

**ENCYCLOPEDIA ON  
WATER RESOURCES DEVELOPMENT AND  
MANAGEMENT IN  
ARID AND SEMI-ARID REGIONS OF THE  
ARAB WORLD**

**I N D E X**

**December 2009**

## PREFACE

The decision to conceive and publish this Encyclopedia on water resources development and management in arid and semi-arid regions of the Arab world is the perfect result and unique model of cooperation between the Arab Water Council and the CIHEAM/Mediterranean Agronomic Institute of Bari, Italy.

The Encyclopedia was planned to combine, as a fundamental source, some selected scientific and technical publications in the water sector issued by Bari Institute in the last 15 years. The Encyclopedia will be then translated from English into the Arabic language.

The translation of the Encyclopedia into the Arabic language will give great opportunity to a relatively high number of experts to be acquainted with the water resources challenges and possible solutions, especially the issues of the Arab world, thereby increasing the mass-media awareness as well as putting into action the statement "*water is the subject of all to all*".

The preparation of the Encyclopedia by both Bari Institute and Arab Water Council started four years ago. This collaboration has been strengthened since the Mediterranean Agronomic Institute of Bari joined the Arab Water Council as one of the foundation members in the AWC Board of Governors.

The role of Bari Institute, through its technical and financial support to the Arab Water Council during the preparation of the Encyclopedia, is the real interpretation of the solid collaboration between both the Institutions to achieve the final goal of having the Encyclopedia in our hands, today.

Indeed, for Bari Institute, this is the first programme accomplished under the umbrella of the Arab Water Council which will be followed by many other successful programmes.

The Encyclopedia consists of 13 volumes, as follows:

***Volume 1 :***

Water Resources in the Arab World

***Volume 2 :***

Water Vision for the Arab World and the Mediterranean

***Volume 3 :***

Water, Food and Agricultural Challenges in the Arab World

***Volume 4 :***

Supply and Demand Water Management in the Arab World: the case of the Mediterranean

***Volume 5 :***

Coping with Water Scarcity in the Arab World: Options and Tools

***Volume 6 :***

Drought Water Management:  
Crop Water Productivity and Water Use Efficiency Improvements

***Volume 7 :***

Non-Conventional Water Resources:  
Salinity and Saline Irrigation Practices

***Volume 8 :***

Crop Response to Salinity and Salt Tolerance Analysis

***Volume 9 :***

Sustainable Use and Management of Treated Sewage Waste Water

***Volume 10 :***

Gender and Water Resources Management and Development

***Volume 11 :***

Water Valuation in the Irrigation Sectors:  
Tools and Mechanisms

***Volume 12 :***

Capacity Building for Water Resources Development and Management

***Volume 13 :***

Application of New Technologies in Water Resources Management

This comprehensive work will remain not only as a tangible proof of the common efforts made for the development of a field which is so strategic and important in the economic growth of the whole Arab region, but also as a cornerstone for the coming generation.

The Encyclopedia will contribute to improve and update the capacity of the Institutions and the know-how of technicians, scientists and decision-makers involved in the water sector activities in the Arab world.

Mahmoud Abu-Zeid  
*President, Arab Water Council*

Cosimo Lacirignola  
*Director, CIHEAM/MAI Bari, Italy*

# VOLUME 1

## Water Resources in the Arab World

### CONTENTS

|  |   |
|--|---|
| Introduction   | 1 |
| <i>M. Abu-Zeid and A. Hamdy</i>  |   |
| Water Crisis in the Arab World: Analysis and Solutions   |   |
| <i>M. Abu-Zeid and A. Hamdy</i>  |   |
| Water Resources Challenges and irrigated Agriculture<br>in the Arab Countries                    |   |
| <i>A. Hamdy and C. Lacirignola</i>   |   |
| Water Resources in the Mediterranean: an Overview  |   |
| <i>A. Hamdy</i>  |   |
| The Application of Optimization Techniques to<br>Water Resources Problems                        |   |
| <i>M. Ait Kadi</i>   |   |
| Water Resources and Irrigation Water Policies in the Mediterranean                               |   |
| <i>A. Hamdy</i>  |   |
| Use of Water in the Mediterranean Sectional<br>Distribution and Prospects                        |   |
| <i>A. Hamdy and C. Lacirignola</i>   |   |
| Non-renewable Groundwater and Sustainable Agriculture:<br>Current Status and Future Perspectives |   |
| <i>F. Abdel Rahman Attia</i>   |   |

The Water Paradox: Scarce and Valuable but Inefficient  
Use and Poor Political Decisions-Who should be blamed?

*I. Carruthers*

The Law of Water – Historical Record

*S. El-Din Amer*

Traditional Knowledge Role for Security and  
Mitigation of Water Conflicts

*P. Laureano*

Conceptual Frame of Water Conflicts in the Mediterranean

*M. Shatanawi, M. Shammout, S. Naber, N. Aboul-Fotouh,  
A. E. Abdin, S. Sedky, L. Candela, F. Domingo, J. Berbel,  
J. José Alarcón, P. Laureano, K. Tamoh, W. Von Igel,  
M. Escobar Soler, E. R. Trevisiol, T. Cambruzz, G. Baldo,  
F. Pra Levis and R. Rodriguez*

## **VOLUME 2**

# **Water Vision for the Arab World and the Mediterranean**

## **CONTENTS**

Introduction

*M. Abu-Zeid and A. Hamdy*

Water Vision for the Twenty First Century in the Arab World

*M. Abu-Zeid and A. Hamdy*

Mediterranean Vision on Water and Action Plan  
for Implementation

*A. Hamdy, C. Lacirignola and G. Trisorio-Liuzzi*

Water Legislation in the Mediterranean Countries

*G. Le Moigne*

# **VOLUME 3**

## **Water food and Agricultural Challenges in the Arab World**

### **CONTENTS**

|  |   |
|--|---|
| Introduction<br><i>M. Abu-Zeid and A. Hamdy</i>  | 1 |
| Water, Land and Food Security in arid and semi-arid Regions<br><i>J. Margat and M. Blinda</i>  |   |
| Water, Food and Agriculture: Challenges for sustainable rural<br>Development and Poverty Alleviation<br><i>M. Abu-Zeid and A. Hamdy</i>                    |   |
| Securing Food for a growing Population:<br>the Water Scarcity Challenge<br><i>J.M. Faurès</i>  |   |
| The Road Map Towards Water Security, Food Security and<br>Environmental Sustainability in arid and semi-arid<br>Mediterranean Countries<br><i>A. Hamdy</i> |   |
| Water Scarcity Management towards Food Security in the<br>Middle-East Region<br><i>A. Hamdy and G. Trisorio-Liuzzi</i>                                     |   |
| Global Warming-Water Scarcity and Food Security in the<br>Mediterranean Environment<br><i>D. De Wrachien and R. Ragab</i>                                  |   |
| How to achieve the required Food Production to meet the<br>growing Demand?<br><i>A. Hamdy and G. Trisorio-Liuzzi</i>                                       |   |



Towards Food Security: promising Pathways for increasing  
agricultural Water Productivity

*A. Hamdy*

Agricultural Water Management to meet the growing  
Food Demand

*A. Hamdy*

Agricultural Biotechnology-Food Security & Hunger Alleviation

*A. Hamdy*

**VOLUME 4**  
**Supply and Demand Water Management**  
**in the Arab World:**  
**the Case of the Mediterranean**

**CONTENTS**

|  |   |
|--|---|
| Introduction<br><i>M. Abu-Zeid and A. Hamdy</i>  | 1 |
| Integrated Water Resources Management towards<br>long-term Water Security in the Mediterranean<br><i>A. Hamdy, C. Lacirignola and G. Trisorio-Liuzzi</i> |   |
| Satisfying future national and international Water Demands<br><i>M. Abu-Zeid</i>   |   |
| Best Policies and Practices for agricultural Water<br>Management in the Near East Region<br><i>M. Bazza</i>  |   |
| Sustainability Challenges in Water Management<br><i>L. S. Pereira</i>  |   |
| Water Management and Water Scarcity Perspectives in the<br>Mediterranean<br><i>A. Hamdy and G. Trisorio-Liuzzi</i>                                       |   |
| Water Management Strategies to combat Drought in<br>the semi-arid Regions<br><i>R. Ragab and A. Hamdy</i>  |   |
| Water Scarcity Management: Building Capacity is<br>the Key Strategy<br><i>A. Hamdy and G. Trisorio-Liuzzi</i>  |   |

Going from Rain to gain: blue and green Water Management  
*A. Hamdy*

Water Resources Management and Climate Change in the  
Mediterranean Countries  
*R. Ragab and A. Hamdy*

Climatic Hazards and Water Management in  
the Mediterranean Region  
*N. S. Sehmi*

The Integration of Soil and Water Resources Management  
towards a sustainable Agricultural Development  
in the Mediterranean  
*A. Hamdy, C. Lacirignola and G. Trisorio-Liuzzi*

Water Resources Planning and Management in arid and  
semi-arid Areas: case study - Tunisia  
*A. Bahri*

Disengagement Policy of the State in Water Resources Management  
*O. Tekinel and J. Doorenbos*

Sustainable Land and Irrigation Water Management Policies in  
Mediterranean Region: the Role of Decentralization and  
Participation Context  
*A. Hamdy*

Irrigation Management Transfer. Monitoring and Evaluation  
Concepts and Approaches  
*A. Hamdy*

Assessment and Monitoring of Participatory Irrigation Management  
*J. A. Sagardoy*

Participatory Irrigation Management: gaining Benefits  
and rising Problems  
*A. Hamdy*

**VOLUME 5**  
**Coping With Water Scarcity in the Arab World:**  
**Options and Tools**

Introduction

*M. Abu-Zeid and A. Hamdy*

1

Coping with Water Scarcity in the Arab World

*M. Abu-Zeid and A. Hamdy*

Coping with Water Scarcity: Water Saving and increasing  
Water Productivity

*A. Hamdy, R. Ragab and E. Scarascia-Mugnozza*

Agricultural Policies of Mediterranean Countries and  
Water Shortages: some preliminary Thoughts

*A. Simantov*

Drought Planning and Drought Mitigation Measures in the  
Mediterranean Region

*A. Hamdy and G. Trisorio-Liuzzi*

From Water Scarcity to Water Security through  
integrated Management

*A. Hamdy*

Effective Water Governance is the Entry-Visa to  
achieve sustainable Water Management in arid and  
semi-arid Environment

*A. Hamdy*

An Initiative towards Water Saving and sustainable  
Demand Irrigation Management in the Mediterranean

*A. Hamdy*

Research Needs for sustainable use of low Quality  
Water in Agriculture

*L. S. Pereira*

## VOLUME 6

# **Drought Water Management: Crop Water Productivity and Water Use Efficiency Improvements**

## CONTENTS

- Introduction 1  
*M. Abu-Zeid and A. Hamdy*
- Droughts: Concepts, Indices and Prediction  
*L. S. Pereira and A. A. Paulo*
- Drought Preparedness and Mitigation in the Mediterranean Region  
*A. Hamdy*
- Analysis and Improvement of Water Use Efficiency for Crops  
cultivated in the Mediterranean Regions: The State of the Art  
*N. Katerji, M Mastroilli and G. Rana*
- A systematic and quantitative Approach to improve Water Use  
Efficiency in Agriculture  
*T. C. Hsiao*
- On-Farm Water-Use Efficiency: Reflections on ESCWA'S Experience  
*M. Ehsan Osman*
- The Question of Water Efficiency from integrated Water Resources  
Management Approach  
*A. Hamdy, and M. E. Venezian-Scarascia*
- Supplemental Irrigation and Water Harvesting for  
upgrading Water Productivity in dry Areas  
*T. Oweis and A. Hachum*

Water Use Efficiency and its Potential for Water Saving  
*A. Hamdy*

Water Use Efficiency in irrigated Agriculture:  
an analytical review  
*A. Hamdy*

Diagnosys of a pressurized Irrigation System for Water Saving  
*N. Lamaddalena, F. Lebdi*

**VOLUME 7**  
**Non-Conventional Water Resources:**  
**Salinity and Saline Irrigation Practices**

**CONTENTS**

|  |   |
|--|---|
| Introduction<br><i>M. Abu-Zeid and A. Hamdy</i>  | 1 |
| A Review Paper on Soil Salinity, Crop Salt Response and<br>Crop Salt Tolerance Mechanisms<br><i>A. Hamdy</i>   |   |
| Irrigation Management Aspects under Saline Water Practices :<br>an analytical Review<br><i>A. Hamdy and M. Todorovic</i>   |   |
| Saline Irrigation Problems and Perspectives<br><i>J.W. van Hoorn</i>   |   |
| Saline Irrigation Management for a sustainable Use<br><i>A. Hamdy</i>  |   |
| Biosaline Agriculture: an international Perspective within a<br>regional Context of the Middle East and North Africa (MENA)<br><i>K. Taha, S. Ismail and A. A. Dakheel</i> |   |
| Evidence of the potential Use of Saline Water in Irrigation as<br>Freshwater saving Practice<br><i>A. Hamdy</i>  |   |
| Agricultural Drainage Water Quality Management and<br>Sustainable Re-use<br><i>A. Hamdy</i>  |   |

Re-Use of Drainage Water in Irrigation: Assessment and Conditions  
*S. Abdel-Dayern*

Participatory Irrigation Management and Irrigation Practices with  
non-conventional Water Resources  
*A. Hamdy*

Halophytes: a precious Resource  
*V. Sardo and A. Hamdy*

Conservation, Reclamation and the Development of Cash Crop  
Halophytes: Contradictory or Complementary Approaches ?  
*H.W. Koyro, N. Geissler and H. Lieth*

Halophytes and Salt-Tolerant Glycophytes: a potential Resource  
*V. Sardo*

Halophytes as a Biological Means for Reclamation and  
Rehabilitation of Saline Wasteland  
*R. Choukr-Allah*



**VOLUME 8**  
**Crop Response to Salinity**  
**and Salt Tolerance Analysis**

*CONTENTS*

- Introduction 1  
*M. Abu-Zeid and A. Hamdy*
- Salt Tolerance Classification of Crops according to  
Soil Salinity and to Water Stress Day Index  
*N. Katerji, J.W. van Hoorn, A. Hamdy, M. Mastrorilli*
- Salt Tolerance Classification of Winter Cereals Varieties according  
to Grain Yield Performance and Water Use Efficiency.  
*N. Katerji, M. Mastrorilli M.M. Nachit, J.W. van Hoorn, A. Hamdy,  
T. Oweis, O. Abdalla, S. Grando*
- Salt Tolerance of Crop according to their Classification Methods  
and Examination of some Hypothesis about Salt Tolerance.  
*N. Katerji, J.W. van Hoorn, A. Hamdy, M. Mastrorilli*
- Salinity Effect on Crop Development and Yield - Analysis of Salt  
Tolerance according to several Classification Methods.  
*N. Katerji, J.W. van Hoorn, A. Hamdy, M. Mastrorilli*
- Modeling Crop Response to Soil Salinity: Review and Proposal  
of a new Approach.  
*A. Castrignanò, N. Katerji, M. Mastrorilli*
- A Modified Version of CERES - Maize Model for predicting  
Crop Response to Salinity Stress.  
*A. Castrignanò, N. Katerji, F. Karam, M. Mastrorilli, A. Hamdy*
- Productivity Analysis of Crops Grown in Saline Environment:  
Presentation of the major Research.  
*N. Katerji*

**VOLUME 9**  
**Sustainable Use and Management of**  
**Treated Sewage Waste Water**

*CONTENTS*

|   |   |
|---|---|
| Introduction  | 1 |
| <i>M. Abu-Zeid and A. Hamdy</i>   |   |
| <br>  |   |
| An Overview on urban Wastewater: Problems, Risks and its Potential Use for Irrigation |   |
| <i>M. Shatanawi ,A. Hamdy, H. Smadi</i>   |   |
| <br>  |   |
| Perspective Use of treated Wastewater for Irrigation in the Mediterranean Basin       |   |
| <i>I. Papadopoulos</i>  |   |
| <br>  |   |
| Wastewater as a Source: Perspectives and Challenges                                   |   |
| <i>A. Hamdy</i>   |   |
| <br>  |   |
| Sustainable Use of non-conventional Water Resources in Agriculture                    |   |
| <i>A. Hamdy and R. Ragab</i>  |   |
| <br>  |   |
| Wastewater Treatment & Reuse as a potential Water Resource for Irrigation             |   |
| <i>R. Choukr-Allah and A. Hamdy</i>   |   |
| <br>  |   |
| Reuse of treated Wastewater in Irrigation Challenges and Perspectives                 |   |
| <i>A. Hamdy and R. Ragab</i>  |   |

Wastewater Recycling & Reuse as a potential Resource  
for Water Saving in the Mediterranean Region

*R. Choukr-Allah*

Impact of Sewage Wastewater & Sludge on environmental  
Pollution & Human Health Alleviation using ionized Radiation

*R. A. El-Motaium*

Technologies for Water & Wastewater Treatment

*G. Boari, I.M. Mancini, E. Trulli*

Research Needs for sustainable Use of low Quality  
Water in Agriculture

*L. S. Pereira*

**VOLUME 10**  
**Gender and Water Resources Management  
and Development**

**CONTENTS**

|   |   |
|---|---|
| Introduction  | 1 |
| <i>M. Abu-Zeid and A. Hamdy</i>   |   |
| <b>Gender Mainstreaming in the Water Sector:<br/>Theory, Practices, Monitoring and Evaluation</b>                 |   |
| <i>Editor: A. Hamdy</i>   |   |
| <b>PART I</b>   |   |
| Gender and Development : Concepts and Definitions   |   |
| <b>PART II</b>  |   |
| Gender and Water Resources Development: emerging Issues   |   |
| <b>PART III</b>   |   |
| Gender Monitoring and Evaluation: Gender Sensitive Indicators   |   |
| Gender Mainstreaming in Water Management:<br>a Challenge to sustainable Development                               |   |
| <i>A. Hamdy and R. Quagliariello</i>  |   |
| Mainstreaming Equality in Gender Water Resources Management   |   |
| <i>A. Hamdy, R. Quagliariello and G. Trisorio-Liuzzi</i>  |   |
| Integration of Gender Dimensions into Water Resources<br>Development and Management: Issues and Information Needs |   |
| <i>J. A. Sagardoy</i>   |   |
| Why is it critical to mainstream Gender in integrated<br>Water Resources Management in the Mediterranean ?        |   |
| <i>A. Hamdy, J.A. Sagardoy and R. Quagliariello</i>   |   |

Gender and sustainable rural Development:  
the Need for an integrated Strategy  
*A. Hamdy, G. Trisorio-Liuzzi and R. Quagliariello*

Gender Mainstreaming in Water Management:  
a Key to Food Security and Poverty Alleviation  
*A. Hamdy, G. Trisorio-Liuzzi, J.A. Sagardoy and R. Quagliariello*

## **VOLUME 11**

# **Water Valuation in the Irrigation Sectors: Tools and Mechanisms**

## **CONTENTS**

|  |   |
|--|---|
| Introduction<br><i>M. Abu-Zeid and A. Hamdy</i>  | 1 |
| Principles and Examples for the Allocation of scarce Water<br>Resources among economic Sectors<br><i>G. Le Moigne, A. Dinar and S. Giltner</i> |   |
| Principles and Issues in Water Pricing Policies<br><i>A. Hamdy</i>   |   |
| Water Pricing in Irrigation Agriculture<br><i>M. Abu-Zeid</i>  |   |
| Economic Value and Pricing of Water in Agriculture<br><i>H. Kasnakoglu E. H. Çakmak</i>  |   |
| Water Pricing in Agricultural Sector Charging Mechanisms and<br>Implementation<br><i>A. Hamdy</i>  |   |
| Irrigation Cost Recovery in developing Countries<br><i>M. Abu Zeid</i>   |   |
| Overcoming Water Scarcity and Quality constraints:<br>Water Pricing and Cost Recovery Potentialities<br><i>A. Hamdy and C. Lacirignola</i>     |   |

Sustainability, Cost Recovery and Pricing for Water in  
Irrigation Investment

*G. J. Mergos*

Cost Effective and Sustainable Maintenance: some Ways  
to adapt and develop the technological Approach.

*T. E Brabben*

The Economics of Groundwater Use in Agriculture under different  
Water Prices and Supply Regimes in the upland Area of Jordan

*A. Salman, K. Raddad, M. Shatanawi and H. Al-Qudah*

Cost Recovery for Irrigation Agriculture: Egyptian Experience

*E. Barakat*

Irrigation Water Pricing Policy in Morocco's Large Scale  
Irrigation Projects

*M. Ait Kati*

## Volume 12

# Capacity Building for Water Resources Development and Management

## CONTENTS

- Introduction 1  
*M. Abu-Zeid and A. Hamdy*
- Capacity Building for the next Century  
*M. El-Kady*
- Improving the Irrigation Water Sector Performance and the Need for  
effective Capacity Building Programmes  
*A. Hamdy*
- FAO Capacity Building Activities in Socio-Economic and Gender  
Analysis in Water Management  
*I. Sisto*
- The Role of Bari Institute in developing the Capacity Building in the  
Mediterranean Region  
*A. Hamdy*
- Institutional Capacity Building and integrated Water Resources  
Management in the Mediterranean  
*E. Chioccioli , A. Hamdy and C. Lacirignola*
- Critical Issues in Rainfall Enhancement Experiments Via Cloud Seeding:  
Past, Present and Future  
*R. T Bruintjes*



Capacity Building in Water Resources Sector: Human Resources Development

*A. Hamdy*

Experiences on Distance Learning Analysis: Case Study in the Mediterranean Region

*A. Hamdy*

Gender Mainstreaming in Water Sector:  
Capacity Development : Options and Tools

*R.. Quagliariello, G. Trisorio-Liuzzi and A. Hamdy*

**VOLUME 13**  
**Application of New Technologies in**  
**Water Resources Management**

**CONTENTS**

- Introduction  
*M. Abu-Zeid and A. Hamdy* 1
- Decision Support Tools in Environmentally Based Water Resources  
Planning and Management: an Overview  
*A. Hamdy and M. Todorovic*
- Data Base Issues and New Technologies for Data Acquisition.  
*A. Hamdy and C. Lacirignola*
- Modern Technology Tools for Water Management  
*Khaled M. Abu-Zeid*
- Introduction to GIS and Spatial Modeling  
*A. Hamdy and C. Lacirignola*
- The Role of GIS in the Decision Support System ODESSEI  
(Open Architecture Decision Support System for Environmental  
Impact Assessment)  
*E. Todini*
- Expert Systems: a Step-up from Decision Support to  
Decision Making Systems  
*Khaled M. Abu-Zeid*
- Information Systems for Water Resources Planning  
and Management: Application to Irrigation  
*L. S. Pereira*

Modeling for Crop Response to Water physiological Aspects  
*P. Steduto*

Bio-Economic Models for integrating agronomic, environmental  
and economic Issues with Agricultural Use of Water  
*G. Flichman*

Role of Decision Support Systems and New Technologies in Water  
Saving  
*M. Tawfik and. H. Fahmy*

A Proposal for integrating environmental Impact Assessment, Cost  
Benefit Analysis and Multicriteria Analysis in Decision Making  
*A. Nardini*

Information and Communication Technology  
*L. Sisto*

Prospects of Irrigation Modernization in the Mediterranean  
*A. Hamdy, N. Lamaddalena and G. Trisorio-Liuzzi*

Modeling and New Technologies: Tools to be combined for improving  
Irrigation Systems Management  
*N. Lamaddalena*