

Contents

| | |
|--|-----------|
| Foreword by the Regional Director, UNDP Regional Bureau for Arab States | III |
| Report team | V |
| Acronyms | VI |
| <hr/> | |
| Overview | 1 |
| Managing and adapting to water scarcity | 2 |
| Augmenting water availability | 2 |
| Challenges to effective governance | 3 |
| Achieving effective governance | 6 |
| <hr/> | |
| Chapter 1 Water in the Arab region: availability, status and threats | 11 |
| Water resources | 12 |
| Vulnerabilities of Arab water systems | 28 |
| <hr/> | |
| Chapter 2 Challenges to water governance in the Arab region | 39 |
| Water coverage and distribution | 39 |
| Water rights, social equity and economic development | 46 |
| Water and food security | 53 |
| Water-energy nexus | 54 |
| Water institutions and policy formulation | 55 |
| <hr/> | |
| Chapter 3 Concepts and approaches for effective water governance in the Arab region | 69 |
| Water security, poverty alleviation and sustainable human development | 69 |
| Water scarcity: a major determinant for water security | 70 |
| Effective water governance: the vehicle for achieving water security | 72 |
| Cost-effectiveness analysis: an important tool for guiding effective water governance | 75 |
| Cost-effectiveness analysis and achieving effective water governance in the Arab region | 77 |
| <hr/> | |
| Chapter 4 Effective water governance: water's value and cost-effectiveness | 81 |
| Water's economic value | 81 |
| Costs of lack of water and sanitation: an estimate for 2010 | 84 |
| Projection of water-associated costs for 2010-2020: cost of action versus cost of inaction | 89 |
| Proper valuation of water and cost-effectiveness analysis: tools for establishing effective water governance | 93 |

| | |
|---|-----------|
| Chapter 5 Building blocks of effective water governance in the Arab region | 99 |
| Reorienting policy | 99 |
| Reforming institutions | 102 |
| Legislation and enforcement | 105 |
| Empowerment: exploring new levels | 107 |
| Water rights and social equity | 110 |
| Financing and economics | 110 |
| Research and development: a missing link | 115 |
| Cooperation: at the regional and transboundary level | 116 |

| | |
|--|------------|
| Chapter 6 The way forward | 119 |
| Towards effective and sustainable water governance | 119 |

Annexes

| | |
|---|-----|
| Annex I. Cost-benefit analysis versus cost-effectiveness analysis | 125 |
| Annex II. Water institutions and legislation in Arab countries | 129 |
| Annex III. Statistics | 137 |
| References | 157 |

Tables

| | | |
|--------------------|---|-----|
| Table 1 | The expected cost and benefit of action and estimated rate of return on investment in improved water and sanitation provision for 2010–2020 | 5 |
| Table 1.1 | Size and discharge of major drainage basins in the Arab region | 13 |
| Table 1.2 | Total and per capita dam capacity and share of individual countries in the Arab region | 14 |
| Table 1.3 | Major groundwater systems in the Arab region | 16 |
| Table 1.4 | Cost breakdown for typical reverse osmosis desalination plant in the Arab region | 21 |
| Table 1.5 | Desalination cost in selected Arab countries | 22 |
| Table 1.6 | Water dependency ratio in the Arab region, 2011 (surface water only) | 29 |
| Table 2.1 | Estimated energy consumption for desalination processes | 53 |
| Table 2.2 | Regional examples of shared water resources in the Arab region | 56 |
| Table 4.1 | Economic benefits arising from water and sanitation improvements | 85 |
| Table 4.2 | Estimated total costs attributable to none or lack of provision of improved water and sanitation in selected Arab countries, 2010 | 86 |
| Table 4.3 | Estimated costs attributable to none or lack of provision of improved water and sanitation in selected Arab countries, 2010–2020 | 91 |
| Table 4.4 | Estimated required investment in water and sanitation services provision, 2010–2020 | 93 |
| Table 4.5 | The expected cost and benefit of action and expected rate of return on investment in improved water and sanitation provision for 2010–2020 | 94 |
| Table 5.1 | Possible allocation of public/private responsibilities across different water demand management options | 111 |
| Table A.2.1 | Water institutional settings and legislation in Arab countries | 129 |

| | | |
|---------------------|---|-----|
| Table A.2.2 | List of major water-related non-governmental organizations in the Arab region | 136 |
| Table A.3.1 | Physical characteristics of Arab countries | 137 |
| Table A.3.2 | Conventional water resources availability in Arab countries, 2011 | 138 |
| Table A.3.3 | Nonconventional water resources availability in Arab countries, various years | 139 |
| Table A.3.4 | Fluctuations in renewable water resources availability from 1962 to 2011 | 140 |
| Table A.3.5 | Major drainage basins in the Arab region | 141 |
| Table A.3.6 | Characteristics of selected non-renewable shared aquifers | 142 |
| Table A.3.7 | Agricultural land and land use in Arab countries, 1990 and 2011 | 143 |
| Table A.3.8 | Water losses in the water supply distribution system in selected Arab countries, 2005 | 143 |
| Table A.3.9 | Investments needs in water supply and sanitation facilities in selected Arab countries, 2000–2025 | 144 |
| Table A.3.10 | Total dam capacity and share of freshwater stored in reservoirs, selected Arab countries | 145 |
| Table A.3.11 | Socio-economic profile of Arab countries | 146 |
| Table A.3.12 | Total population estimates and projections for Arab countries, 1955–2100 | 147 |
| Table A.3.13 | Human development indicators in Arab countries | 148 |
| Table A.3.14 | Population with access to improved water source, 1995, 2000, 2005 and 2010 | 149 |
| Table A.3.15 | Population with improved sanitation facilities, 1995, 2000, 2005 and 2010 | 150 |
| Table A.3.16 | Water demand in Arab countries by sector, 2011 | 151 |
| Table A.3.17 | Water use and GDP contribution of agriculture and industry | 152 |
| Table A.3.18 | Economically active people overall, by gender and in agriculture, 2011 | 153 |
| Table A.3.19 | Share of the agricultural domestic product to the total GDP and per capita share for Arab countries | 154 |
| Table A.3.20 | Estimates of worldwide governance indicators for Arab countries | 155 |

Figures

| | | |
|--------------------|--|----|
| Figure 1 | Net grain imports to the Arab Middle East and North Africa, 1960–2011 | 5 |
| Figure 1.1 | Total renewable water resources per capita, 1992, 2002 and 2011 | 12 |
| Figure 1.2 | Share of total freshwater stored in reservoirs | 14 |
| Figure 1.3 | Annual average fill of dams in Morocco, 1986–2004 | 16 |
| Figure 1.4 | Observed declines in the groundwater level of the Saïss basin, Morocco, 1963–2007 | 18 |
| Figure 1.5 | Value of groundwater depletion in Jordan, Yemen, Egypt and Tunisia, 2005 | 18 |
| Figure 1.6 | Accumulated desalinated water in selected Arab countries, 2010 and 2016 | 20 |
| Figure 1.7 | Reduction in the unit cost of multi-stage flash desalination plants, 1955–2003 | 21 |
| Figure 1.8 | Wastewater produced and treated in some Arab countries, 2009–2010 | 24 |
| Figure 1.9 | National Rainfall Index for Arab countries, standard deviations for 1988–1992 and 1998–2002 | 28 |
| Figure 1.10 | Survey on recognition of the problem of climate change in the Arab region, February–May 2009 | 33 |
| Figure 2.1 | Trends in population with access to improved drinking water sources in Arab countries, 1990, 2000 and 2010 | 39 |
| Figure 2.2 | Trends in population with access to improved sanitation services in Arab countries, 1990, 2000 and 2010 | 40 |

| | | |
|--------------------|--|-----|
| Figure 2.3 | Water uses in the Arab region | 40 |
| Figure 2.4 | Flood irrigation practices in Bahrain use water inefficiently | 42 |
| Figure 2.5 | Contribution of agriculture to GDP in selected Arab countries, 2010 | 42 |
| Figure 2.6 | Nonrevenue water in water supply utilities in selected Arab countries and cities | 45 |
| Figure 2.7 | Water use distribution between the municipal sector and agricultural sector in the Gulf Cooperation Council countries | 46 |
| Figure 2.8 | Access to improved water source in Arab countries in urban and rural areas, 2011 | 48 |
| Figure 2.9 | Access to improved sanitation in Arab countries in urban and rural areas, 2011 | 48 |
| Figure 2.10 | Operating cost recovery ratio for utilities in selected countries and major cities in the Arab region, latest year available | 51 |
| Figure 2.11 | Annual cost of environmental degradation of water in selected Arab countries | 51 |
| Figure 2.12 | Food imports in selected Arab countries, 2010 (% of merchandise imports) | 52 |
| Figure 2.13 | Electricity production by source in selected Arab countries | 53 |
| Figure 2.14 | Public spending on water in selected Arab countries | 59 |
| Figure 3.1 | Water governance dimensions | 72 |
| Figure 3.2 | Effective water governance scheme | 76 |
| Figure 3.3 | The cost-effectiveness analysis and effective governance triangle | 79 |
| Figure 4.1 | Estimated cost of water purchase from vendors in selected Arab countries, 2010 | 85 |
| Figure 4.2 | Estimated avertive costs on bottled water in selected Arab countries, 2010 | 86 |
| Figure 4.3 | Estimated cost of diarrhoeal death in selected Arab countries, 2010 | 87 |
| Figure 4.4 | Estimated costs of diarrhoeal morbidity (illness and treatment) in selected Arab countries, 2010 | 87 |
| Figure 4.5 | Estimated costs attributable to lack of provision of improved water and sanitation in selected Arab countries, 2010 | 88 |
| Figure 4.6 | Projected costs of water purchase from vendors in selected Arab countries, 2010–2020 | 89 |
| Figure 4.7 | Projected avertive costs on bottled water in selected Arab countries, 2010–2020 | 89 |
| Figure 4.8 | Projected costs of diarrhoeal death in selected Arab countries, 2010–2020 | 90 |
| Figure 4.9 | Projected costs of diarrhoeal morbidity (illness and treatment) in selected Arab countries, 2010–2020 | 90 |
| Figure 4.10 | Projected costs attributable to lack of provision of improved water and sanitation in selected Arab countries, 2010–2020 | 92 |
| Figure 4.11 | Projected cumulative number of households without access to improved water in selected Arab countries, 2010–2020 | 93 |
| Figure 4.12 | Projected cumulative number of households without access to sanitation services in selected Arab countries, 2010–2020 | 94 |
| Figure 4.13 | Water and sanitation in selected Arab countries: Projected cost of action versus cost of inaction | 95 |
| Figure 4.14 | Estimated average annual rate of return on investments in water and sanitation provision in selected Arab countries, 2010–2020 | 95 |
| Figure 6.1 | Comprehensive system of effective water governance | 120 |

Boxes

| | | |
|-----------------|--|-----|
| Box 1 | The World Water Assessment Programme principles of good governance | 6 |
| Box 2 | Gender mainstreaming in water governance | 7 |
| Box 1.1 | The impact of the Aswan High Dam | 15 |
| Box 1.2 | Great Man-Made River in Libya | 17 |
| Box 1.3 | Groundwater use rights | 19 |
| Box 1.4 | Desalination processes and the dominant technology used in the Arab countries | 20 |
| Box 1.5 | Recommended actions for enhancing water desalination sustainability | 23 |
| Box 1.6 | Wastewater reuse: grey water | 24 |
| Box 1.7 | Wastewater regulatory management in the Arab countries | 25 |
| Box 1.8 | Drainage capacity building in North Africa | 26 |
| Box 1.9 | The social cost of groundwater overexploitation and depletion: Bahrain | 30 |
| Box 1.10 | Climate change: impact, vulnerabilities and risks | 31 |
| Box 1.11 | Flood management and mitigation | 34 |
| Box 2.1 | Agricultural expansion based on fossil groundwater resources | 41 |
| Box 2.2 | Water demand management strategies in Tunisia and Morocco | 43 |
| Box 2.3 | Human rights to water and sanitation | 47 |
| Box 2.4 | Women are especially vulnerable to the effects of climate change | 49 |
| Box 2.5 | Scarcity, conflict and adaptation in the Sa'dah basin | 50 |
| Box 2.6 | Somalia food crisis: origins and threats | 52 |
| Box 2.7 | Water in customary laws and traditions | 54 |
| Box 2.8 | Water security issues in Sudan after the separation of South Sudan | 57 |
| Box 2.9 | Managing shared water resources: the Arab region's experience | 58 |
| Box 2.10 | Water governance in the State of Palestine | 60 |
| Box 2.11 | Reducing water losses by combining a management contract with rehabilitation work in Amman, Jordan | 62 |
| Box 3.1 | Water security in Iraq | 70 |
| Box 3.2 | Water sustainability | 71 |
| Box 3.3 | Water decisions and governance systems | 73 |
| Box 3.4 | Integrated Water Resources Management | 73 |
| Box 3.5 | Iraq: water governance in a post-conflict country | 74 |
| Box 3.6 | The World Water Assessment Programme principles of good governance | 75 |
| Box 3.7 | Elements of sustainable water governance | 77 |
| Box 3.8 | Water governance benchmarking | 78 |
| Box 3.9 | Cost-effectiveness analysis | 79 |
| Box 4.1 | Costs of low-quality drinking water: a case from Amman, Jordan | 82 |
| Box 5.1 | Governance systems: hierarchical, market-led and distributed | 101 |
| Box 5.2 | Polycentric governance | 103 |
| Box 5.3 | Data and information availability | 105 |
| Box 5.4 | Steps forward for improving legislation compliance | 106 |
| Box 5.5 | Pioneering water user associations in Lebanon: the Association of the Friends of Ibrahim Abd El Al | 107 |
| Box 5.6 | Public participation in water management | 107 |
| Box 5.7 | Jordan water conservation education | 108 |
| Box 5.8 | Heroes of the UAE | 109 |

| | | |
|-----------------|--|-----|
| Box 5.9 | Gender mainstreaming in water governance | 110 |
| Box 5.10 | Financial analysis of Jordan's cost recovery programme | 112 |
| Box 5.11 | Operation and maintenance requirements | 113 |
| Box 5.12 | Arab Ministerial Water Council | 114 |

Maps

| | | |
|------------------|--|----|
| Map 1.1 | Rainfall distribution in the Arab region | 11 |
| Map 1.2 | Major drainage basins in the Arab region | 13 |
| Map 1.3 | Multi-stage flash (MSF) and reverse osmosis desalination plants in the Gulf, 2008 | 22 |
| Map 1.4.a | Regional climate model projections of average temperature changes (°C) for the 2020s, 2040s and 2070s, relative to 1990s | 32 |
| Map 1.4.b | Regional climate model projections of precipitation changes (%) for the 2020s, 2040s and 2070s, relative to 1990s | 32 |