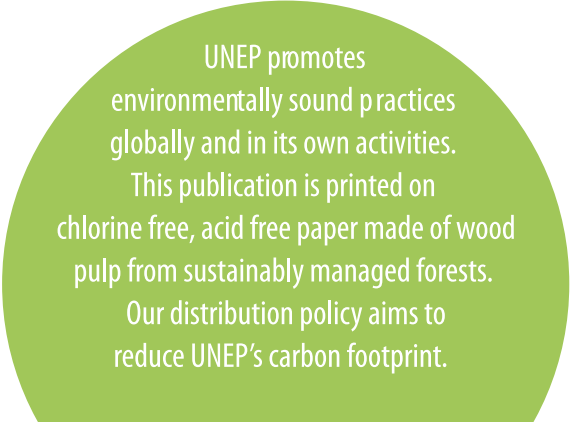
ISBN: **978-92-807-3292-4**

This publication may be reproduced in whole or in part and in any form for educational or non profit services without special permission from the copyright holder, provided acknowledgement of the source is made. The United Nations Environment Programme (UNEP) would appreciate receiving a copy of any publication that uses this publication as a source.

No use of this publication may be made for resale or any other commercial purpose whatsoever without prior permission in writing from UNEP. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to the Director, DCPI, UNEP, P.O. Box 30552, Nairobi, 00100, Kenya.

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of UNEP concerning the legal status of any country, territory or city or its authorities, or concerning the delimitation of its frontiers and boundaries.

Mention of a commercial company or product in this publication does not imply the endorsement of UNEP. The use of information from this publication concerning proprietary products for publicity or advertising is not permitted.



UNEP promotes environmentally sound practices globally and in its own activities. This publication is printed on chlorine free, acid free paper made of wood pulp from sustainably managed forests. Our distribution policy aims to reduce UNEP's carbon footprint.

# Vulnerability Assessment of **Freshwater** Resources to Climate Change: Implications for Shared Water Resources in the **West Asia** Region

---



UNEP

United Nations Environment Programme  
(UNEP)



Arab Center for the Study of Arid Zones  
and Dry Lands (ACSAD)



Arabian Gulf University  
(AGU)



CEDARE

Centre for Environment and Development for  
the Arab Region and Europe (CEDARE)

# Acknowledgements

UNEP acknowledges the contribution made by many individuals and institutions that have contributed to the preparation and publication of the "Assessment of Freshwater Resources Vulnerability to Climate Change: Implication for Shared Water Resources in the West Asia Region". Sincere thanks and appreciation go to Arabian Gulf University (AGU) and the Arab Center for the Studies of Arid Zone and Dry Lands (ACSAD) for providing necessary support and help regarding the project. Our gratitude also goes to the Centre for Environment and Development for the Arab Region and Europe (CEDARE) for the editing and layout of the report. Special thanks are extended to the list of names given below:

## **UNEP Coordination**

Adel Abdelkader

## **Lead Coordinating Authors**

Abdulla Droubi, ACSAD  
Waleed K Al-Zubari, AGU

## **Authors**

### **ACSAD**

Mahmoud Al-Sibai  
Hiam Al-Ashqar

### **AGU**

Alaa Abdallah El-Sadek  
Mohammad Jameel Abdulrazzak

## **Reviewers**

Fatma Attia Abdulrahman  
Yousif Al-Mooji  
Mona Radwan  
Matthew Broughton  
Arlene O'Neill  
Kate de Smeth

## **Technical Editor**

Mayar Sabet, CEDARE

## **Scientific Editor**

Mona Radwan, UNEP

## **Cover, Design and Layout**

Dalia El Shamy, CEDARE

## **Graphics and Maps**

Dalia El Shamy, CEDARE  
Ayman Soliman, CEDARE  
Asmaa Ali Abdelmonem, CEDARE

## **Editorial Support**

Tarek Abdel Monem, CEDARE  
Yasmine Adra, UNEP

# Contents

<b>EXECUTIVE SUMMARY</b>	2
CHAPTER ONE <b>INTRODUCTION</b>	7
CHAPTER TWO <b>WATER RESOURCES IN WEST ASIA: AN OVERVIEW</b>	13
CHAPTER THREE <b>METHODOLOGY</b>	37
CHAPTER FOUR <b>ASSESSMENT OF FRESHWATER VULNERABILITY TO CLIMATE CHANGE</b>	43
CHAPTER FIVE <b>SHARED FRESHWATER VULNERABILITY TO CLIMATE CHANGE</b>	71
CHAPTER SIX <b>FUTURE OF FRESHWATER VULNERABILITY IN WEST ASIA</b>	117
CHAPTER SEVEN <b>CHALLENGES AND OPPORTUNITIES</b>	130
CHAPTER EIGHT <b>POLICY SOLUTIONS: THE WAY TOWARDS SUSTAINABLE WATER MANAGEMENT</b>	137
<b>REFERENCES</b>	140
ANNEX: <b>VULNERABILITY INDEX (VI) ESTIMATION</b>	145
<b>ACRONYMS AND ABBREVIATIONS</b>	152

## List of Illustrations

### CHAPTER TWO: WATER RESOURCES IN WEST ASIA: AN OVERVIEW

Figure 1: Rainfall distribution in West Asia	15
Figure 2: Shared groundwater aquifers in the Arabian Peninsula	16
Figure 3: Water dependency ratio by country	17
Figure 4: Population growth for West Asia countries 1975-2005	19
Figure 5: Per capita freshwater availability trend	20
Figure 6: Trends and projection of per capita share of renewable freshwater sources in West Asia	20
Figure 7: Population with access to safe drinking water; 1990, 2005 and 2015	22
Figure 8: Population with access to sanitation, 1990, 2005 and 2015	22
Figure 9: Total water use in West Asia countries	24
Figure 10: Water resources in West Asia by origin and use	24
Figure 11: Trend and projection in water demand in West Asia	25
Figure 12: Percentage of water use in different sectors in the Mashriq sub-region	25
Figure 13: Regional climate model projections of precipitation changes (%) for 2020, 2040 and 2070 relative to 1990	33

### CHAPTER FOUR: ASSESSMENT OF FRESHWATER VULNERABILITY TO CLIMATE CHANGE

Figure 18: Trends of water exploitation pressure (DPs) in West Asia, 1985-200	48
Figure 19: Aerial coverage of water exploitation pressure (DPs)	48
Figure 20: Variation trend of safe drinking water inaccessibility (DPd)	49
Figure 21: Safe drinking water inaccessibility parameter (DPd) for the year 2005	50
Figure 22: Trends in water pollution levels (EHp)	51
Figure 23: Areal variation of water pollution (EHp) for the year 2005	52
Figure 24: Ecosystem deterioration (EHe) trend	53
Figure 25: Ecosystem deterioration (EHe) for the year 2005	54
Figure 26: Trend of water use inefficiency (MCe)	55
Figure 27: Water use inefficiency coverage for the year 2005	56
Figure 28: Trend variation of Improved Sanitation Inaccessibility Parameter (MCs)	57
Figure 29: Improved sanitation inaccessibility parameter (MCs) for 2005	58
Figure 30: Conflict management capacity parameter (MCg), year 2005	59
Figure 31: Calculated vulnerability index with different parameters	61
Figure 32: Calculated Vulnerability Index for each country according to the parameters (RS, DP, EH and MS)	62
Figure 33: Vulnerability Index map, 2005	62

预览已结束，完整报告链接和二维码如下：

[https://www.yunbaogao.cn/report/index/云报告?reportId=5\\_9301](https://www.yunbaogao.cn/report/index/云报告?reportId=5_9301)

