Achieving Sustainable Development in Jordan

Country Environmental Analysis

EDITORS Raffaello Cervigni and Helena Naber

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On behalf of the government of Jordan it gives me great pleasure to introduce the “Country Environmental Analysis” document for Jordan, prepared in cooperation with the World Bank’s Sustainable Development Sector Department for Middle East and North Africa.

This document, which should be an essential policy tool, was the result of long, tedious and creative efforts of many Jordanians and World bank experts, who have succeeded in putting together the most comprehensive outlook of the state of the environment in Jordan. We are thankful for the support of the World Bank.

The Country Environmental Analysis will be a vital instrument for designing Jordan’s future policies, by integrating the economic policy tools in our decision making processes. As the latest economic crises and its implications have shown, an economic model that is based on consumption alone cannot be sustained, accordingly many countries identified the need to green their economics as the base for sustainable growth and development. Jordan’s Green Economic Initiative will enhance social integration, economic growth an environmental sustainability within one focused, measured and stable economic plan.

The tools that have been used in the process to produce this document will be developed and utilized again for our future execution program. We are engaging all the active stakeholders in the country, and injecting fresh ideas in Jordan’s Green Economy Strategy and Plans. The development of the Green Economy strategy was supported by the
Cabinet, and initiatives such as: the Green financing, Public Private Partnerships in Energy Efficiency, Water Use Efficiency, Waste Management and the Internalization of Environmental Costs within our policy making process, have already been launched.

Jordan is a small country that is rich in human capital; the “Green Journey” will be a twenty years program to retrofit our infrastructure, to become energy, water and resource efficient.

The recommendations identified in this document will be the main drivers for the environmental policies in the country. We look forward to working with the World Bank team, again, to seize the opportunities in mainstreaming the environmental guidelines in the socio-economic development processes.

I wish to thank and congratulate all those who were involved in the preparation of this report, and I am proud that such country-driven effort, produced a scientifically sound reference, and helped us gain in-depth understanding of the complex dynamics of linkages between the economy and the environment in Jordan.

Thank you

Minister of Environment

Hazem Malhas
This Country Environmental Analysis (CEA) has been developed by the World Bank in cooperation with the Government of Jordan. It aims to integrate environment into development and poverty reduction priorities. The Jordan Country Environmental Analysis is the third CEA to be completed in the Middle East and North Africa (MENA) region.

The preparation of this analytical work was made possible by the full commitment of the leadership and staff of the Ministry of Environment, and with the active partnership of a broad range of stakeholders at the political and technical levels. The intergovernmental working group, comprising sector ministries, the Ministry of Planning and International Cooperation, the Ministry of Finance, and the Greater Amman Municipality, was key in facilitating access to data and providing strategic direction during CEA preparation. The contributions of representatives from industrial and private sectors, academia, and nongovernmental organizations have further served to strengthen the CEA’s findings and recommendations. The preparation of this report should be considered good practice in terms of on-the-ground cooperation with local development partners, both through their participation in consultation meetings, and through USAID’s financial support for the industrial section of the report.

The analysis highlights Jordan’s remarkable accomplishments in various aspects of environmental protection that make it stand out among the countries in the MENA region and for which Jordan is to be
congratulated. The country has been ranked second among six MENA countries in terms of adjusted net savings, and third among MENA countries in terms of the environmental sustainability index. Jordan has already achieved MDG target 10, to halve by 2015 the proportion of people without sustainable access to safe drinking water, and is on track to achieving the other targets of MDG goal number 7 on environmental sustainability. The country is unique in the region in its approach to natural protected areas that are managed by the Royal Society for the Conservation of Nature - a nongovernmental organization, which works closely with local communities in managing the protected resources and creating sustainable livelihoods. Moreover, over the past decade the country has made remarkable strides in strengthening its environmental governance system.

However, challenges remain, and Jordan’s ambitions for economic growth and development will pose new and additional challenges to its environment. The CEA, stresses the importance of integrating the environment into broader development and growth priorities. It formulates a number of recommendations for interventions that could help focus efforts within the key areas of transport, water quality and industrial pollution, as well as focus the efforts of the World Bank and other donors in providing development assistance to Jordan.

We look forward to our continued cooperation with Jordan to address its environmental challenges together with other development partners.

Hedi Larbi
Country Director for Iran, Iraq, Jordan, Lebanon, Syria
The World Bank
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In the spirit of the CEA cross-sector approach to the environment’s agenda, the government formed an interinstitutional working group to facilitate access to data and provide strategic and technical feedback during the various stages of the report preparation. The active participation of the members of the working group, both in terms of process and of substance, was essential for the completion of the report.


Additional important contributions were provided, in alphabetical order, by Ms. Suna Abu Zahra (Department of Statistics, DOS), Eng. Mohammad Al-Alem (Ministry of Environment), Ms. Norma Al-Hersh (Ministry of Finance), Dr. Saleem Al-Moghrabi (Aqaba Special Economic Zone Authority, ASEZA), Eng. Husain Badarin (Ministry of Environment), Eng. Jabier Daradkah (Ministry of Environment), Mr. Mohammad Khalaf (Department of Statistics, DOS), Dr. Mohammad Khashashneh (Ministry of Environment), Ms. Suha Mustafa (Jordan...
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The final report benefited from the comments of the participants to the wrap-up workshop held in Amman, Jordan, on June 24–25, 2009. They represented government agencies, academia, and the private sector, as well as nongovernmental organizations (NGOs).

The World Bank team was led by Raffaello Cervigni, senior economist, and included: Dahlia Lotayef, senior environmental specialist; Sherif Arif, senior consultant; Lelis Croitoru, extended-term consultant; Helena Naber, young professional; Ahmed Shawky, senior water resources specialist; Amer Jabarin, lead national consultant; Gert Soer, water quality consultant; Erling Hvid and Henrik Duer, road transport consultants; Robert Anderson and Nedal Aloran, institutional capacity assessment consultants; and Syvie Creger, team assistant. Additional contributions were provided by Kanta Kumari (senior environmental specialist), Vladislav Vucetic (lead energy specialist), Kazi Fateha Ahmed (consultant). Johanne Holten helped with proofreading the final draft of the report and the organization of the wrap-up workshop. The World Bank team operated under the management oversight of Shamshad Akhtar, Regional Vice-President; Hedi Larbi, Director of the Middle East Country Department; Laszlo Lovei, Director of the Sustainable Development Sector Department; Luis Constantino, Sector Manager, Environment and Agriculture Units. The USAID team included Dr. Amal Hijazi (focal point), and Tarek Tarawneh, Jamal Jaber, and Loay Hidmi (consultants). The executive summary was translated into Arabic by Iman Chammas. The production of this book would not have been possible without the contribution of Nedal Aloran, who coordinated the translation and publication process in Jordan, and without the support received from the World Bank offices in Amman and Beirut (Faten Abdulfattah, Ghada Shaqour, Hanan Nawar Obeid, Mohammed Ahmed Karim, Sriram Aiyaswamy, Ziad Badr).

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### Acronyms & Abbreviations

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<tr>
<td>AEWA</td>
<td>African Eurasian Waterbird Agreement</td>
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<tr>
<td>AFD</td>
<td>Agence Française de Développement</td>
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<td>ANS</td>
<td>Adjusted Net Savings</td>
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<td>AOAD</td>
<td>Arab Organization for Agricultural Development</td>
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<td>APEC</td>
<td>Asia-Pacific Economic Cooperation</td>
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<td>ARC</td>
<td>Aqaba Railway Corporation</td>
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<td>ASEZA</td>
<td>Aqaba Special Economic Zone Authority</td>
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<td>AWC</td>
<td>Aqaba Water Company</td>
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<td>BAT</td>
<td>Best Available Technology</td>
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<td>BOD</td>
<td>Biological Oxygen Demand</td>
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<td>BREF</td>
<td>Best Available Technique Reference Documents</td>
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<td>CAFE</td>
<td>Clean Air for Europe</td>
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<td>CAS</td>
<td>Country Assistance Strategy</td>
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<td>CAU</td>
<td>Civil Aviation Authority</td>
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<td>CBA</td>
<td>Cost Benefit Analysis</td>
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<td>CDM</td>
<td>Clean Development Mechanism</td>
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<td>CEA</td>
<td>Country Environmental Analysis</td>
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<td>CEPA</td>
<td>Classification of Environmental Protection Activities</td>
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<td>CIESIN</td>
<td>Center for International Earth Science Information Network</td>
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<td>CO</td>
<td>Carbon Monoxide</td>
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<td>COED</td>
<td>Cost of Environmental Degradation</td>
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<td>Acronym</td>
<td>Full Form</td>
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<td>COFOG</td>
<td>Classification of Functions of Government</td>
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<td>COPERT III</td>
<td>Computer Programme to Calculate Emissions from Road Transport</td>
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<td>Common Services Councils</td>
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<td>DALYs</td>
<td>Disability Adjusted Life Years</td>
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<td>DHS</td>
<td>Jordan Demographic and Health Survey</td>
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<td>DM</td>
<td>Dry Matter</td>
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<td>Department of Statistics</td>
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<td>DVLD</td>
<td>Drivers and Vehicles Licensing Directorate</td>
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<td>EC</td>
<td>Electrical Conductivity</td>
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<td>Environmental Impact Assessment</td>
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<td>Environmental Management Plan</td>
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<td>EMS</td>
<td>Environmental Management System</td>
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<td>Greater Amman Municipality</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GEF</td>
<td>Global Environment Facility</td>
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<td>Government Financial Statistics</td>
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<td>Geographic Information Systems</td>
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<td>GOJ</td>
<td>Government of Jordan</td>
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<td>HC</td>
<td>Hydrocarbon</td>
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<tr>
<td>HCA</td>
<td>Human Capital Approach</td>
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<tr>
<td>HDV</td>
<td>Heavy-Duty Vehicle</td>
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<td>HSC</td>
<td>Higher Scientific Council</td>
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<tr>
<td>IIED</td>
<td>International Institute for Environment and Development</td>
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<tr>
<td>IPPC</td>
<td>Integrated Pollution Prevention and Control</td>
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<tr>
<td>IPPS</td>
<td>Industrial Pollution Projection System</td>
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<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
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<tr>
<td>IWRM</td>
<td>Integrated Water Resources Management</td>
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</table>
### JAPM
Jordanian Association of Manufacturers of Pharmaceuticals and Medical Appliances

### JCI
Jordan Chamber of Industry

### JCO
Jordan Cooperative Organization

### JEDCO
Jordan Enterprise Development Corporation

### JFEMA
Jordan Furniture Exporters and Manufacturers Association

### JHR
Jordan Hejaz Railway

### JHRC
Jordan Hejaz Railway Corporation

### JIEC
Jordan Industrial Estates Corporation

### JIEM
Jordan Integrated Ecosystem Management in the Jordan Rift Valley project

### JISM
Jordan Institution for Standards and Metrology

### JMA
Jordan Maritime Authority

### JNA
Jordan National Agenda

### JR
Jordan Refinery

### JS
Jordanian Standard

### JSCDBD
Jordan Society for Combating Desertification and Badia Development

### JSSD
Jordan Society for Sustainable Development

### JTI
Jordan Transport Institute

### JVA
Jordan Valley Authority

### JVD
Jordan Valley Development

### KAC
King Abdullah Canal

### KTR
King Talal Reservoir

### LDV
Light-Duty Vehicle

### LIMS
Laboratory Information Management System

### MDGs
Millennium Development Goals

### MEMR
Ministry of Energy and Mineral Resources

### MENA
Middle East and North Africa

### MIT
Ministry of Industry and Trade

### MoA
Ministry of Agriculture

### MoEnv
Ministry of Environment

### MoH
Ministry of Health

### MoMA
Ministry of Municipal Affairs

### MoPIC
Ministry of Planning and International Cooperation
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>MoPWH</td>
<td>Ministry of Public Works and Housing</td>
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<tr>
<td>MOU</td>
<td>Memoranda of Understanding</td>
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<tr>
<td>MoWI</td>
<td>Ministry of Water and Irrigation</td>
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<td>NA</td>
<td>National Agenda</td>
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<tr>
<td>NGO</td>
<td>Nongovernmental Organization</td>
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<tr>
<td>NGWA</td>
<td>Northern Governorates Water Authority</td>
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<tr>
<td>NOx</td>
<td>Nitrogen Oxides</td>
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<td>NRA</td>
<td>Natural Resources Authority</td>
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<td>NRH</td>
<td>National Rangeland Rehabilitation</td>
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<tr>
<td>NWMP</td>
<td>National Water Master Plan</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<tr>
<td>OP</td>
<td>Operational Policy</td>
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<tr>
<td>P</td>
<td>Phosphorous</td>
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<td>PAs</td>
<td>Protected Areas</td>
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<tr>
<td>PEER</td>
<td>Public Environmental Expenditure Review</td>
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<td>PTRC</td>
<td>Public Transport Regulatory Commission</td>
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<tr>
<td>QIZ</td>
<td>Qualified Industrial Zone</td>
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<tr>
<td>R&amp;E</td>
<td>Research and Extension</td>
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<tr>
<td>RO</td>
<td>Reverse Osmosis</td>
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<tr>
<td>RSCN</td>
<td>Royal Society for Conservation of Nature</td>
</tr>
<tr>
<td>RSS</td>
<td>Royal Scientific Society</td>
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<tr>
<td>SABEQ</td>
<td>Sustainable Achievement of Business Expansion and Quality</td>
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<tr>
<td>SEA</td>
<td>Strategic Environmental Assessment</td>
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<td>SMI</td>
<td>Small and Medium Industries</td>
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<td>SO$_2$</td>
<td>Sulfur Dioxide</td>
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<tr>
<td>SO$_4$</td>
<td>Sulfate</td>
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<tr>
<td>SWM</td>
<td>Solid Waste Management</td>
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<td>TDS</td>
<td>Total Dissolved Solids</td>
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<td>TEC</td>
<td>Technical Evaluation Committee</td>
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<tr>
<td>TRC</td>
<td>Technical Review Committee</td>
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<tr>
<td>TSP</td>
<td>Total Suspended Particulates</td>
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<td>ToR</td>
<td>Terms of Reference</td>
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<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>UNCC</td>
<td>United Nations Compensation Commission</td>
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<tr>
<td>UNECE</td>
<td>United Nations Economic Commission for Europe</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<tr>
<td>UNICEF</td>
<td>United Nations Children's Fund</td>
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<tr>
<td>UNIDO</td>
<td>United Nations Industrial Development Organization</td>
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<tr>
<td>USAID</td>
<td>U.S. Agency for International Development</td>
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<tr>
<td>USEPA</td>
<td>U.S. Environmental Protection Agency</td>
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<tr>
<td>VSL</td>
<td>Value of Statistical Life</td>
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<tr>
<td>WAJ</td>
<td>Water Authority of Jordan</td>
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<td>WHC</td>
<td>World Heritage Convention</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<td>WIS</td>
<td>Water Information System</td>
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<td>WQO</td>
<td>Water Quality Objectives</td>
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<td>WTP</td>
<td>Willingness to pay</td>
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<tr>
<td>WUAs</td>
<td>Water User Associations</td>
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Jordan is a small, middle-income, open economy, with a limited natural resources base and active trade flows. As the integration of Jordan into the world economy progresses, enhancing Jordan’s environmental management can not only improve the well-being of Jordanians, but also enable the country to better compete in increasingly environmentally conscious markets.

To date, Jordan’s environmental agenda has not yet been comprehensively assessed, particularly in terms of providing indications on how to integrate long-term environmental concerns into the development process.

Striking a balance between breadth and depth of the analysis, this report fills such a gap and provides insights to inform the dialogue between the World Bank and the Government of Jordan on selected areas of particular relevance for continued sustainable economic and social development. The report has been prepared by a World Bank team that has worked in full partnership and cooperation with a Jordanian team, led by the Ministry of Environment, and representing a broad cross-section of government institutions.

To achieve its core objectives of identifying key strategic priorities for improved environmental policy across sectoral boundaries, the Country Environmental Analysis (CEA) analyzes sequentially the country’s key environmental concerns and their relative priority; the links between development and environmental pressure in selected themes or sectors (water quality, road transport), and the capacity of Jordan’s institutions to reconcile development and growth objectives.
Most of the data and information used for the report have been collected in the period 2007–08, although efforts have been made to take into account selected key developments in relevant policies that have occurred since then.

A. FINDINGS

Key environmental issues in Jordan

Over the last decade, the Government of Jordan has made considerable progress in its ability to reduce environmental degradation. It has made this progress through an improved legislative framework, stronger institutions, and a number of publicly funded projects. Since its establishment in 2003, the Ministry of Environment has achieved the following:

» Spearheaded efforts to improve treatment of industrial wastewater (establishing recently in partnership with the private sector an industrial wastewater treatment plant in Irbid, with plans on the way for the construction of another plant in Zarqa); as well as medical and hazardous wastes (a plant due to start operation at the end of 2009 will treat some 70 percent of the annual waste flow);

» Enhanced the inspection system through updated and comprehensive regulations, soon to be adopted;

» Played a key role in the establishment of the environmental rangers department in 2006, which has improved, among other things, the effectiveness of vehicle inspection; and

» Promoted, in partnership with local NGOs, public consultations on a range of environmental matters.

Important challenges remain, however.

In spite of the current limits of air quality monitoring, available evidence indicates that in selected hot spots of industrial activity and vehicular traffic, air quality is poor. Transport, power generation and industry account for the bulk of air emissions, particularly total suspended particulates (TSP), sulfur dioxide (SO₂), and nitrogen oxides (NOₓ). Recent policies on fuel quality (phase-out of leaded gasoline and high-sulfur diesel) and diversification of energy sources (with a stronger role given to gas-fired power plants and renewable energy) are important steps in the
right direction. At the same time, a 7 to 10 percent annual growth in the vehicular fleet (where older, more polluting combustion technologies still dominate) is reason for concern, along with continued pressure on air quality from important industries such as mining and cement production.

Jordan’s chronic water scarcity (available water resources are 133 m$^3$/capita/year, including wastewater reuse) has resulted in mining of renewable groundwater resources (with extraction currently 50 percent above safe yields, 2005), increased salinity, declining water table levels and increasing pumping costs. The 1997 Water Strategy, the 2005 National Water Master Plan (NWMP 2005) and the 2005 National Agenda call for an increase in water supply (expected, according to the NWMP 2005, to reach 1.1 billion m$^3$/year in 2020) and an enhanced role for treated wastewater (expected to reach 200 million m$^3$/year in 2025), especially in agriculture. These interventions will relax to some extent the water quantity constraint, and probably result in improved quality. The cost of the policy mix, however, is likely to be high, and there are probably important margins for improvement and cost savings on the demand side, where average returns to irrigation water are in the order of Jordanian dinar (JD) 0.6/m$^3$, far from the ambitious National Agenda target of JD 5/m$^3$ by the year 2017.

Land degradation takes a heavy toll on ecosystem stability and on farmers’ income (especially among the poor). Productivity of rangeland, which is a key source of livelihood for most of Jordan’s rural poor, has dropped about 50 percent over the last decade and half, due to overgrazing and the inflow of refugees (and their livestock) from the first Gulf War. The Ministry of Agriculture is attempting to reverse the problem by establishing 84,000 hectares (ha) of reserves for rangeland rehabilitation. More recently, the government has included an integrated financial strategy to combat desertification in the executive development program 2009–11.

Biodiversity conservation is an area of significant progress in Jordan, with rapid growth in the land area under protection over the last couple of decades (expected to reach more than 6 percent of total land area in the country, that is, double the average of the Middle East and North Africa [MENA] region), and a model of decentralized Protected Area (PA) management operated through a partnership with nongovernmental organizations (NGOs). However, legal issues, conflicting attributions
on land use planning, and funding constraints need to be addressed to ensure the long-term viability of Jordan’s PA system.

*Solid waste management* (SWM) has been improving in Jordan, with current collection rates estimated at 90 percent and 70 percent in urban and rural areas, respectively. With the notable exception of Amman (which accounts for about half of total solid waste generation), safe disposal remains a concern, however, since most of the other municipalities discharge solid waste in open dump sites with no lining, leachate management, or biogas collection. Management of hazardous and medical waste is also inadequate, because most of the former (totaling 23,000 tons in 2001 and expected to increase to 68,000 tons per year by 2017) is disposed of with no treatment; whereas half of the latter is treated in outdated incinerators located in populated areas, and the other half is mixed with municipal waste in open dump sites. Key issues to be addressed to improve Jordan’s SWM system following Amman’s example include the need for a more comprehensive and detailed legislative framework, as well as for a fully formulated sector strategy and policy. In addition, cost-recovery rates will need to improve to alleviate the resource constraint that hinders the SWM system in many municipalities.

When benchmarked against standard *international indicators of environmental performance*, Jordan fares quite well in comparison to other middle-income countries in the MENA region and elsewhere. In particular it has achieved progress on attaining target nine (environmental sustainability) of the Millennium Development Goals (particularly with respect to access to potable water), it ranks third in the MENA region in terms of the Environmental Sustainability Index (ESI), and it ranks second in MENA in terms of Adjusted Net Savings (which measure a country’s ability to maintain a balance among natural, physical, and human capital). This progress could be an indication of favorable conditions for focusing the country’s effort on the main present and future environmental challenges, provided that information is adequate on relative priorities across environmental themes, and on key trade-offs to be addressed to make progress on those priorities.

**The cost of environmental degradation**

Environmental degradation inflicts a cost to society, in terms of mortality and morbidity from air and water pollution, foregone income of ac-
tivities linked to natural resource use (such as agriculture, tourism), and cost of “aversive behavior” (for example, water filtration, purchase of bottled water to reduce exposure to water-borne diseases). The Cost of Environmental Degradation (COED) in Jordan is evaluated taking into account both immediate and long-lived impacts of degradation that occurred in a reference year (2006). Using a range of well-established and internationally accepted methodologies, the total COED is estimated to be in the range of JD 143–332 million, with an average of JD 237 million, or 2.35 percent of gross domestic product (GDP) in 2006. If the impact of emissions on global environment is added, the total cost to Jordan and the global community as a whole would be JD 393 million.

Figure 1 illustrates the magnitude of impacts estimated for each environmental theme. The most important contributor to the overall damage is air pollution, which is highly localized and accounts for 1.15 percent of GDP. The impact of inadequate water supply, sanitation and hygiene is the second most significant, representing about 0.81 percent

![FIGURE 1 ANNUAL COST OF ENVIRONMENTAL DEGRADATION BY CATEGORY, 2006](image)

Source: Authors.
Note: GDP = gross domestic product.
of GDP. The cost of improper disposal of solid waste ranks third, followed by that of degradation of soil and coastal zone.

Given data limitations, these estimates should be interpreted as approximations; they are likely to be conservative, because several forms of degradation could not be quantified (notably the possible impacts on health of untreated industrial wastewater). The relatively high cost of outdoor air pollution should be interpreted as a signal of degradation in selected road traffic and industrial hot spots (such as downtown Amman, Zarqa, Fuheis, and so on), and not as a reflection of overall poor air quality at the national level. In particular, air pollution does not affect tourism poles such as Petra, the Dead Sea, Jerash, and so on. The magnitude of the problem in Jordan is less significant than in comparator countries in the region (for example, the Arab Republic of Egypt) or elsewhere (for example, Peru).

**Water quality**

As one of the most water-scarce countries in the world, one of Jordan’s key priority is management of water quantity. But water quality matters, too: poor water quality is a significant social concern because of its effects on human health and productive activities; conversely, water of better quality means that more resources are available to mitigate the scarcity problem. These are the main reasons why this chapter focuses on the quality aspect of Jordan’s water agenda, proposing an integrated approach, in terms of resources evaluated (surface, ground, and treated wastewater), sources of pollution (urban, industrial, and agriculture sectors), and range of impacts considered (human health, income of farmers, and water consumers).

The issue of adequate incentives for better quantity management clearly remains important, but is not addressed in this report. After the National Agenda was established, it appears that the reduction of water-related subsidies and the creation of incentives for allocating water to higher value added uses are being recognized as necessities that public policies will address in the future.

Although significant limitations to data access and availability prevent at the moment a fully statistically representative assessment of water quality, a number of important policy indications can be extracted from existing data. In particular, the following:
Surface water, which appears to be of overall acceptable quality, presented, at the time of data collection, important problems of salinity and bacteriological contamination of a localized nature, which because of impacts on human health and agriculture are of strategic significance. In particular, levels of *E. coli* and total dissolved solids (TDS) concentrations at the Zarqa junction of the King Abdullah Canal (KAC), which is located upstream of important irrigation schemes in the Jordan Valley—have been in recent years well above the respective quality norms. Improved quality of effluent from the new As-Samra treatment plant might mitigate the problem. Considering the overall decline of fresh surface-water resources observed in recent years and in particular due to the drying up of the Yarmouk River base flow, it is possible that Jordan will experience a more general worsening of average quality of surface water.

In terms of groundwater, the evidence suggests a simultaneous trend of declining water tables and increasing salinity in most aquifers, with resulting higher extraction costs (in terms of pumping as well as accelerated well replacement), and the need to use more irrigation water for leaching. Higher production costs and declining yields affect farmers’ income, for a share of some 40 percent of the 2006 cost of environmental degradation linked to poor water quality (not including industrial wastewater impacts). The cost, however, likely will escalate in the future, as water tables keep declining, and as increased demand for potable use in urban areas raises the opportunity costs of the additional water required to decrease salinity. Nitrates pollution of aquifers appears of concern mainly in the Amman-Zarqa basin.

Access to sanitation is relatively high (with some exception in rural areas), and the quantity of municipal wastewater collected and treated has been increasing steadily. The quality of the wastewater effluent is a reason for concern: about half of the total effluent does not seem to meet national quality norms for pollutants such as Biological Oxygen Demand (BOD) (55 percent of noncompliance) and *E. coli* (46 percent). The situation has improved recently with the establishment of the new As-Samra treatment plant, which has the potential to increase compliance rates to 80 percent; further progress may be expected if the targets of the National Agenda are met, although the cost is likely to be high.

In terms of industrial wastewater, only an estimated 28 percent of the total effluent is treated (almost 50 percent excluding wastewater from
potash mining, which is likely to have limited environmental impacts). About 40 percent of industrial wastewater is estimated (net of mining effluents) to be discharged to the public sewer network, but the quality of the effluent is of concern because of high rates of discharges without licensing, the rather lenient standards for heavy metals and organic toxics, and the considerable rates of noncompliance with applicable regulations (more than 30 percent for ammonia and suspended solids). As for the 60 percent of wastewater not disposed of in sewers, monitoring of the effluent quality is limited and does not adequately cover certain toxic substances. Disposal of wastewater through tankers is a widespread practice, virtually unmonitored in terms of effluent quality, and likely to pose health hazards where wastewater is disposed of in unlined landfills (such as Al-Ekeider), with resulting possible infiltration into groundwater. Current policies seem to focus on centralized treatment plants as the strategy of choice to address the problem. Important opportunities may exist, however, to reduce the overall public and private cost of treatment by encouraging plant-level interventions (both production process and end-of-pipe treatment).

In the face of the combined effects of groundwater mining, dwindling surface resources population growth, and policies aimed at promoting industrial development, several of the quality problems reviewed in this report are likely to worsen in the medium to long term, and result in impacts on human health, income and agriculture outputs, well beyond the 0.8 percent of GDP estimated in this CEA for 2006.

The National Agenda establishes a number of targets of increased water supply and enhanced wastewater treatment, which are likely to reduce water scarcity and deliver water quality benefits as well. This report however argues that those programs could be complemented and optimized by considering interventions that could significantly alleviate water quality problems at relatively low cost. Such interventions could include hygiene programs to reduce at-recipient exposure; but more important, water savings policies (especially in irrigation) that could enable—if supported by water rights regulation—on-site increased dilution, bulk-water arbitrages, and reduction of polluting concentrations at larger geographic scales.

A simplified cost-benefit analysis at the macrolevel suggests that it might be possible to eliminate up to 80 percent of the social cost of
EXECUTIVE SUMMARY AND RECOMMENDATIONS

water degradation (as estimated by the CEA) by optimally combining hygiene programs, enhanced dilution via water savings, and wastewater treatment. Under the assumption used in the CEA (and subject to limited information on baseline concentrations, unit costs, and other parameters), this could be achieved by a water-saving program aimed at reducing losses in irrigation at a rate of 3 percent per year, accompanied by hygiene programs targeted at some 80,000 households.

Air pollution and road transport

The transport sector in Jordan accounts for a large share of air emissions (estimated at 80 percent for \( \text{NO}_x \); 20 percent for \( \text{SO}_x \), and 40 percent for TSP). By developing indicative estimates of transport emissions by vehicle type, fuel, and traffic location, both for the reference year (2006) and for a no-intervention future baseline, the CEA identifies policy options for reducing the environmental impacts of road transport.
With 7 to 10 percent annual growth of the vehicular fleet, a relatively large share (32 percent) of older technology (and thus higher emissions) vehicles, a low rate of replacement of old vehicles, and—pending implementation of recent reforms—low-quality fuels (high sulfur diesel), Jordan’s transport sector is poised to remain a large emitter in the future, unless suitable policy actions are undertaken. Growth in vehicular emissions might even become more significant if demand (vehicle-km) increase, and/or occupancy rates decrease. These are likely side effects of per capita income growth, as the experience of member countries of the Organisation for Economic Co-operation and Development (OECD) suggests. In recent times, the government has adopted a transport strategy that purports to increase the share of rail in freight transport. Once implemented, this will reduce polluting emissions from the sector.

As part of the CEA, a basic traffic-emission model was developed to assess current and future levels of emissions. The model permits to evaluate the total volume of road transport emissions, as well the associated social damage, which is estimated to be in order of JD 130 million per year. In addition, the model permits to identify Light-Duty Vehicles (LDV) and minibuses, as well as Heavy-Duty Vehicles (HDV) as the main sources of PM, NOx, and SO2 emissions (with contribution ranging between 60 and 90 percent of the total), whereas passenger cars appear to be the key source of carbon monoxide (CO) and hydrocarbon (HC) emissions (more than 80 percent).

These results suggest that to abate key pollutants such as PM, SO2, HC, and NOx, for which quantification of health impacts effects is readily obtainable, both in physical terms (increased risk of premature mortality and of morbidity) as well as in monetary terms, policies should focus on higher emitting vehicles (LDV, minibus, HDV), seeking in the short term to reduce emissions per unit of traffic, and in the longer term, to decouple growth of traffic from growth in population and per capita income.

On the other hand, policies to increase the use of public transport or more generally increase occupancy rates (number of passengers per vehicle-km), will have most of their environment benefits in terms of decrease in other pollutants, such as CO, for which monetary estimates of damage are not available in the literature, and which thus are less amenable to being evaluated in cost-benefit terms.
**EXECUTIVE SUMMARY AND RECOMMENDATIONS**

The CEA assesses in simple cost-benefit terms the merits of different policy options to reduce, in the shorter term, “monetizable” emissions (PM, SO₂, HC, and NOₓ). These options are as follows:

» Improvement of fuel quality by phasing out high-sulfur diesel. This option already has been adopted by the government, but the precise phasing out schedule is still subject to uncertainty, so the analysis might help in the implementation phase of the policy;

» Improvement of vehicle maintenance through workshop certification and staff training; and

» Improvement of the environmental quality of the vehicle fleet through stringent environmental requirements to newly registered vehicles.

The results of the analysis suggest (see figure 4) that sequential adoption of these policies could reduce about 50 percent of the social cost of air pollution that would occur in a no-intervention scenario; and that this can be achieved in a fairly cost-effective manner (that is, with a cost-benefit ratio well below 1).
The analysis indicates that margins are wide for further, cost-effective, abatement interventions, such as fiscal incentives (for example, fuel taxation, road charging); and, in the longer term, through reduced demand (per capita or per unit of GDP) for use of the higher polluting vehicles (LDVs and HDVs), through modal shifts, improved logistics, and so on). These options were not further analyzed because of the lack of data on freight and passenger demand (ton-km and passenger-km), which represent a serious hindrance to the design and evaluation of transport policies, let alone air quality management.

In terms of the other “nonmonetizable” pollutants (such as CO), the CEA also provides a preliminary evaluation of the emission reduction that can be achieved by increasing the use of public transport. Based on the goal of increasing the share of public transport in total traffic, which the Greater Amman Municipality has indicated to be 75 percent for the year 2020, the CEA estimates (using 2006 data) that CO and HC emissions could be reduced up to 60 percent. Considering the estimated current level of public ridership is about 40 percent, the proposed increase to 75 percent would represent a step change, which is likely to require a high level of institutional, financial, and political commitment.
Industrial pollution

On account of its current importance in Jordan’s economy (more than 22 percent of GDP), its fast rate of annual growth (12 percent in recent years), and the lack of an adequate regulatory and enforcement framework, the industrial sector is an important source of environmental pressure in Jordan, and is likely to become more so in the future, especially if the full implementation of trade agreements will result in an increase of foreign demand for Jordanian industrial products.

Poor or not easily accessible monitoring data on polluting emissions makes it difficult to evaluate priorities for pollution abatement across sectors, locations, pollutant types, and enterprise size. To overcome this obstacle and provide policy makers with broad indications for action, this chapter proposes to apply international emission coefficients (obtained from the World Bank’s Industrial Pollution Projection System [IPPS] system) to estimate the structure of industry’s pollution. The results are subject to obvious caveats linked to the limitations of the methodology, and to some data classification issues, but are found to be in line with the limited empirical evidence available. The following key findings should be used as first indications of areas of policy interest, but they should be revisited on the basis of Jordan-specific industrial emission data as soon as they become available:

- The bulk of pollution originates from enterprises located in the Amman and Zarqa industrial districts; the relatively lower share of total pollution in Irbid and Zarqa is associated to advanced forms of localized environmental degradation, which is no less important than Amman’s pollution.

- While at the national level most of the pollution comes from (larger) industrial enterprises (70 percent to 90 percent depending on the pollutant), in Irbid, and particularly Zarqa, microenterprises are an important source of pollution, accounting for up to 60 percent of some emissions (that is, BOD in Zarqa).

- At the national level, the chemical, medical, and engineering and electrical sectors account for the larger contributions to most polluting emissions. The sector ranking is different, however, when specific pollutant types are considered. In particular, the food supply sector is estimated to be the top air and water polluter; the engineering and
electrical sector has the largest share of heavy metal pollution; and the leather and garment sector is the top contributor to toxic emissions (particularly water). For virtually all pollutants, the “cleanest” sector is the packing and paper sector.

» Pollution shares of industrial subsectors vary by location. The ranking of polluting industries per medium in Amman and Zarqa is similar to that at the national level. For Irbid, however, the ranking is different: leather is the most polluting industry of air and air toxics and is a relatively important contributor to water pollution (BOD). This suggests that efforts to abate pollution should be site specific and take into account local conditions.

» Mining is important in terms of air pollution. Because it is remotely located with respect to urban areas, however, it is difficult to determine its importance in terms of health impacts.

» Projections of environmental pressures for 2012 and 2017 indicate that the top four polluting industry will remain the same (chemical, medical, engineering and electrical, and construction sectors). Some of the lower rankings may change, however, with the plastic and rubber sector poised to become a more important polluter in 2017.

» Because of large variations across sectors in unit abatement costs and relative contribution to total emissions, the cost of abatement policies is likely to be very sensitive to the selection of target sectors. As an example, it is estimated that the cost of reaching a given abatement target for all pollutants (for example, 50 percent or better) can vary by a factor of up to 3.5, depending on whether or not the optimal combination of abatement efforts across subsectors is selected.

» A few abatement cost curves are estimated to further illustrate the importance of carefully targeting abatement efforts. In the case of air pollution, some 80 percent of total emissions can be abated by focusing on the food, chemicals, medical, and plastic sectors, at a cost of $4,000 per ton or less; the unit cost of achieving the remaining 20 percent is estimated to be in the range of US$8,000–14,000. For water toxics (see figure 5), priority should be given to the leather, food, construction, and furniture sectors, which have the lowest unit abatement cost and account for 80 percent of total emissions. The level of abatement attainable at any given unit cost varies considerably from one industrial location to the other.
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**Institutional Assessment**

The CEA conducts an institutional assessment to evaluate Jordan’s environmental governance system based on the World Development Report 2003 framework. This framework identifies three main functions that institutions should carry out to promote sustainable environmental management and long-term human well-being: (1) picking up signals on environmental conditions; (2) balance interests, and (3) execute decisions. The CEA benchmarks Jordan performance against standards of international good practice, such as the Aarhus convention on access to information, public participation, and access to justice; and European Union and World Bank procedures for carrying out Environmental Impact Assessment (EIA).

Over time, legislation has been delegating responsibilities for environment-related matters to a number of different institutions. It is only with the environmental protection law (introduced in 2003 and amended in 2006) that Jordan established an institution (the Ministry of Environment) entrusted with a broad mandate of policy making and coordination of the country’s environmental agenda.

As a result, a complex system of attributions of similar or related functions to different institutions remains, which weakens the overall

![Figure 5: Abatement Cost Curves for Water Toxics](image-url)
effectiveness of Jordan’s environmental management because of overlaps in roles and responsibilities (particularly in terms of monitoring, regulation, and enforcement).

**Picking up signals** from society relies on monitoring environmental quality, disseminating results, and gathering feedback from society. Air and water quality monitoring suffer from overlapping roles, limited data disclosure and reporting, and, particularly in the case of air monitoring, limited coverage across space and time.

The general public in Jordan shows interest in environmental matters (according to surveys, more so than in comparator countries in MENA and elsewhere), several NGOs are engaged in environmental management, and the media promote awareness on environmental issues. However, access to information on environmental quality is limited by the lack of a comprehensive environmental database and is restricted by requirements of justification to access. Also, in spite of increased individual cases of public consultation, institutionalization of public participation is limited in the development of plans, programs, and policies as well as laws, rules, and legally binding norms.

The ability of Jordan’s institutions to **balance interests** is assessed first in terms of its environmental standards. These standards compare well to OECD countries for several important air pollutants, indicating a strong importance attached to the environment in regard to potentially conflicting development goals. At the same time, a mechanism seems to be lacking to systematically evaluate trade-offs between economic growth and environmental quality, the enforcement of standards remains problematic, and little effort has been made to combine standards with market-based mechanisms to balance interests.

Integration of environmental concerns into sector strategies has consisted largely of a statement of principle with no clear targets and dedicated resources. A structured system to make environmental mainstreaming more concrete (such as Strategic Environmental Assessment, SEA) is warranted.

**Executing decisions.** Because availability of resources is one of the main constraints to executing decisions of environmental management, the CEA conducted (for the first time in Jordan) a public environmental expenditure
review (PEER). The PEER showed that public expenditure on environment during the period 2002–06 amounted to an average of 0.8 percent of Jordan’s total GDP, and formed 2.3 percent of total government spending. This compares well to a number of EU countries; however, the magnitude of environmental degradation (2.35 percent of GDP in 2006 according to the CEA estimate) might indicate that additional environmental protection efforts are in order. The PEER does not yet provide indications on the quality or effectiveness of the expenditure. It points to a strong bias of public expenditure in favor of wastewater treatment (which accounts for at least 40 percent of the total). This finding is prima facie at odds with the results of the cost of environmental degradation analysis, which suggest that air pollution is a more serious concern than water quality.

Within the amount of resources dedicated to environmental protection, those available to the Ministry of Environment have particular importance, especially given the ministry’s strategic role in policy making, coordination, monitoring, and enforcement. The CEA finds that although improvements have been achieved since its establishment in 2003, the ministry remains severely understaffed (as confirmed by international comparisons) and short of equipment.

Apart from the special case of the Aqaba Special Economic Zone, for which environmental protection, along with most other functions of government is transferred to a local entity (the Aqaba Special Economic Zone Authority, ASEZA), environmental management in Jordan remains quite centralized. To achieve stronger environmental management at the local level, the following efforts are needed: increasing resources and strengthening the capacity of regional directorates within the Ministry of Environment, enhancing their mandates and delineating responsibilities in relation to the units at headquarters, and enhancing the environmental capacity of other agencies’ local directorates.

The implementation of the EIA is an important form of executing decision. An equivalence assessment between Jordan’s system and international best practice systems (World Bank and European Union) finds that many features of the Jordanian EIA system are compatible with the World Bank and the European Union requirements. In contrast, however, some moderate and significant gaps remain between the systems and effective application of EIA procedures is limited by staffing constraints in the ministry.
B. RECOMMENDATIONS

The CEA contains (see chapter 8 for details) a number of recommendations for action on air quality, water quality, and cross-cutting themes, which include the identification of lead and partner agencies for implementation, and a qualitative assessment of expected impacts and likely coordination and transactions costs. Main recommendations, which take into account comments and suggestions made by the participants to the CEA wrap-up workshop, include the following:

Short term (up to 18 months)

Air quality

1. The Ministry of Environment, in partnership with the Greater Amman Municipality, and building on the technical assistance provided by the French development agency, should lead national efforts to accelerate the enhancement of the air monitoring system, including ambient air quality, as well as emission from stationary sources (possibly giving priority to the likely highest emitting sectors, such as those identified in the chapter on industrial pollution), as well as mobile ones. The geographic coverage should include the major population and industrial centers in the country.

2. Accelerate the phase-out of high sulfur diesel: the decision has already been made by the Ministry of Energy, so it is important to mobilize the resources required for its enactment (for example, refinery upgrade, and so on). This can decisively contribute to the reduction of SO₂ emission, and to a lesser extent, of PM. Options to improve the quality of fuel used by the industrial sector should be considered.

3. Define an action plan for implementing other key policies to reduce emission per unit of traffic (that is, emissions per vehicle/km, ton/km), namely, enhancing maintenance of vehicles, improving the environmental performance of vehicular fleet through strengthened regulation of imports, and promoting the replacement of older vehicles.

4. Establish Jordan-specific emission factors (based on driving-circle measurement or other internationally accepted methodologies) to improve information on the volume and distribution across the vehicular fleet of polluting emissions from road transport. The tech-
nical capacity and equipment of relevant authorities (for example, Ministry of Environment, Drivers and Vehicles Licensing Directorate, and so on) need to be adequately strengthened.

**Water quality**

5. Enhance the monitoring of groundwater resources by synchronizing the quality and quantity parameters to better evaluate the impacts of accelerated aquifer use on the quality and availability of groundwater. This requires establishing a dedicated network of observation wells.

6. Revise and strengthen the standard for wastewater discharged from industries (JS 202/2007), in particular with respect to TDS, heavy metals, and other toxic organic materials. Revise the regulation related to discharging industrial effluents in the domestic sewer network.

**Cross-cutting themes**

7. Policy, strategy, and legislation
   - Adopt a strategic approach to inspections, defining in a transparent manner priority locations and sectors (as opposed to the current approach which primarily is driven by complaints).
   - Based on the results of improved air and water quality monitoring, establish a list (or improve existing ones) of priority pollution hot spots, particularly in Zarqa.
   - Encourage compliance with environmental regulation through public disclosure of performance of the polluters by the NGOs and the media.

8. Coordination and mainstreaming
   - Focus the scarce resources of the Ministry of Environment on core functions of strategy development and follow-up, policy making, environmental advocacy within the cabinet, and improved coordination across sectors; limit to the minimum the Ministry of Environment’s direct engagement in project implementation activities.
   - Improve the decentralization of the Ministry of Environment’s activities and enhance the role of the regional directorates.

9. Awareness, public participation, and disclosure
   - Improve the application of the EIA system in Jordan, initially through strengthening the existing system, through application of
the Jordanian Public Law related to public consultation and disclosure, and through development of standard terms of reference (ToRs), guidelines for sector EA guidelines and EA reviews, and decision-making criteria for the Central Licensing Committee and the EIA Review Committee.

10. Technical support and capacity building

- Support compliance with environmental regulation through the provision of advisory services and technical assistance to industries (for example, on cleaner technologies, processes, energy efficiency, and environmental management system (EMS) implementation).

**Medium term (one to three years)**

**Air quality**

1. Establish, as part of the strategic planning of large urban areas (starting with the implementation of Amman’s Master Plan), traffic models to optimize the design of transportation system and the related air pollution and congestion reduction benefits.

2. Define—in priority pollution hot spots and where not already available—air pollution abatement plans, containing the following: (1) targets for selected environmental improvement objectives, (2) a clear assignment of roles and responsibilities for the different stakeholders involved; and (3) subject to criteria of financial sustainability and cost recovery, incentive mechanisms (including soft loans) to encourage industries to comply with environmental regulation.

**Water quality**

3. Adopt a unified national water law, based on the principles of Integrated Water Resources Management (IWRM), that links water quality and water quantity sustainability objectives.

4. Under the initiative of the Ministry of Water and Irrigation, streamline the national water quality monitoring system to avoid duplication of efforts and enhance data management.

5. Promote pollution control through a combination of (1) positive incentives (including soft loans and technical assistance) to encourage the use of cleaner production processes; and (2) gradual phasing-in
of negative incentives (pollution levy for industrial emissions exceeding a given standard) to induce firms to meet effluent and ambient standards (for example, end-of-pipe treatment). The levy initially could be linked to level of activity or employment, and later, once adequate monitoring capacity is in place, to emission levels.

6. Conduct a study to evaluate the potential for reducing the social damage of water quality degradation through water-saving policies, to be combined with hygiene programs and enhanced wastewater treatment. The mix of policy tools would be defined following criteria of cost-effectiveness and using analytical methods, such as water quality simulation, multicriteria and economic optimization models, Geographic Information Systems (GIS), and water Public Expenditure Reviews.

Cross-cutting themes

7. Policy, strategy, and legislation
   › Undertake a rapid assessment (based on environmental audits or other tools) of the average and marginal abatement cost by pollutant type and industrial sector, as a basis to better inform pollution abatement policies and programs.
   › Promote the inclusion of specific targets of environmental improvements in selected sector strategies (starting with the implementation with the recently adopted transport strategy), as well as the definition of responsibilities for their achievement, performance indicators, and the allocation of the required human and financial resources.

8. Coordination and mainstreaming
   › Accelerate, through the development of the necessary regulation, the adoption of SEA to promote the integration of environmental concerns across sectors.

9. Awareness, public participation, and disclosure
   › Improve public access to information and participation in environmental matters. To that end, the Ministry of Environment, in collaboration with relevant agencies, should consider revising the Environment Law No. 52/2006, after a suitable implementation time.
Institutionalize the practice of disseminating information, holding consultations, and instituting the right of access to information without justification. This might require amendments to the law regulating access to information (47/2007), to be agreed on at the cabinet level.

Amend the EIA regulations to allow for public consultation and disclosure (starting with the distribution of scoping statements to relevant stakeholders); conduct environmental audits; and outsource to qualified third parties the inspection of large polluting installations, as well as monitoring and follow-up of the environment management plans.

10. Technical support and capacity building

Establish a system of accounting of public and private expenditure for environmental protection in adherence to international statistical standards and explore ways in which the results could be discussed at the cabinet level to evaluate the adequate volume and composition of public expenditure for environmental protection.
Jordan is a small, middle-income, open economy, with a limited natural resources base and active trade flows, with exports accounting on average for almost 50 percent of gross domestic product (GDP) in the period 2000–05 (compared with about 30 percent for the Middle East and North Africa [MENA] and the average lower-middle-income country). Growth of exports in Jordan has been twice as fast in the last five years as the MENA average. As the integration of Jordan in the World Economy progresses, enhancing Jordan’s environmental management can not only improve the well-being of Jordanians, but also enable the country to better compete in increasingly environmentally conscious markets.

Despite significant progress in the last few years on environmental management, there has not yet been a comprehensive assessment of Jordan’s environmental agenda. This Country Environmental Analysis (CEA) intends to help fill such a gap and to provide analytical insights that can inform the dialogue between the World Bank and the Government of Jordan on a selected number of areas of particular relevance for continued sustainable economic and social development.

The CEA, which is one of the nonlending activities included in the Country Assistance Strategy (CAS) for Jordan 2006–10, is a diagnostic tool aimed at providing the analytical underpinning for integrating the environment into the development process and sustainable development assistance, including not only investment lending, but also policy lending, as mandated by Operational Policy (OP) 8.60 (Development Policy Lending).
1.1 OBJECTIVES

The three main objectives for the Jordan CEA are as follows:

» To provide a comprehensive overview of Jordan’s environmental agenda and an identification of key strategic priorities for policy action;
» To promote mainstreaming of environment issues into selected key sector policies for improving development and poverty alleviation; and
» To help focus development assistance provided by the World Bank and other development partners on key interventions, at the policy and project level, required to address environmental priorities.

1.2 STRUCTURE

This report adopts World Bank CEA corporate guidelines and adapts them to the case of Jordan by structuring the analysis along the three following sections:

Section A. State of the environment and environmental priorities. Chapter 2 sets the stage for the rest of the report by presenting an overview of the current state of the environment in Jordan, discussing progress, highlighting remaining challenges, and benchmarking Jordan’s environmental performance through the use of standard comparative indicators (Environmental Sustainability Index [ESI], Millennium Development Goals [MDG], adjusted savings). Chapter 3 evaluates the cost of environmental degradation for the reference year 2006, thereby providing insights into the overall magnitude of the problem, as well as the relative importance of different forms of degradation.

Section B. Policy analysis. This section examines current and future pressures on selected environmental themes of sector development. It discusses the role of sector policies for mitigating those pressures, and to the extent possible, it quantifies broad trade-offs in a cost-benefit framework.

The themes and sectors analyzed within this analysis are (1) water quality1 (chapter 4); (2) air pollution from land transport (chapter 5); and (3) industrial pollution (chapter 6).
The World Bank team and the Government of Jordan have selected these particular areas for this CEA for the following reasons:

» First, *relative priority* in terms of social impacts: the Cost of Environmental Degradation (COED) analysis indicates that air and water pollution are the two most important forms of environmental degradation. In the case of air pollution, the selection of the transport and industry sectors for the analysis is natural, on account of the large contribution of these sectors to several key air pollutants (particulate matter [PM], nitrogen oxides [NO\textsubscript{x}], sulfur dioxide [SO\textsubscript{2}]) and because of the fast growth of the vehicular fleet (7 percent over the last few years).

» Second, opportunities for *spurring intersectoral dialogue* and coordination: this applies, for example, to transport, where several agencies are involved in the regulation of vehicular emissions, fuel quality, the design and management of transport infrastructure, and the monitoring of air quality.

In the case of water quality, the issue is equally important and perhaps even more challenging: in the presence of multiple actors that are responsible for discrete portions of the water quality agenda, it is easy to lose sight of the integral nature of the problem (which spans different water types, including surface, ground, treated wastewater), of the need to look at different sources of pressures (urban development, agriculture, industry), and more generally, of the need to address in an integral manner the quantity agenda (which tends to dominate in the public debate and government programs alike) as well as the quality agenda (which is important for human health and economic productivity, particularly in agriculture).

» Third, expectations of *future growing pressure* on the environment: industry is an important sector of Jordan’s economy (accounting for almost 20 percent of value added), growing fast over the last few years (12 percent per year in 2000–06 against the average of 4 percent for middle-income countries), and poised to sustain or accelerate its growths if the targets of the national agenda are to be met. Relatively little is known of the volume and composition of industrial pollution in Jordan, and so far efforts to engage the private sector in improving the sector’s environmental performance have generated limited results.
Section C. Institutional capacity assessment. This section “closes” the CEA by evaluating (in Chapter 7) the country’s capacity to address key environmental challenges (as identified under section A), and to undertake policy actions to enhance environmental sustainability across sectors, such as those discussed in section B of the CEA. Based on the findings of previous chapters, Chapter 8 proposes a number of short- and medium- to long-term recommendations.

1.3 APPROACH AND CAVEATS

In the design and preparation of this report, a concern was how to address the key challenge inherent to the nature of CEAs as a diagnostic tool, namely, its broad and encompassing nature. This analysis addresses this challenge by striking a balance between breadth and depth of the analysis, given the time and resource constraints. In particular, on the one hand, the report analyzes in more detail the sector themes included in section B, proposing where possible simple tools for evaluating selected trade-offs in quantitative terms.

On the other hand, it purports to cover in a more exhaustive fashion (and thus necessarily less in-depth) issues of priority-setting across environmental themes (chapter 3) and of integration of environmental concerns into the rules and behavior of relevant stakeholders, beyond sector and institutional boundaries (chapter 7).

Several of the topics covered by CEA could have deserved a self-standing study. As a result, the CEA should not be substituted for issue-specific analyses and more detailed modeling exercises. Rather, it should be used to inform, on the basis of the best evidence that could be mobilized in the report’s time frame, policy makers, donor communities, and the general public on the key issues that need to be addressed in the environmental domain.

Most of the data and information used for the report have been collected in the period 2007–08, although efforts have been made to take into account selected key developments in relevant policies that have occurred since then.

NOTE

1 This analysis was intended to complement the Water Sector Update study, a separate nonlending activity programmed for fiscal year 2008 (FY08), which was designed to focus primarily on issues of water quantity, rather than quality. At the request of the Ministry Planning, the Water Sector Update has been suspended.
2.1 INTRODUCTION

Over the last decade, Jordan’s economy performed above the average of other MENA countries, achieving macroeconomic stability and a GDP of about US$2,630 per capita in 2006 (World Bank 2007b). The economy is mostly based on services (67 percent of GDP) and industry and mining (30 percent). The annual growth rate reached 5.8 percent in 2006—mainly because of the construction and manufacturing sectors—and is expected to continue at a rate of 6.3 percent in 2007 and 5.7 percent in 2008 (CIA Factbook 2008). Economic growth contributed to a decline of poverty from 21.3 percent in 1997 to 14.2 percent in 2002.1 Moreover, illiteracy among the poor dropped by 41 percent because of the government’s literacy campaigns and Education for All strategy, and the infant and child mortality among the poor declined by nearly 33 percent.2

The socioeconomic record is accompanied by significant progress in the environmental sector. This includes the following:

- The establishment in 2003 of the Ministry of Environment (MoEnv), and its gradual strengthening in terms of institutional capacity, legal upgrading, and training;
- The adoption in 2006 of Environmental Impact Assessment (EIA) legislation and regulations (2006); and
Efforts to integrate environmental concerns into sector strategies, such as the water strategy, the National Water Master Plan (NWMP, 1997 and 2005), and the agricultural sector strategy (2001).

The introduction in the National Agenda (2005), the country’s road map and overarching policy framework for the years 2006–11, of ambitious targets for improved environmental performance related to water, energy, transport, and waste.

Despite these positive developments, several pressures remain. A rapidly increasing population (2.5 percent per year; World Bank 2007b) puts pressure on natural resources, particularly water and arable land. Concentration of population and hence of environmental strain, is likely be particularly acute in urban areas: the Greater Amman Municipality’s (GAM) master plan forecasts a population increase from 2.2 million in 2010 to 6.5 million in 2020 (GAM 2008). Economic growth, particularly through the development of transport and industry, has negative effects on water and air quality. The country’s limited water availability often results in unsustainable groundwater use, with consequent declines in the water table and in water quality, which may be further exacerbated by climate change.

This chapter reviews the current state of the environment and identifies the main environmental priorities facing Jordan. It analyzes the key accomplishments and challenges for the primary environmental areas and natural resources (see section 2.2), and then benchmarks Jordan’s environmental performance in terms of the MDGs, the ESI, and genuine savings (see section 2.3).

2.2 KEY ENVIRONMENTAL ISSUES

2.2.1 Air quality
Air pollution is one of the most important environmental challenges faced by Jordan (Government of Jordan 2005). The country adopted regulations aimed at reducing emissions that have a negative impact on the environment, setting ambient air quality standards comparable with international standards, and limiting values for industrial emissions. The transport sector strategy addresses environmental concerns related to different subsectors: for example, it includes provisions to re-
duce impacts from road freight transport and rationalize energy consumption; in the case of air transport, the strategy aims at reducing noise and emissions from aircraft by adopting relevant international standards and upgrading national legislation. The revised national energy strategy (2007) sets a target for use of renewable energy of 6 percent by 2020 and emphasizes the need for increased energy efficiency, which would reduce energy requirements by approximately 20 percent.

Jordan has made significant progress in adopting cleaner fuels in the energy and transport sectors. In recent years, use of natural gas to replace diesel and heavy fuel oil by the power sector increased substantially, reaching 77 percent of total fuel use in 2006. Moreover, in 2008 Jordan started to phase out leaded gasoline and high-sulfur diesel in an effort to improve fuel quality to meet the European EURO 4 emission standards.6

Air quality is a problem in low-area, high-density hot spots of vehicular traffic and industrial activity. Most polluting emissions come from vehicles, industries, and residential activities. Table 2.1 shows that vehicles represent a significant source of emissions in Jordan. The vehicle fleet is rapidly increasing, at an annual rate of 7 to 10 percent.7 Nevertheless, the vehicle fleet is relatively old, with about 33 percent of the vehicles produced before 1990. Old cars are maintained and used,

<table>
<thead>
<tr>
<th>Source of Emissions</th>
<th>NOₓ</th>
<th>SO₂</th>
<th>TSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road transportation (%)</td>
<td>79a</td>
<td>20b</td>
<td>39</td>
</tr>
<tr>
<td>Other diesel (%)</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Air transport (%)</td>
<td>2</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Industry (%)</td>
<td>7</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>Electricity production (%)</td>
<td>11</td>
<td>48</td>
<td>29</td>
</tr>
<tr>
<td><strong>Total (t)</strong></td>
<td><strong>72,900</strong></td>
<td><strong>123,000</strong></td>
<td><strong>6,500</strong></td>
</tr>
</tbody>
</table>

*Source: Derived from AFD 2006.*
*Note: TSP = total suspended particulates; NOₓ = nitrogen oxides; SO₂ = sulfur dioxide.*
*a. Average corresponding to emissions ranging from 53,063 t (AFD 2006) and 62,160 t (Transport chapter 5).*
*b. Average corresponding to emissions ranging from 24,240 t (AFD 2006) and 25,994 t (Transport chapter 5).*
contributing significantly to emissions. As Amman and South Amman host about 69 percent of all Jordanian vehicles (AFD 2006), they represent a major hot spot for air pollution. Emissions from the industrial sector mainly originate from the cement plants in Fuheis and Rashadeia, the industrial area of Hashimyeh near Zarqa, power plants and phosphate and potash industries in Aqaba, and others. Among these, mining is the most important contributor to air pollution, accounting for about 62 percent of the total suspended particulates (TSP), 78 percent of the PM$_{10}$, and 39 percent of the nitrogen oxides (NO$_x$) generated by industry.

Table 2.2 summarizes the information made available to the World Bank CEA team on the main sources of pollution, monitoring institutions, and pollutants monitored. Most of this information is drawn from AFD (2006) and completed with data from the MoEnv. Monitoring is undertaken by several institutions, including the MoEnv in Hashimyeh and the Ministry of Health (MoH) in GAM, and a centralized repository of information on ambient air quality and emissions does not exist. The lack of accessible data makes it difficult to arrive at a comprehensive understanding of the situation.

According to AFD (2006), air quality monitoring in Jordan mostly focuses on large industries. In Hashimyeh, monitoring of hydrogen sulfide (H$_2$S), CO, and SO$_2$ at Ibn Al-Anbari, Um-Shuriak, and the Electrical Training Center is performed every hour. Figure 2.1 illustrates the monthly exceedances relative to existing standards for H$_2$S and SO$_2$ monitored at Ibn Al-Anbari. Data on H$_2$S exceedances are higher than SO$_2$ ones, and both peak during August.

In other areas, however, monitoring is carried out less frequently. For example, it is performed only once a week for the phosphorous plant of Aqaba and only once a month for the cement plant in Rashadeia. No air quality data appear to be available in other polluted cities, such as Irbid. This lack of data suggests a need for improving ambient air monitoring by making it more systematic, unlike the current situation, which is infrequent, and by initiating monitoring where it is lacking.

### 2.2.2 Water resources

With a total renewable water availability of 133 m$^3$/capita in 2005, or less than 15 percent of the Middle East and North Africa’s (MENA’s) average, Jordan is one of the world’s poorest countries in wa-
CHAPTER 2 | KEY ENVIRONMENTAL ISSUES IN JORDAN

Balancing scarce resources with growing demand is at the heart of water policy in Jordan. The water strategy (1997) and NWMP (2005) aim at securing a reliable supply of water, particularly for drinking water and irrigation. The groundwater management policy aims at reducing abstraction from renewable aquifers to sustainable quanti-

<table>
<thead>
<tr>
<th>Location</th>
<th>Main source of emissions</th>
<th>Monitoring institutions (stations)</th>
<th>Pollutants monitored</th>
<th>Frequency of monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuheis</td>
<td>Cement plant</td>
<td>MoEnv (RSS)</td>
<td>PM$_{10}$</td>
<td>every 2 days</td>
</tr>
<tr>
<td>Rashadeia</td>
<td>Cement plant</td>
<td>MoEnv (RSS)</td>
<td>NO$_x$, CO, SO$_2$, TSP</td>
<td>once a month</td>
</tr>
<tr>
<td>Hashimyeh (near Zarqa)</td>
<td>Refinery, power plant, steel industries, quarries</td>
<td>MoEnv (RSS), through: – Ibn Al-Anbari school for SO$_2$, H$<em>2$S, PM$</em>{10}$ – Um-Shuriāk school for SO$_2$, H$<em>2$S, PM$</em>{10}$ – Electrical training center for SO$<em>2$, CO, PM$</em>{10}$</td>
<td>SO$_2$, H$<em>2$S, PM$</em>{10}$, CO</td>
<td>every hour at Ibn Al-Anbari school for SO$_2$ and H$_2$S$^+$</td>
</tr>
<tr>
<td>Remote areas$^b$</td>
<td>Phosphate mines</td>
<td>RSS</td>
<td>PM$_{10}$</td>
<td>n.a.</td>
</tr>
<tr>
<td>Aqaba</td>
<td>Phosphorous acid plant</td>
<td>ASEZA (RSS)</td>
<td>SO$_2$, NO$_x$, CO, HF</td>
<td>once a week</td>
</tr>
<tr>
<td>Power plants</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>GAM</td>
<td>Traffic</td>
<td>MoH (RSS), through: – Ean Jalout School/ Shmeisani. – Civil Defense/Abu Nusair. – Ali Ben-Abi Taleb Mosque/ Marka – Al-Husaini Mosque/ Down Town (City Center)</td>
<td>TSP, PM$_{10}$, Pb</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

Sources: AFD 2006, except as noted.
Note: n.a. = not available. CO = Carbon monoxide. H$_2$S = Hydrogen sulfide. HF = Hydrogen fluoride. NO$_x$ = Nitrogen oxides. PM$_{10}$ = Particulate matter of 10 micrometer or less. Pb = Lead. RSS = Royal Scientific Society. SO$_2$ = Sulfur dioxide. TSP = Total suspended particulates.

b. Including Al-Albiad.
ties. Jordan has several water and wastewater quality standards and undertakes three types of monitoring: (1) environmental monitoring of the quality of surface water and groundwater and of pollution sources; (2) quality control monitoring of drinking water supply and sanitation; and (3) environmental health monitoring, related mainly to the hygienic control of drinking water and wastewater as well as of other water uses such as bathing and recreation.

Despite the high attention given to improving water management, water scarcity remains a major challenge. Moreover, rapid population growth is increasing water demand, putting additional pressure on the limited water resources. Overall, water resources are expected to decline to about 90 m$^3$/capita by 2025, putting Jordan in the category of absolute water shortage (Ministry of Environment 2006b).

Annual water consumption is 941 million m$^3$ (2005 data), of which about 64 percent is used for irrigation. Water demand is mostly met by groundwater (54 percent), followed by surface water (37 percent), and treated wastewater (9 percent). The high water demand is already

![MONTHLY EXCEEDANCES OF H$_2$S AND SO$_2$ MONITORED](image-url)
met by extracting groundwater well above the safe yields. Total groundwater overextraction from the 11 nonfossil basins is 148.8 million m³, which is 50 percent above the safe yield of 293.5 million.\(^{16}\)

Figure 2.2 presents data on the total abstraction and safe yields of the 12 major basins in Jordan. Overextraction occurs in eight basins and is especially significant in Amman-Zarqa, the Dead Sea, Azraq, and Yarmouk.\(^{17}\) In particular,

- **Amman-Zarqa** is the country’s largest renewable groundwater basin. Total extraction is 148.6 million m³, representing 170 percent of safe yield.
- **Yarmouk** basin is second in size and is recharged in the relatively high rainfall mountain areas in northern Jordan and southern Syria. Total extraction is 51 million m³, or 128 percent of safe yield.

**FIGURE 2.2 SAFE YIELDS AND OVERABSTRACTION FROM THE 11 NONFOSSIL BASINS, 2005**

Source: Based on MoWI data quoted in chapter 4.
Azraq basin supplies water to Amman Municipality. Total water extraction is currently 58.2 million m³, or more than 240 percent of safe yield.

Dead Sea basin supplies the highest share of industrial needs, especially for the potash industry in the Dead Sea region. Total extraction from this basin is 91.2 million m³, or about 160 percent of the safe yield.

Groundwater overexploitation leads to declining groundwater levels, decreasing the base flow and spring discharge and drying up springs. The Ministry of Water and Irrigation (MoWI) monitors groundwater levels through observation wells¹⁸ distributed all over Jordan. Figure 2.3 shows data on the groundwater level of Amman-Zarqa basin during 1968–2007. The water table declined from 50 m to about 84 m during this period, corresponding to about 0.87 m per year. From 1992 to 2007, however, the groundwater

Source: Based on MoWI data 2007.
Note: The figures refer to observation well AL1041.
table declined about 23 m, which is equivalent to a drop of 1.5 m per year. This suggests that groundwater overexploitation has worsened in recent years, an issue that needs to be addressed through an improved water management.

Another important issue is the deterioration of water quality, which is closely linked to water scarcity. The high demand for the limited water supply often leads to decreasing water quality: (1) for domestic use, through an intermittent water supply provided to elevated tanks; and (2) for agriculture, because of increasing water salinity caused by groundwater overexploitation. Moreover, the rapid growth of the industrial sector often results in discharge of untreated water in natural water bodies. Chapter 4 provides a thorough analysis of water quality aspects and chapter 6 discusses the industrial sector, as a major source of water and air pollution.

2.2.3 Land degradation

Jordan’s agricultural area covers about 247,400 ha\(^9\), or 3 percent of the country’s total land. Agriculture accounts for 3 percent of the country’s GDP (World Bank 2007b) and employs about 58 percent of the rural population.\(^20\) In 2002, about 19 percent of the rural population was poor (Hashemite Kingdom of Jordan and World Bank 2004). As most of the rural poor depend on agriculture, this sector is critical for socio-economic development in rural areas.

Rangelands, defined as areas receiving less than 200 mm of rainfall annually, cover more than 90 percent of the total land or 8.1 million ha. About 7.1 million ha of this area belong to Badia and the rest is steppe (FAO 2001). Most rangelands are located in the arid zone, where livestock is the major source of income for local communities. Here, lands usually are overgrazed by nomadic and seminomadic flock owners from late winter to midsummer. The most productive rangelands are located within the 100–250 mm rainfall zone and are represented by steppe grassland and brush. In this zone, barley is cultivated for hay, as rainfall rarely is adequate to produce a reasonable crop and limited vegetative growth is common (Ministry of Environment 2006b).

Sheep and goats form the major part of the country’s livestock herd, with 2.5 million heads (DOS 2006b). Nearly 40 percent are found in Mafraq governorate, which includes the major part of the country’s Badia. Unsound management practices such as uncontrolled grazing and
inadequate land tenure have resulted in severe rangeland degradation in Jordan. Such degradation is reflected *qualitatively* through the decrease in the most palatable and nutritious plants and soil degradation; and *quantitatively*, through a lower vegetative cover. Most of the rangelands are now characterized by poor structural stability of soils and vulnerability to erosion (Ministry of Environment 2006b).

Despite the wide consensus concerning rangeland degradation, only a few efforts to estimate the decrease in rangeland productivity have been undertaken. The MoEnv (2006b) estimates that rangeland carrying capacity decreased by 70 percent over the last 70 years. Juneidi and Abu Zanat (1993) and the Arab Organization for Agricultural Development (AOAD 2006) report data on rangeland productivity in specific years. A comparison across these studies shows that fodder productivity of steppe declined from 200 kg dry matter (DM)/ha in 1990 to 83 kg DM/ha in 2006. Meanwhile, fodder productivity of the Badia decreased from 80 kg DM/ha in 1990 to 40 kg DM/ha in 2006. Moreover, AOAD (2006) reported the actual productive area of rangelands in Jordan at 4.1 million ha, which is nearly 50 percent of the total area of rangelands.

Several development projects were undertaken for rangeland rehabilitation. According to the Food and Agriculture Organization of the United Nations (FAO 2006), the Ministry of Agriculture established 29 reserves covering 84,400 ha in all regions, with the aim of protection, water harvesting, replanting, reseeding, and grazing control. The ministry also carried out development projects in specific areas, such as the Hamad basin, aiming at water development for livestock, animal production and health, and range development and management. The ministry is implementing the National Rangeland Rehabilitation Program using a participatory approach involving the stakeholders. The range directorate also implements microprojects to encourage private range development, water harvesting, and fodder production. In addition, the Jordan Cooperative Organization is carrying out a program of planting fodder shrubs and improving grazing in communal lands allocated to those cooperatives by the Ministry of Agriculture.

### 2.2.4 Biodiversity and protected areas

Jordan covers four different biogeographic zones: the Mediterranean, Irano-Turanian, Saharo-Arabian, and Sudanian Penetration, which endow the country with a rich variety of plant and animal life. The coun-
Country is home to more than 2,500 wild plant species from 700 genera, of which approximately 100 are endemic, 250 are rare, and 125 are very rare (Government of Jordan 2003; UNEP et al. 2000). The rich biodiversity suggests Jordan’s high potential for the development of nature tourism, as illustrated by a high number of tourists visiting Dana and Azraq nature reserves. Overall, tourism is an important sector at national level, accounting for 10 percent of Jordan’s GDP (Government of Jordan 2004) and having a positive balance, with receipts 2.6 times higher than expenditures (Ministry of Tourism 2007).

Biodiversity is an important element of the country’s vision on the environment. At the regional and international levels, the Government of Jordan has ratified the following conventions: the Convention on Biological Diversity, the Convention to Combat Desertification, the Ramsar Convention, the Convention on Migratory Species, the World Heritage Convention, the African Eurasian Waterbird Agreement (AEWA), and the Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment. Jordan is party to the International Union for Conservation of Nature (IUCN) and United Nations Educational, Scientific and Cultural Organization (UNESCO) Man and Biosphere Program through a national committee.

Biodiversity in Jordan is exposed to several threats, such as an accelerated pace of development and investment, population growth, including forced regional migration (recently from Iraq), lack of coordinated land-use policy, lack of understanding and appreciation of the economic and social value of biodiversity, and limited financing. These factors likely are leading to declining biodiversity in certain sites.

Jordan’s vision for Protected Areas (PAs) is captured in its Biodiversity Strategy and Action Plan (Government of Jordan 2003). Currently, seven legally constituted PAs extend over 1,143 km², or 1.3 percent of Jordan’s land area. Most of this area is located in the desert. The process of PA establishment started in the mid-1940s, but it has accelerated significantly over the two decades (see figure 2.4).

An additional 10 PAs, covering about 4,500 km² are proposed for establishment (Government of Jordan 2003; UNEP et al. 2000). They would increase the PAs to about 6.4 percent of total land area country, which would compare favorably with the MENA average of 3 percent (in 2004). Among them, four PAs are expected to be legally designated through the ongoing World Bank–executed and Global Environment
Facility (GEF)-funded Integrated Ecosystem Management in the Jordan Rift Valley Project. These PAs, constituted as national parks or national wildlife reserves, come under the jurisdiction of the MoEnv. An additional 23 forests and rangeland reserves extend over 600 km² and fall under the ownership of Forestry Administration, Ministry of Agriculture. Table 2.3 summarizes the different types of protected areas.

Jordan is making progress toward meeting its vision for PAs. In 2004, the MoEnv accorded a legal remit, approved by the Council of Ministers, to the NGO Royal Society for Conservation of Nature (RSCN) to establish, develop, and manage PAs. RSCN has built on their positive experiences from the Dana and Azraq PAs to advance the agenda of PAs. These experiences have been the hallmark of the country’s fame in conservation. Overall, Jordan has been successful in terms of the approaches and methodologies applied to biodiversity conservation at site level. Key elements of success include the following:

- Incorporating scientifically and socially proven methodologies into PA management.
- Involving local people and other stakeholders from the outset in the designation process of PA boundaries to gain the confidence of the stakeholders.

*Source:* Authors based on World Bank 2007d.
Successfully use an incentive-driven approach rather than regulatory approach to PA management by using income generation programs in PAs, as a vehicle to engage local communities, and changing their attitudes related to some ecologically damaging practices.

Introducing private sector and business planning approaches to the marketing and management of its nature-based enterprises—particularly the use of ecotourism as a strategy to improve local economy and livelihood strategies—while conserving biodiversity has been successfully applied in PAs.

Establishing a database of ecological and biodiversity-related data and linking it to PAs management through GIS and remote-sensing technology.

To consolidate the results achieved and further proceed toward sustainability of the PA system, Jordan will need to address a number of key issues related to the PA legal status, to land use planning, clarification of institutional roles, and mobilization of adequate resources. These are discussed in more detail in box 2.1.

2.2.5 Solid waste

Jordan currently generates an estimated 1.5 million t of municipal solid waste annually. Due to population and consumption growth, this quantity will grow to about 2.5 million t per year by 2015. About 55 to 70 percent of waste is organic. Waste collection rates are estimated at 90 percent in urban areas and 75 percent in rural areas. About 50

<table>
<thead>
<tr>
<th>Type of area</th>
<th>Number of areas under protection</th>
<th>Area (km²)</th>
<th>Percent of Jordan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legally constituted protected areas</td>
<td>7</td>
<td>1,143</td>
<td>1.30</td>
</tr>
<tr>
<td>Proposed for establishment</td>
<td>10</td>
<td>4,500</td>
<td>5.12</td>
</tr>
<tr>
<td>Forests and rangeland reserves</td>
<td>23</td>
<td>600</td>
<td>0.68</td>
</tr>
<tr>
<td>Non protected areas</td>
<td>81,680</td>
<td></td>
<td>92.90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>87,923</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

BOX 2.1 PRIORITY ISSUES TO BE ADDRESSED BY JORDAN’S PROTECTED AREAS POLICY

Legal and Policy Context for Protected Areas (PAs). Jordan does not, as yet, have an officially endorsed policy on PAs. A draft policy framework was produced under the auspices of the Ministry of Planning in 1996. The legal context for PAs is also inadequate. While the Environment Protection Act, through its bylaws, guides the legal provisions for PA development and management, significant legal deficiencies still are not addressed by these bylaws, particularly related to land-use planning and land tenure. There is an urgent need for a clear set of policies, grounded in legal provisions, to provide a frame of reference for the PAs’ future. This should provide a context for PAs in relation to development priorities in the country, including priorities related to land-use provisions. As part of the policy development, there is also an urgent need for awareness and advocacy programs for decision makers to reflect the importance of biodiversity, especially in terms of the economic and social benefits it provides.

Land-Use Planning and Institutional Mandates. There is an institutional overlap of mandates with regard to land use and land-use planning, and a lack of clarity with regard to the designation of PAs. This challenge is especially evident in the Jordan Rift Valley where much of the critical habitats of importance for biodiversity are situated and which is also the major development corridor for the country. Within this valley the mandates, priorities and interests of key entities such as the Jordan Valley Authority, Aqaba Special Economic Zone Authority (ASEZA), the Natural Resources Authority, Ministry of Planning and International Cooperation, and Ministry of Environment, sometimes overlap and the demands can be conflicting. The government’s priority to pursue an investment driven agenda may be valid, but it is critical that this be undertaken with due regard to the natural resources base of the valley, its carrying capacity, and an understanding of the consequences of irreversibility associated with habitat conversion or degradation. It is essential that decisions be made on the basis of adequate information and within a broader policy and legal context. As a priority, there is a need to develop a land use planning system, with particular attention to good public consultation and enforcement processes. Such a system would provide a guiding planning framework within which the different institutions would operate. There is also need to strengthen the institutional capacities of the Ministry of Environment and the challenges facing the long-term strategic positioning of the Royal Society for Conservation of Nature (RSCN) to ensure that the long-term stewardship of the issues facing PAs is effective.

Budgetary Resources. Budgetary resources to manage the PAs and the expansion of the PA network are critical to ensure that biodiversity in these parks is conserved. RSCN has established some financing mechanisms, including the endowment fund Jordan Fund for Nature, and ecotourism and other socioeconomic programs to meet the recurrent costs associated with the management of PAs. For example, the Jordan Fund for Nature has about $7 million and is expected to increase to $9 million (World Bank 2007c). The endowment is currently invested in the financial market and the generated revenue stream supports the core expenses of RSCN, including the running costs of some PAs. These mechanisms, however, are not sufficient to meet the needs for managing PAs. Additional funds are needed to ensure that biodiversity can

Continued on next page
percent of waste is disposed of in 16 open dump sites without lining or leachate and biogas connections. The exceptions are Russeifah and Gabawi, in Greater Amman, which account for 50 percent of total waste. Voluntary burning of waste and aerobic decomposition (self-ignition) in open dumps are common ways of waste disposal. The most significant health impacts and risks are associated with the open dumps around the large cities of Amman, Zarqa, Irbid, Madaba, Tafila, Ramtha, Middle Shouneh, and Aqaba. Scavengers are permitted to segregate waste and take away recyclable materials.

Jordan generated about 23,000 t of hazardous and chemical waste in 2001. This quantity is expected to increase to about 68,000 t per year in 2017. Hazardous and chemical wastes currently are disposed untreated with municipal waste in open dumps. Jordan further generated about 5,330 t of medical waste in 2004. About 53 percent of this waste, mostly from public health care centers, is treated in outdated incinerators located in populated areas, while the remaining 47 percent is mixed with municipal and hazardous waste in open dump sites (Government of Jordan 2005).

Solid waste management (SWM) is regulated by Environment Protection Law No. 1 of 2003 and its executive regulations: No. 27 of 2005 for municipal waste management and No. 24 of 2005 on hazardous waste management. These regulations, however, describe only general responsibilities and principles and are disseminated on the MoEnv web site. Gaps in criteria exist for identifying municipal and hazardous wastes and the procedures used in various international and legal instruments, such as in the Basel Convention. The detailed specifications and standards to establish sanitary and hazardous landfills are lacking.
Until the mid-1990s, the government did not view waste management to be a pressing issue, which instead focused on investments in water resources and wastewater management. Greater emphasis was placed on waste collection carried by each of the 99 municipalities or by their private contractors. Waste disposal and management is entrusted to the 21 Common Services Councils (CSC), except in Russeifah and Ghabawi in Greater Amman. CSCs were established in 1980 to serve a group of municipalities and achieve a more controlled management of disposal sites, thus reducing environmental impacts and public complaints. These councils, however, lack the human, technical, and financial capacity to manage even the existing open dump sites. With the approval of the Jordan National Agenda, in which waste management is a priority, the situation is now changing and the Government of Jordan is determined to address solid waste issues on par with water and wastewater issues.

As of April 2008, only a draft policy on municipal waste management had been developed by the MoEnv. Responding to the five objectives in the Government National Agenda for Sustainable Development in the waste sector, this draft policy calls for (1) minimizing the generation of municipal waste; (2) reusing, recycling, and composting of municipal waste; (3) encouraging the implementation of pilot projects for sorting and segregating waste and replicating the successful ones; (4) proper disposing of municipal waste in sanitary landfills; (5) increasing environmental awareness and capacity building; (6) extending the coverage of waste collection and waste sorting; and (7) addressing the economics of waste management, enlarging private sector participation in waste management, and taking advantage of the Kyoto Protocol's Clean Development Mechanism.

Despite the lack of a well-defined policy, a supporting legal and institutional framework, and necessary waste planning, there have been achievements in many Jordanian cities, and in particular in the GAM. The MoEnv and the mayor of GAM provide strong leadership to ensure a successful SWM in GAM, an example to be replicated in other governorates. A rigorous but expensive waste collection effort (costing about JD 25 per ton in GAM) is improving the cleanliness of streets in the main Jordanian cities. Jordan has one of the best solid-waste cost-recovery rates in MENA, thanks to an effective system of collecting household tariffs via electricity bills, and a recent increase in the tariff
(from JD 14 to JD 20 per household per year). Nevertheless, SWM revenues currently do not cover SWM costs, with an estimated financing gap of about JD 8 million in 2007. The private sector is now involved in recycling municipal waste for GAM.

The Government of Jordan is pursuing a number of initiatives aimed at strengthening SWM in Jordan, at the policy and institutional level, as well as on the investment side. To ensure long-term success, these initiatives need to be scaled up, extended to better cover such issues as medical and hazardous waste, and supported by an active cost-recovery policy. Main initiatives under way and key remaining challenges are further discussed in box 2.2.

2.3 BENCHMARKING JORDAN’S ENVIRONMENTAL PERFORMANCE

2.3.1 The Millennium Development Goals
Adopted by the UN members in 2000, the MDGs have become a universal framework for development agreed by all the world’s countries and leading development institutions. The MDG system includes eight goals associated with 18 targets and 48 indicators of sustainable development. Jordan’s report on MDGs achievements (MoPIC and UN 2004) reflects the country’s progress on the environmental sustainability goal, in reference to its three targets and seven indicators (see table 2.4). Overall, the country achieved the target on access to safe drinking water by 2002. The targets of integrating the sustainable development principles into country’s policies and programs and improving the lives of 100 million slum dwellers potentially can be achieved. Available data suggest good progress particularly on forested land, areas protected for biodiversity, and access to improved water sources and to safe sanitation.

2.3.2 Environmental Sustainability Index
It is interesting to compare Jordan’s environmental performance with that of other countries. Several environmental sustainability indexes can be used for this purpose. The ESI, which was developed by the Yale Center of Environmental Law and Policy in collaboration with Center for International Earth Science Information Network (CIESIN)
BOX 2.2 SOLID WASTE MANAGEMENT: RECENT PROGRESS AND REMAINING CHALLENGES

The Government of Jordan is pursuing a number of reforms aimed at establishing an environment conducive to sound solid waste management (SWM) in Jordan, beginning in the GAM and the Middle Region:

At the policy and legal levels, the Ministry of Environment in consultation with representatives of the sector ministries, Common Services Councils (CSCs), and civil society is completing the development of a SWM policy. The ministry is receiving technical assistance from the European Commission to prepare a draft framework law and waste regulations compatible with EU directives.

At the institutional level, the government is taking steps to restructure the SWM sector in the municipalities and CSCs. Such restructuring will be carried out first in the Greater Amman Municipality (GAM) with the assistance of the World Bank, through its forthcoming Amman Solid Waste and Carbon Finance project (see below), and the U.S. Agency for International Development (USAID) through its Sustainable Achievement of Business Expansion and Quality (SABEQ) program.

In terms of investment, the government is attempting to attract increased private sector investments and foreign technology and know-how in the collection and disposal of hazardous and medical waste of the Middle Region. A public–private partnership will be established with an international operator during mid-2008 for a 30-year build-own-operate-transfer for the collection, transport, treatment, and disposal of medical and industrial waste with an investment level of US$20 million. The operator will be provided with a 3 ha site in Ghabawi landfill for installation of an incinerator and for physical, biological, and chemical treatment of waste, and with a 6 ha site for hazardous waste landfill in Swaka, 150 km south of Amman. The operator will be responsible for collecting fees from industrial and medical installations.

The government intends to provide a guarantee for a US$18 million World Bank loan to the GAM, which is expected to be approved in late 2008. The project will enhance GAM capacity to develop private sector participation in management of SWM in Amman; environmentally upgrade and expand the existing municipal solid waste landfill to meet the city’s disposal needs up to 2014; and generate electricity while mitigating greenhouse gases through a waste-to-energy clean development mechanism project; and improve the cost-effectiveness of the existing municipal solid waste collection and transport system and improve overall cost recovery.

Building on achievements and reform measures to date, the following additional actions will be required:

- Establish a comprehensive legal framework that sets up legally binding principles and requirements to ensure a gradual adoption of an integrated SWM. Regulatory guidelines and standards for implementation should be flexible and adaptable to local conditions with community participation. Incentive systems, cost recovery, and risk guarantees should be clearly defined.

Continued on next page
at Columbia University, evaluates the environmental sustainability relative to paths developed by other countries. It is a composite index of 21 indicators that cover five broad categories of environmental pressure: environmental systems, reducing environmental stresses, reducing human vulnerability to environmental stresses, societal and institutional capacity to respond to environmental challenges, and global stewardship.

One weakness of ESI is that it gives equal weights to all its subcomponents, thus assuming a uniform distribution of environmental pressures across countries. In reality, countries may be vulnerable to different pressures: some are vulnerable to water scarcity, others to ecosystem losses. Thus, ESI scores are meaningful if used to benchmark the performance of countries facing similar environmental constraints. Table 2.5 presents the ESI scores and ranks for MENA countries. With a few exceptions mentioned in the table notes, these countries have two common features: (1) desert covers more than 50 percent of each country’s land; and (2) they are either water stressed or water scarce. In 2005, Jordan ranked 84th out of 146 countries in terms of ESI. It occupies the third position among MENA countries, after Israel and Oman. The higher ESI score compared with other MENA countries may suggest the country’s relatively greater capacity to address the environmental stresses it faces.

BOX 2.2 SOLID WASTE MANAGEMENT: RECENT PROGRESS AND REMAINING CHALLENGES (continued)

- Strengthen the institutional framework with clear roles and responsibilities for action at the regional and local level, taking into account the formal sector of private operators and investors, CSCs and municipalities, and supported by a strengthened human capacity on SWM.
  A regulatory function for compliance with the Environmental Impact Assessment provisions and environmental standards should be reinforced at the Ministry of Environment to protect public health, and environmental resource quality.
- Prepare master plans for the collection and disposal of municipal, medical, and hazardous waste in the urban and periurban areas to deliver effective and affordable management services to the local community, using simple and efficient technologies.
- Gradually improve the cost-recovery mechanism to cover the financial costs of the existing and upcoming SWM contracts, in a socially acceptable way. This will assist the Government of Jordan to successfully progress in the integrated SWM approach and to solve the persistent problem of SWM throughout the country.

2.3.3 Adjusted Net Savings

Adjusted Net Savings (ANS), known also as genuine savings, is another sustainability indicator. Building on the concepts of green national accounts, it measures the true rate of savings in an economy after taking into account investments in human capital, depletion of natural resources, and damage caused by pollution. First, estimates of capital consumption of produced assets are deducted to obtain national savings. Current expenditures of education are then added to net domestic savings as an appropriate value of investments in human capital. Next, estimates of the depletion of a variety of natural resource are deducted.
to reflect the decline in asset values associated with their extraction. Finally, pollution damages—mainly health damages due to urban air pollution—are deducted.

\[
\text{Genuine Savings} = \text{Gross national savings} - \text{Depreciation of Fixed Capital} + \text{Education expenditure} - \text{Depletion of natural resources} - \text{Pollution damages}
\]

The World Bank estimated ANS for six MENA countries. Table 2.6 shows that Jordan ranks second in MENA, after Morocco. Jordan’s good performance is mainly due to a very low value of natural resource depletion and a relatively high expenditure in human capital. The ANS estimate is negative for the other countries. This is mainly because Egypt, Iran, and Syria have a high level of energy depletion (see table 2.6) while Lebanon has a negative value of gross national savings.

The fairly good environmental performance of Jordan when measured through the indicators reviewed above can be interpreted that,

<table>
<thead>
<tr>
<th>Country</th>
<th>Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>50.90</td>
<td>62</td>
</tr>
<tr>
<td>Oman</td>
<td>47.90</td>
<td>83</td>
</tr>
<tr>
<td>Jordan</td>
<td>47.80</td>
<td>84</td>
</tr>
<tr>
<td>Algeria</td>
<td>46.00</td>
<td>96</td>
</tr>
<tr>
<td>Morocco</td>
<td>44.80</td>
<td>105</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>44.60</td>
<td>110</td>
</tr>
<tr>
<td>Egypt, Arab Republic of</td>
<td>44.00</td>
<td>115</td>
</tr>
<tr>
<td>Syria</td>
<td>43.80</td>
<td>117</td>
</tr>
<tr>
<td>Libya</td>
<td>42.30</td>
<td>126</td>
</tr>
<tr>
<td>Lebanon</td>
<td>40.50</td>
<td>129</td>
</tr>
<tr>
<td>Iran</td>
<td>39.80</td>
<td>132</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>37.80</td>
<td>136</td>
</tr>
<tr>
<td>Yemen, Republic of</td>
<td>37.30</td>
<td>137</td>
</tr>
<tr>
<td>Kuwait</td>
<td>36.60</td>
<td>138</td>
</tr>
</tbody>
</table>


Note: The desert covers more than 50 percent of the land in all countries except for Syria and Lebanon.
TABLE 2.6 ADJUSTED NET SAVINGS ESTIMATED FOR MENA COUNTRIES, 2006

<table>
<thead>
<tr>
<th>Country</th>
<th>Gross National Savings (1)</th>
<th>Consumption of Fixed Capital (2)</th>
<th>Education Expenditure (3)</th>
<th>Depletion of natural resources and pollution damages (4)</th>
<th>Adjusted net savings (1–2+3–4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morocco</td>
<td>35.0</td>
<td>10.5</td>
<td>6.5</td>
<td>1.5</td>
<td>29.4</td>
</tr>
<tr>
<td>Jordan</td>
<td>13.8</td>
<td>10.2</td>
<td>5.6</td>
<td>2.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Egypt, Arab Rep. of</td>
<td>22.1</td>
<td>9.8</td>
<td>4.4</td>
<td>26.9</td>
<td>−10.2</td>
</tr>
<tr>
<td>Lebanon</td>
<td>−4.5</td>
<td>11.9</td>
<td>2.5</td>
<td>1.5</td>
<td>−15.4</td>
</tr>
<tr>
<td>Iran</td>
<td>40.7</td>
<td>11.0</td>
<td>4.4</td>
<td>57.3</td>
<td>−23.2</td>
</tr>
<tr>
<td>Syria</td>
<td>17.6</td>
<td>10.3</td>
<td>2.6</td>
<td>33.8</td>
<td>−24.0</td>
</tr>
</tbody>
</table>

Note: MENA = Middle East and North Africa.

FIGURE 2.5 ENVIRONMENTAL DEGRADATION IN MENA COUNTRIES, 2006

Source: Authors.
Note: CO₂ = carbon dioxide; GNI = gross national income; PM = particulate matter.
compared with other countries in MENA and elsewhere, conditions are favorable for focusing the country’s effort on the main present and future environmental challenges. What is likely to be needed is adequate information on relative priorities across environmental themes and good insights on how to best address priority issues through cost-effective policy interventions across relevant sectors. The rest of the CEA addresses these issues, starting in chapter 3 with the analysis of the Cost of Environmental Degradation.

NOTES
1 This estimate is based on a poverty line of JD 392 per capita per year, or JD 1 per capita per day for 2002–03. It reflects the calorie requirements for Jordanians and allows for actual expenditure on nonfood items (Hashemite Kingdom of Jordan and World Bank 2004).
2 Based on Demographic and Health Surveys, 1997 and 2002, as quoted by Hashemite Kingdom of Jordan and World Bank (2004).
3 Environmental Protection Law No. 1 of 2003.
4 The ambient air quality standards (JS 1140, updated in 2006) provide limits for total suspended particulates (TSP) and PM10 and gaseous substances SO2, CO, NO2, H2S, and lead (Pb) (see Institutional Capacity Assessment Chapter 7 for more details).
5 The standards for emissions from stationary sources (JS 1189, updated in 2006) set limits for TSP by type of industry as well as gaseous substances (see Institutional Capacity Assessment chapter 7 for more details).
6 The EURO 4 standard for passenger cars specify per kilometer emissions for diesel of 0.5g of CO, 0.3g of HC and NOx, 0.25g of NOx and 0.025g of PM; and for gasoline of 1 g of CO, 0.1 g of HC and 0.08g of NOx (see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1998L0069:19981228:EN:PDF).
7 Based on the information provided by the Drivers and Vehicles Licensing Directorate and the Ministry of Environment.
8 See the Air Pollution and Road Transport chapter 5 for more details on the current fleet.
9 The estimates are based on Industrial Pollution Projection System (IPPS) methodology. See the Industrial Pollution chapter 6 for more details.
10 Available data show that monitoring was undertaken during only 14 days for November and 23 days for December. This may partly explain the low level of exceedances during these months.
12 The average water availability in MENA is about 1,200 m3/capita (World Bank 2003a).
14 See chapter 4 for more details on water monitoring.
See chapter 4 for more details.

Other sources report different figures on overextraction. For example, the Ministry of Environment (2004) reports that overextraction of groundwater accounted for 226 million m$^3$ in 2003. Japan International Cooperation Agency (JICA 2001) estimated a groundwater budget deficit of 130–145 million m$^3$ for 1988, and the MoWI National Water Master Plan estimated a deficit of 104 million m$^3$ for 2002. The differences between these figures likely are due in part to the different methods used for calculation and in part to the different reference years.

A trend analysis of water consumption during 1998–2002 shows that groundwater abstraction in these basins reached the peak during 1991–93, corresponding to the influx of refugees after the first Gulf crisis (see World Bank 2010).

According to the NWMP, a total of 117 observation wells are equipped with automatic recorders. Manual measurements are taken at irregular time interval from 81 well sites, of which 55 wells are observation wells for static water levels, while 26 are production wells suitable for dynamic-level recording. In 2002, Jordan had 198 observation wells, of which 80 are for the A7/B2 aquifer, while the others are for the remaining aquifers.

Including the area covered by crop fields, vegetables, and trees (DOS 2006).

The proportion is based on an agricultural population estimated at 560,000 in 2005 (FAOSTAT 2005) and a rural population of about 959,000 in the same year (World Bank development data platform database 2007).

The damage was intensified by the influx of more than 1 million refugees in addition to hundreds of thousands of sheep and goats crossing the borders from Iraq following the Gulf War. As part of the Gulf War compensations, the United Nations Compensation Commission (UNCC) has awarded Jordan a sum of US$160 million for rehabilitation of the rangelands of the Badia region, which were affected severely by the Gulf War (UNCC, Governing Council, report no. S/AC.26/2005/10, 2005).

The report does not explain how the estimate was calculated.

The World Bank (2008c) reports that protected area in Jordan was about 11 percent of the country’s land in 2004, as opposed to MENA’s average of 3 percent for the same year. The available information does not provide any explanation on the differences in the estimates for Jordan (11 percent versus 1.3 percent).

The data used in this section are based on World Bank (2008a) unless otherwise specified.

See more discussion in World Bank (2005b).

See the World Bank Web site at go.worldbank.org/3AWKN2ZOY0.
3.1 INTRODUCTION AND MAIN FINDINGS

This chapter estimates the COED from anthropogenic sources in Jordan, focusing on water, air, land, waste, and coastal zone. The overall COED is estimated within a range of JD 143–332 million, with an average of JD 237 million, or 2.35 percent of GDP in 2006 (see table 3.1). Natural factors also contribute to deteriorating environmental quality (as in the case, for example, of seasonal winds contributing to the concentration of particulate matter in the air); however, this report does not analyze these factors.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Minimum (million JD)</th>
<th>Maximum (million JD)</th>
<th>Mean (million JD)</th>
<th>Percent of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>29.1</td>
<td>200.3</td>
<td>114.8</td>
<td>1.15</td>
</tr>
<tr>
<td>Water</td>
<td>76.8</td>
<td>89.2</td>
<td>83.1</td>
<td>0.81</td>
</tr>
<tr>
<td>Waste</td>
<td>20.6</td>
<td>25.2</td>
<td>22.9</td>
<td>0.23</td>
</tr>
<tr>
<td>Soil</td>
<td>10.7</td>
<td>10.7</td>
<td>10.7</td>
<td>0.11</td>
</tr>
<tr>
<td>Coastal zone</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>143.1</strong></td>
<td><strong>331.3</strong></td>
<td><strong>237.4</strong></td>
<td><strong>2.36</strong></td>
</tr>
</tbody>
</table>

Source: Authors’ calculations.
Note: GDP = gross domestic product; JD = Jordanian dinars.
Figure 3.1 and figure 3.2 illustrate the magnitude of impacts estimated for each environmental category. The most important contributor to the overall damage is air pollution, which is highly localized and accounts for 1.15 percent of GDP. The impact of inadequate water supply, sanitation, and hygiene is the second most significant, representing about 0.81 percent of GDP. The cost of improper disposal of solid waste ranks third, followed by that of degradation of soil and coastal zone.

Several estimates suffer from data constraints. In some cases, the absence of local information imposed the use of benefits transfer from international studies. This is the case of valuing the impact of urban air pollution on the quality of life, the impact of forest degradation on tourism, the effect of improper waste collection, and the degradation of the Aqaba gulf. In other cases, data limitations were so severe that some losses could not be estimated. The major issues not covered by this study include the following: the impact of pollutants other than PM$_{2.5}$, PM$_{10}$, and SO$_2$ on health; the impact of PM$_{2.5}$ and PM$_{10}$ on health in polluted areas other than Amman, Zarqa, Fuheis, Rashadeia; the impacts of SO$_2$...
in polluted areas other than Zarqa; and the impacts of untreated wastewater in areas other than Zarqa and Al-Hassan qualified industrial zone on environment and health. Because of these reasons, the overall COED estimate should be regarded as an order of magnitude, which most likely underestimates the true value of damage. This exercise should be repeated at regular time intervals, to make use of new data as they become available and to capitalize on accumulated knowledge.

### 3.2 AIR QUALITY

In selected areas such as downtown Amman, Zarqa, Aqaba, Fuheis, and Rashadeia, degradation of air quality is an important problem. Although particulates of less than 10 micrometres ($PM_{10}$) are thought to cause substantial health damages, Pope and others (2002) show that even smaller particulates ($PM_{2.5}$) have the largest health effects. $SO_2$ and $NO_x$ also may have important consequences, as they can react with other substances in the atmosphere to form particulates. This section estimates the costs associated with the following:

![Figure 3.2 Impacts of Air Pollution](image-url)

*Source: Figure based on authors' calculations.
Note: $PM_{2.5}$ = particulates of less than 2.5 micrometres; $PM_{10}$ = particulates of less than 10 micrometres; $SO_2$ = sulfur dioxide.*
Adult mortality related to cardiopulmonary diseases and lung cancer caused by long-term exposure to PM$_{2.5}$

Infant and child mortality related to respiratory diseases caused by short-term exposure to PM$_{10}$

All-age mortality related to exposure to SO$_2$

All-age morbidity related to exposure to PM$_{10}$, such as chronic bronchitis, hospital admissions of patients with respiratory problems, emergency room visits, restricted activity days, lower respiratory infections in children, and general respiratory symptoms

These impacts are estimated for GAM, Zarqa, Aqaba, Fuheis, and Rashadeia. The exception is SO$_2$, which is estimated to affect only Zarqa. Valuation is based on the following steps:

1. **Identification of pollutants and measurements of concentration**
   Table 3.2 presents the average PM$_{10}$ concentration estimated for the selected areas and the main sources of information. Because GAM accounts for about half of the country’s population, we illustrate the main steps to estimate the average PM$_{10}$ concentration for this area:

   The Al-Husseini station in downtown Amman is selected as a reference for what is likely to be the highest concentration of PM$_{10}$ throughout Amman. Downtown Amman corresponds to Al-Madeenah, which is only one of the 27 districts of the GAM. The MoH has

<table>
<thead>
<tr>
<th>Location</th>
<th>Estimated average PM$_{10}$ concentration (µg/m$^3$)</th>
<th>Notes/Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAM</td>
<td>67</td>
<td>MoH for data in Al-Husseini, annual average 2002–2007</td>
</tr>
<tr>
<td>Zarqa</td>
<td>95</td>
<td>RSS for MoEnv for 2003–2004$^a$</td>
</tr>
<tr>
<td>Fuheis</td>
<td>58</td>
<td>MoEnv, annual average 2004–2006</td>
</tr>
<tr>
<td>Rashadeia</td>
<td>54</td>
<td>MoEnv, annual average 2003–2006</td>
</tr>
</tbody>
</table>

*Source:* As noted.

*Note:* GAM = Greater Amman Municipality; MoEnv = Ministry of Environment; MoH = Ministry of Health; PM$_{10}$ = particulates of less than 10 micrometres; RSS = Royal Scientific Society.

$^a$ Based on observations taken every other day, as reported by MoEnv.
been conducting measurements of \( \text{PM}_{10} \) concentration at Al-Husseini over the period 2002–2007. The average annual concentration of \( \text{PM}_{10} \) over this period is estimated at 124 \( \mu \text{g/m}^3 \).

The \( \text{PM}_{10} \) concentrations for the other districts are estimated by using the \( \text{PM}_{10} \) concentration in Al-Madeenah and a specific scaling factor (varying between 0 and 100 percent), reflecting the potential impact on reference \( \text{PM}_{10} \) concentration (that is, concentration measured at the Al-Husseini station) of wind, topography, and traffic in each district, based on local expert opinion (staff of the MoEnv and GAM).

The average \( \text{PM}_{10} \) concentration in GAM is calculated based on the \( \text{PM}_{10} \) concentration and the population density in each district. The weighted average concentration for GAM as a whole is estimated at 67 \( \mu \text{g/m}^3 \).

2. Estimating the population exposed

For each GAM district, exposed population is estimated by multiplying total resident population by a coefficient of exposure. The latter reflects the proportion of total population that spends most of the time in the district where they reside and is based on the opinion of staff of the MoEnv and GAM. The average total exposed population in GAM is the sum of the exposed population in each district and accounts for 64 percent of the total GAM population. In absence of more information, the proportion of exposed population in the other areas is assumed to be equal to that in GAM.

3. Establishing a dose-response coefficient

The impacts of \( \text{PM}_{10} \) and \( \text{PM}_{2.5} \) on mortality are estimated by using the following relative risk (RR) functions provided below (Ostro 2004). The impacts of \( \text{PM}_{10} \) on morbidity are based on dose-response coefficients from Ostro (1994) and Abbey et al. (1995), which are presented in table 3.3. As \( \text{PM}_{2.5} \) data are not available for Jordan, we approximate them by converting \( \text{PM}_{10} \) levels using a factor of 0.6 (Cohen et al. 2004). We use a threshold level (baseline concentration) of 10 \( \mu \text{g/m}^3 \) for \( \text{PM}_{2.5} \) and of 20 \( \mu \text{g/m}^3 \) for \( \text{PM}_{10} \), given by the World Health Organization (WHO) air quality guidelines (WHO, 2005).

a. For mortality related to short-term exposure of children under five years:
\[ RR = \exp[\beta(x-x_0)] \]

where \( \beta \) ranges between 0.0006 and 0.0010;
\( x \) = current annual mean concentration of PM\(_{10}\) (µg/m\(^3\));
\( x_0 \) = baseline concentration of PM\(_{10}\) (µg/m\(^3\)).

b. For cardiopulmonary mortality related to long-term exposure of adults over 30 years (Pope et al. 2002):
\[ RR = [(x + 1)/(x_0+1)]^{\beta} \]

where \( \beta \) ranges between 0.0562 and 0.2541;
\( x \) = current annual mean concentration of PM\(_{2.5}\) (µg/m\(^3\));
\( x_0 \) = baseline concentration of PM\(_{2.5}\) (µg/m\(^3\)).

c. For lung cancer mortality related to long-term exposure of adults over 30 years (Pope et al. 2002):
\[ RR = [(x + 1)/(x_0+1)]^{\beta} \]

where \( \beta \) ranges between 0.08563 and 0.37873;
x = current annual mean concentration of PM$_{2.5}$ (μg/m$^3$);  
\(x_0\) = baseline concentration of PM$_{2.5}$ (μg/m$^3$).

The morbidity health endpoints considered are chronic bronchitis, hospital admissions of patients with respiratory problems, emergency room visits, restricted activity days, lower respiratory infections in children, and general respiratory symptoms.

4. Estimating the health effects

The health effects of air pollution are converted to Disability-Adjusted Life Years (DALYs) to facilitate comparisons with health effects from other environmental factors and between mortality and morbidity using a common indicator. Table 3.4 presents the number of DALYs per 10,000 cases of various health endpoints. Based on the total number of cases estimated in the areas considered, morbidity accounts for 5,634 DALYs and mortality for 7,557 DALYs, totaling 13,191 DALYs.

The cost of adult mortality is based on the human capital approach (HCA) as a lower bound and the Value of Statistical Life (VSL)$^3$ as an upper bound, thus obtaining a wide range. The cost of morbidity and that of child mortality under five is estimated based on HCA only, because of data scarcity in Jordan concerning the willingness to pay (WTP) of individuals to avoid pain and discomfort. Thus, the cost of mortality

**TABLE 3.4 DALYS FOR HEALTH EFFECTS**

<table>
<thead>
<tr>
<th>Annual Health Effect</th>
<th>DALY lost per 10,000 cases</th>
<th>Total DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>80,000</td>
<td>7,557</td>
</tr>
<tr>
<td>Chronic bronchitis (adults)</td>
<td>22,000</td>
<td>1,892</td>
</tr>
<tr>
<td>Respiratory hospital admissions</td>
<td>160</td>
<td>29</td>
</tr>
<tr>
<td>Emergency room visits</td>
<td>45</td>
<td>162</td>
</tr>
<tr>
<td>Restricted activity days</td>
<td>3</td>
<td>1,649</td>
</tr>
<tr>
<td>Lower respiratory illness in children</td>
<td>65</td>
<td>590</td>
</tr>
<tr>
<td>Respiratory symptoms</td>
<td>0.75</td>
<td>1,312</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>13,191</strong></td>
</tr>
</tbody>
</table>


Note: DALY = Disability-Adjusted Life Years.
and morbidity associated with PM_{2.5} and PM_{10} lies within JD 15–158 million. In addition, the cost of treating illnesses and the value of lost work days is estimated at JD 7 million. Overall, the total cost associated with PM_{2.5} and PM_{10} lies within JD 22–166 million (1). The cost of mortality due to exposure to SO_{2} ranges between JD 4 and 32 million (2). Adding up (1) and (2), the value of health impacts associated with PM_{10}, PM_{2.5}, and SO_{2} is estimated at JD 26–198 million, averaging to JD 112 million.

**Impacts on landscape value.** In addition to its impacts on health, air pollution reduces visibility and the aesthetic value of landscapes. Data on such impacts are not available in Jordan. A Contingent Valuation (CV) study of urban households in Rabat-Salé, Morocco, found a WTP for a 50 percent reduction in air pollution of about 67–82 dirhams per household per month (Belhaj 2003 in World Bank 2005c). About 10 percent of this figure is thought to reflect the cost of discomfort from air pollution (the rest being impacts on health). Adjusting for GDP per capita differentials between Morocco and Jordan, the cost of discomfort in the urban areas of Jordan reaches JD 2.7–3.3 million, averaging to JD 3 million. Overall, the damage costs associated with air pollution average to JD 115 million, or 1.15 percent of GDP.

### 3.3 WATER QUALITY

With limited water availability and a steadily growing population, Jordan faces the challenge of unsustainable water use with consequent decline in water table and water quality. This section estimates the impacts of inadequate water supply, sanitation, and hygiene on health and avertive behavior, and the effects of surface water pollution and of groundwater overexploitation.

**Impacts on health.** Inadequate water supply, sanitation, and hygiene cause health damages in terms of mortality and morbidity cases caused by water-borne diseases, such as diarrhea. Valuation uses the DALYs approach, assuming that a death of a child under the age of five represents a loss of 33 DALYs (WHO 2006).
Mortality (children under five). The total number of child deaths in 2006 was 4,112 (UNICEF website⁴). The MoH reports no child deaths due to diarrhea in Jordan. A recent MoH initiative aimed at accurately collecting health data through local dependencies in each governorate reported 1,886 under-five deaths, or 45 percent of the total under-five deaths at national level. The significant sample size suggests that the results of this initiative are quite representative for the overall country. The data also reported that intestinal diseases represented just 26 cases, or 1 percent of the reported under-five deaths. Applying the same rate at the national level,⁵ and considering that 88 percent of total cases are due to inadequate water supply, sanitation, and hygiene (Hutton and Haller 2004; WHO 2002), we obtain 47 child deaths, or about 1,500 DALYs.

Morbidity (all ages). The population of children under five totals about 714,000 (DOS 2006a), with a diarrheal prevalence of 2.12–3.12 episodes per child per year (DHS 2002). Given an average duration of diarrhea of four days, an avoidance ratio of 88 percent (Hutton and Haller 2004; WHO 2002), and a severity weight of 0.12 (WHO 2006), the losses due to under-five child morbidity correspond to about 1,700–2,500 DALYs. The diarrheal incidence reported for the rest of the population is quite low (see annex 2 in World Bank 2010). The total loss resulting from water-borne diarrheal morbidity is estimated at 1,800–2,600 DALYs.

Based on the HCA (assuming that one DALY is equal to GDP per capita), the total damage cost of mortality and morbidity is about JD 6.7 million. In addition, the medical cost of treating diarrhea and the time spent by caregivers are estimated at JD 19.2–27.8 million.⁶ Overall, the impact of inadequate water supply, sanitation, and hygiene on health is about JD 25.9–33.5 million, averaging JD 30 million.

Bottled water. To avoid or reduce the impacts of inadequate water supply, sanitation, and hygiene, some households purchase bottled water. The total quantity of bottled water annually purchased is estimated at 42 million liters. The net cost of bottled water is considered a conservative proxy for the damage to health that otherwise would occur. It is assumed that only 75 percent of the bottled water is consumed to avoid such damage, while the rest is due to other preferences (Sarraf, Larsen,
and Owaygen 2004). Using the local market price of JD 0.2–0.3 per liter, the annual expenses made to avoid health damages reach JD 11.2 million.

**Filtering and cleaning equipment.** As with bottled water, the value of the imported water filtering and cleaning equipment is assumed as a conservative proxy for the potential damage to health. Based on DOS (2006a), the annual cost of such equipment is JD 7.2 million.

**Overexploitation of groundwater.** The overexploitation of groundwater in 2006 leads to a declining water table and an increased risk of groundwater salinization in future years. The cost of the declining water table is measured through the incremental cost of pumping from a deeper level and the cost of well replacement. Based on the actual groundwater exploitation of 414 million m³ and a decline of water table of 1.13 m/year, the increased cost of pumping water from a deeper level is JD 170,000 per year, with a present value of JD 2.7 million (\(t = 25\) years, \(r = 4\) percent; \(i\) = time and \(r\) = discount rate). The cost of building public and private wells to replace those affected by overexploitation is JD 4.9 million. Overall, the estimated cost of groundwater overexploitation is JD 7.6 million.

**Reduction in agricultural yields in the Jordan Valley.** Data from the FORWARD project indicate the economic losses per dunum (du) (1 du = 0.1 ha) of agricultural land due to the deterioration of water quality (FORWARD Team 2000). Based on a total agricultural area of 200,000 dunum and an average loss of JD 58/du, the losses in irrigated agricultural production reach JD 12.3 million.

**Pollution of springs and wells.** Jordan has 17 unprotected sources for municipal drinking water supply, of which nine have experienced bacteriological pollution problems, mainly from septic tanks and poor sanitation. Using the cost of water treatment of JD 0.13 per m³ and a total yield of wells and springs of 22 million m³, the total cost of water pollution is estimated at JD 2.9 million.

**Pollution from industrial wastewater.** Data reflecting the impacts of untreated industrial wastewater from Zarqa and Al-Hassan Qualified
Industrial Zone (QIZ) are not available in Jordan. We thus assume that the cost of treating wastewater reflects partially the real damage caused by industrial wastewater. Overall, the annual cost of establishing and operating industrial wastewater treatment plants is estimated at JD 9.2 million.

**Soil erosion in King Talal Reservoir.** The sedimentation has reduced the storage capacity of the King Talal Reservoir by 625,000 m³ per year (Numayr 1999). In turn, this reduces the capacity to optimally regulate inflows and outflows according to water availability and water needs in the Jordan Rift Valley. Based on the lost storage capacity and a cost of downstream water salinization of JD 0.2–0.3 per m³, the present value of the annual loss due to reservoir sedimentation in 2006 ($t = 25$ years, $r = 4$ percent) is about JD 2.4 million.

Overall, the damage costs associated to water pollution, groundwater overexploitation, and inadequate water supply, sanitation, and hygiene average to JD 83 million, or 0.81 percent of GDP (see figure 3.3).

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**FIGURE 3.3 IMPACTS OF WATER QUALITY DEGRADATION**

Source: Based on authors’ calculations.
3.4 **LAND DEGRADATION**

This section estimates the annual costs of rangeland and forest degradation. These estimates are based on conservative assumptions used in absence of accurate data.

**Rangeland degradation.** Rangelands in Jordan have suffered continuous deterioration and denudation as a result of unsound management practices and socioeconomic pressures. The growing demand for animal products led to overgrazing, which is mostly responsible for decreasing fodder productivity. In theory, reduced fodder productivity may lead to reduced feed for livestock as well as to displacement of rural population to other areas. Available data do not suggest, however, that overgrazing is responsible for any major displacement from rural areas in Jordan. Therefore, this section is limited only to valuing the impact of rangeland degradation on fodder losses for livestock. It is estimated that about 17,705 tons of forage (barley equivalents) is lost annually to overgrazing. Valued at a price of JD 200 per ton of barley, the annual cost of forage loss is about JD 3.5 million.

**Forest degradation.** The limited areas of Jordan’s forests are valuable for recreation and tourism. More than 2 million residents visit them every year (Government of Jordan 2002). Large areas of forests are threatened by pests, misuse, and pressures, resulting from energy shortages in rural areas. No study related to the WTP of local tourists for improved environmental quality is available in Jordan. However, Huybers and Bennett (2000) found that British tourists are willing to pay a premium of around US$70 per day for “unspoiled” versus “somewhat spoiled” destinations and “somewhat spoiled” versus “very spoiled” destinations. Adjusting this result for GDP per capita differentials and applying it to the 2 million local tourists visiting Jordan’s forests, the cost of forest degradation is estimated at JD 7.2 million.

Overall, the damage costs associated with soil degradation average to **JD 11 million, or 0.11 percent of GDP** (see figure 3.4).
3.5 WASTE

This section estimates the annual costs of waste collection and disposal.

**Municipal waste collection.** The cost of inadequate waste collection usually is estimated through individual WTP for improved waste collection. No such study has been conducted in Jordan. Altaf and Deshazo (1996) estimate the mean WTP for improved waste collection in Pakistan at about 8.14 rupees per household per month. Blore and Nunan (1996) estimate a similar WTP for eliminating the drawbacks of living near a solid waste landfill in Bangkok, Thailand. Applying Altaf and Deshazo’s estimate to about 25 percent of households in Jordan by adjusting for GDP per capita differentials gives a total cost of JD 2.4–3.1 million.

**Improved disposal practices.** The volume of municipal waste generated annually in Jordan is estimated at 2 million tons. About 60 percent of it is disposed in the Ghabawi landfill, and the rest is assumed to be disposed of improperly. At a unit cost of proper disposal of JD 8.4 per ton, the total cost to dispose properly the waste is estimated at JD 6.8 million.

**Hazardous waste in Tuba.** The degradation cost due to untreated hazardous waste is estimated through the cost of treating this waste in Tuba.
The annual production of hazardous waste in Tuba is about 27,500 tons. At a cost of JD 300–440 per ton of waste, the annual cost of treatment varies within JD 11.5–15.3 million.

Overall, the damage costs associated to waste average to JD 22.9 million, or 0.23 percent of GDP (see figure 3.5).

### 3.6 COASTAL ZONE

Aqaba is Jordan’s only access to the open sea. The shoreline of Aqaba supports a highly diverse marine environment, including coral reefs of global importance. These reefs represent a diverse ecosystem, where more than 150 species of hard corals are flourishing (Government of Jordan 1998). The development of shipping, industry, and urban centers along the coast threatens to degrade the environment in which this ecosystem thrives and to negatively affect tourism. No study assesses the impacts of development on the marine environmental quality in Aqaba. Applying once again Huybers and Bennett’s (2000) estimate, the 152,000 international tourists in Aqaba leads to a degradation cost of marine environment of about JD 5.9 million, or 0.06 percent of GDP.
3.7 CONCLUSION

Air pollution and water quality are the environmental priority areas at the national level. Air pollution in urban areas such as GAM and Zarqa represents a challenge, mostly as a result of high emissions level from transport and industry. Addressing this problem should be based on a clear understanding of these sectors. Chapter 5 provides a comprehensive overview of the pollution impacts of the transport sector.

Inadequate water supply, sanitation, and hygiene are the second most significant priority, mainly reflected through groundwater over-exploitation, pollution from industrial wastewater, and high-avertive expenditures. The analysis suggests a strong relationship between the country’s water scarcity and the deterioration of water quality. A thorough analysis of the major issues related to water quality in Jordan is provided in chapter 4.

There is a need to address these environmental issues through policies and institutional reforms that create the right incentives for administrators to effectively enforce policies and for polluters to comply with regulations. Doing so not only would reduce the environmental degradation, but also would contribute to sustaining the economic growth in the country. For example, improved biodiversity conservation in protected areas could increase tourism revenues, while a better rangeland management could improve the livelihood of rural population depending on livestock agriculture. Chapter 7 provides a comprehensive assessment of institutions and policies linked to environment, and suggests recommendations to improve sustainable development and growth in Jordan.

NOTES

1. An earlier study (World Bank 2005b) estimated the COED in Jordan at JD 205 million, or 3.13 percent of GDP in 2002. Important methodological and empirical differences between the two studies make a direct comparison of their results difficult.


3. The valuation uses a VSL of US$3.5 million, adjusted for GDP per capita differences at purchasing power parity (PPP) between the United States and Jordan, based on an earlier study of Gayer, Hamilton, and Viscusi (2000) who estimated the VSL to avoid a statistical cancer case in the United States within the range of US$3.2–3.7 million. More recently, Viscusi and Aldy (2003) conducted a meta-analysis of more than 60 studies estimating mortality risk premiums and 40 studies of injury risk premiums.
They estimated the VSL within the range of US$4–9 million in the United States, using labor markets data. Thus, the VSL estimate applied in this study can be considered conservative.


5 WHO database reports that under-five diarrhea mortality accounted for 10.7 per 1,000 live births in 2000. At the same time, the under-five mortality rate declined from 30 to 27 per 1,000 live births from 2000 to 2006. Assuming that the diarrhea-caused mortality rate declined at the same proportion, it would be 9.6 in 2006. This would correspond to about 1,462 deaths, or 36 percent of the total under-five deaths at the national level. Despite the likelihood of unreported cases, this figure seems considerably overestimated. Because of that, we choose to rely on the MoH estimate.

6 It includes the cost of hospital visits (based on unsubsidized cost at private hospitals of JD 8 per visit), the cost of medicines and Oral Rehydration Therapy (JD 11 per episode), and the opportunity cost of caregivers’ time (JD 8 per day).

7 The cumulated impact of groundwater overexploitation carried out each year contributes to reducing water availability for future generations, hence to water-resource depletion. The objective of this section, however, is to estimate the impacts on present and future generations of water overexploitation occurring in 2006 only. Thus, the valuation does not incorporate the opportunity costs of water depletion.

8 Data provided by Ministry of Health and Water Authority of Jordan (WAJ).

9 Despite the decreasing fodder productivity, FAOSTAT data indicate that agricultural employment rose by 15 percent during 1990–2000 (from 491,000 to 567,000 people) and declined by only 1 percent during 2000–2005 (from 567,000 to 560,000 people). As agricultural employment accounts for only 9 percent of the total population—that is, 58 percent of rural population, which represents 17 percent of the total population in 2006 (World Bank database 2008)—the decline in agricultural employment during 2000–2005 does not suggest any significant displacement of rural population as a result of rangeland degradation. Even if such displacement had taken place, it is most likely that it was driven by other factors such as better job opportunities in urban areas.
4.1 MAIN MESSAGES

As one of the most water scarce countries in the world, one of Jordan’s key priorities is management of water quantity. Because of its effects on human health and productive activities, water quality matters too: poor water quality is a significant social concern (as discussed in chapter 3). Conversely, water of better quality means that more resources are available to mitigate the scarcity problem.

These are the main reasons why this chapter focuses on the quality aspect of Jordan’s water agenda, proposing an integrated approach in terms of resources evaluated (surface, ground, and treated wastewater), sources of pollution (urban, industrial, and agriculture sectors), and range of impacts considered (human health, income of farmers, and water consumers).

The issue of adequate incentives for better quantity management clearly remains important, but it is not addressed here. Since the National Agenda was launched, it would appear that the reduction of water-related subsidies and the creation of incentives for allocating water to higher value added uses have been recognized as necessities that public policies will not be able to avoid in the future. The main messages of this chapter are as follows:

» Surface water appears to be of acceptable quality, but presents important problems of salinity and bacteriological contamination of a
localized nature, although possibly with a strategic significance, particularly at the Zarqa junction of the King Abdullah Canal (KAC), which is located upstream of important irrigation schemes in the Jordan Valley. The overall decline of fresh surface-water resources observed in recent years (and due in particular to the drying up of Yarmouk River baseflow) might have significant implications for quality of surface water.

In terms of groundwater, evidence suggests a simultaneous trend of declining water tables and increasing salinity in most aquifers, with resulting higher extraction costs (in terms of pumping as well as accelerated well replacement), and the need to use more irrigation water for leaching. Moreover, the salinity of many groundwater resources is rapidly approaching the limits for drinking water supply, making the provision of drinking water more expensive in the future because of the additional desalination required. Higher production costs and declining yields affect farmers’ income, for a share of some 40 percent of the 2006 cost of environmental degradation (estimated in chapter 3), which is linked to poor water quality (not including industrial wastewater impacts). The cost, however, is likely to escalate in the future, as water tables keep declining, and as increasing demand for potable use in urban areas raises the opportunity costs of the additional water required to lower salinity.

Access to sanitation is relatively high (with some exception in rural areas), and the quantity of municipal wastewater collected and treated has been steadily increasing. The quality of treated wastewater, however, is a reason for concern: about 50 percent of total wastewater treated does not seem to meet national quality norms for pollutants such as biological oxygen demand (BOD) and *E. coli*. The situation recently has improved with the establishment of new As-Samra treatment plant; further progress may be expected if the targets of the National Agenda are to be met, although the cost likely will be high.

In terms of industrial wastewater, only 28 percent of the total effluent is treated (50 percent excluding wastewater from potash mining, which is likely to have limited environmental impacts). About 25 percent of industrial wastewater is estimated to be discharged in the sewer network, but the quality of the effluent is of concern on account of high rates of discharges without licensing, and low rates of compliance with applicable regulations (more than 30 percent for
ammonia and suspended solids). As for the 30 percent of wastewater not disposed of in sewers, monitoring of the effluent quality is limited and does not include important toxic substances. Disposal of wastewater through tankers is a widespread practice, virtually unmonitored in terms of effluent quality, and likely to pose health hazards where wastewater is disposed of in unlined landfills (such as Al-Ekeider), with resulting possible infiltration in the groundwater. Current policies seem to focus on creating a centralized treatment plant as the strategy of choice to address the problem. Important opportunities may exist to reduce the overall public and private cost of treatment by encouraging plant-level interventions (both production process and end-of-pipe treatment).

» In the face of the combined effects of groundwater mining, dwindling surface resources, population growth, and policies aimed at promoting industrial development, several of these quality problems are likely to worsen in the medium to long term, and result in impacts on human health, income, and agriculture outputs, well beyond the 0.8 percent of GDP estimated in this CEA for 2006.

» The National Agenda establishes a number of targets of increased water supply and enhanced wastewater treatment, which are expected to reduce water quantity pressures and deliver water quality benefits as well. This report, however, argues that those programs could be complemented and optimized by considering interventions that significantly could alleviate water quality problems at relatively low cost. Such interventions could include hygiene programs to reduce at-recipient exposure; and particularly water-savings policies (especially in irrigation) that could enable on-site increased dilution, and, if accompanied by water rights regulation, bulk-water arbitrages and reduction of polluting concentrations at larger geographic scales.

» A simplified cost-benefit analysis at the macrolevel suggests that it might be possible to eliminate up to 80 percent of the social cost of water degradation (as estimated by the CEA) by optimally combining hygiene programs, enhanced dilution via water savings, and wastewater treatment. Under the assumption used in the CEA (and subject to limited information on baseline concentrations, unit costs, and other parameters), this could be achieved by a water-saving program aimed at reducing losses in irrigation at a rate of 3 percent per year, accompanied by hygiene programs targeted at some 80,000 households.
Some key institutional constraints need to be overcome to design and implement cost-effective water quality policies:

> First, the legislative and regulatory framework could become far more effective if organized and systematized in a comprehensive framework (“water code”) that would resolve conflicting attributions of roles and responsibilities, and cover strategic areas currently not regulated adequately (such as integrated water resource planning and definitions of quantity and quality objectives).

> Second, monitoring of water quality should be improved, both in terms of organizing and sharing the information already available (essential for properly establishing baselines and trends), and, looking forward, in terms of rationalizing the current system in which several agencies collect similar or related information, but with limited or no scope for integrated analysis, reporting, and provision of input for policy design and evaluation. In addition, water quality monitoring should be fully extended to toxic substances (for example, pesticides, endocrine substances, toxic industrial effluents), which currently are measured in an incomplete manner or not at all.

4.2 INTRODUCTION: WATER QUALITY AND WATER QUANTITY

With a total of renewable water resources (including recycled wastewater) of 133 m³ per inhabitant, Jordan is the most water-scarce lower-middle-income country in the world, and one of the water-poorest countries in the MENA region (see figure 4.1).

This severe scarcity implies that adequate management of water quantity is a key issue in Jordan’s overall development agenda. In environmental terms, water scarcity is an issue of great significance because it might generate pressure on renewable (surface water and shallow aquifers) and nonrenewable resources (fossil aquifers), thereby jeopardizing in the long term the environmental sustainability of the development process.

The topic of Jordan’s water quantity management has been researched heavily and is the subject of a large number of reports by the World Bank and other institutions. Some of the factors that have been
leading to increasing pressure on scarce water resources (such as pricing policies that might discourage water savings in agriculture) have been the subject of intense debates.

In recent times, drafters of the National Agenda have recognized the need to modify such an incentive structure and to decrease gradually subsidies to agriculture (from an estimated 2.7 percent of GDP in 2004 to 1.5 percent in 2012, and 0.5 percent in 2017), while at the same time increasing their productivity (with targets in 2012 and 2017, respectively, of JD 2.5 and 3.5 in agriculture GDP for each 1 JD spent in agriculture subsidies—against the level of JD 0.81 in 2005), and enhancing the returns of agriculture per unit of water (from less than 0.5 JD per m$^3$ to JD 3.6 and JD 5 in 2012 and 2017). Because water-related subsidies are estimated to account for about 50 percent of total agriculture subsidies, achievement of the National Agenda’s target

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**FIGURE 4.1 WATER AVAILABILITY IN THE MENA REGION**

presumably will entail a significant reduction of water subsidies; and, to be sure, a sizeable reduction of the expected share of agriculture in water use—particularly in comparison with the estimates obtained from the MoWI and based on the NWMP (see figure 4.2).

This report focuses on a different environmental dimension of water management, namely water quality, which appears to be a topic less heavily researched than water quantity, and therefore has a wider scope to add value to the existing stock of knowledge. Nevertheless, it is clear that strong linkages exist between the quality and the quantity aspects of water management. On the one hand, overuse of water leads to deteriorating quality as fewer resources are available to dilute the concentration of substances harmful to human health, to productive activities, and to the environment in general. On the other hand, management of water quality might alleviate the quantity problem (for

![Figure 4.2: Current and Projected Water Use in Agriculture](image)

**Source:** Authors’ calculation based on Government of Jordan (2005) and MoWI (2008).

**Note:** the National Agenda (NA) figures have been calculated by combining the NA’s targets for the reduction in the agriculture subsidies to agriculture GDP ratio, the increase in the returns per unit of water, and the growth of GDP. The figures associated to the water master plan have been obtained by exponential interpolation ($R^2=0.93$) of the irrigation water use projected for 2010, 2015, and 2020.
example, through treatment practices that enable reuse of wastewater); or it can exacerbate the problem, insofar as poor quality water creates incentives for increasing pressure on cleaner but vulnerable water bodies, such as fossil aquifers.

This chapter does not address directly the causes of water scarcity or the policy options to ameliorate it. It does, however, emphasize the ways in which inadequate water quantity management contributes to the quality problem, and, conversely, how improved water quantity policies (particularly on the demand side) can improve water quality, and along with it, the health, income, and overall well-being of Jordan's people.

The rest of this chapter is organized as follows. Section 4.3 summarizes key features of the water resource situation in Jordan, in terms of climate, hydrology, and current and projected water balance. Section 4.4 reviews the available evidence on current status and recent trends of quality of surface, ground, and treated wastewater. Section 4.5 discusses the significance of different sources of water pollution. Section 4.6 analyzes Jordan's legal and institutional setup for water quality management; finally, section 4.7 discusses policy options to improve water quality.

4.3 WATER RESOURCES IN JORDAN

Jordan's climate is characterized by low average precipitation (104 mm per year), highly irregular distribution of rainfall throughout the year, and a relatively large variability of yearly precipitation events (the coefficient of variation of a sample of 25 meteorological stations varies between 30 and 45 percent) (see figure 4.3).

Potential evaporation largely exceeds precipitation, and streamflow of wadis and rivers often is intermittent. A permanent spring-fed baseflow is available only in a number of wadis in the western part of the highlands. This makes for semi-arid conditions and poses challenges for both water quantity and quality management. In the face of a historical trend of declining rainfall (see figure 4.3), climate change is expected to result in increasing temperatures (up to 4°C for the Mediterranean area by end of the century), which are likely to increase evaporation and further exacerbate Jordan's main water management challenge, namely, a chronic scarcity of resources available.


### 4.3.1 Water balance

Groundwater is the largest source of water (more than half of the total), and agriculture is the most important user (more than 60 percent). Table 4.1 provides an aggregated water balance for the year 2005.

The historical development of water resources supply is presented in figure 4.4, along with projections for 2010, 2015, and 2020 (MoWI 2008). The graph shows an almost constant use of groundwater resourc-

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#### TABLE 4.1 WATER BALANCE BY SOURCE AND USE, 2005

<table>
<thead>
<tr>
<th>Source</th>
<th>Municipal</th>
<th>Industrial</th>
<th>Irrigation</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface water</td>
<td>74,700</td>
<td>4,500</td>
<td>265,200</td>
<td>7,000</td>
<td>351,400</td>
</tr>
<tr>
<td>Groundwater</td>
<td>209,600</td>
<td>33,800</td>
<td>254,800</td>
<td>7,900</td>
<td>506,100</td>
</tr>
<tr>
<td>Treated wastewater</td>
<td>0</td>
<td>0</td>
<td>83,545</td>
<td>0</td>
<td>83,545</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>284,300</strong></td>
<td><strong>38,300</strong></td>
<td><strong>603,545</strong></td>
<td><strong>14,900</strong></td>
<td><strong>941,045</strong></td>
</tr>
</tbody>
</table>

*Source: MoWI 2008.*
es at a level close to 500 million m³ per year. Projections of future water supply include a significant decrease of groundwater extraction to reduce overextraction and deterioration of aquifers. To compensate for a decline in groundwater use, surface water use is supposed to increase from about 350 million m³ per year to somewhat more than 400 million m³ per year. The persistent decline of the baseflow of the Yarmouk River may make it difficult to reach such a target. Additionally the total of treated wastewater and desalination resources will need to increase from 85 million m³ per year in 2005 to 300 million m³ per year in 2020. This increase will have a considerable impact on the general quality of water resources.

Figure 4.5 shows the historical development of water resources use for different water-use categories and the predictions of use until the year 2020 (yearly reports on water resources, MoWI Web site).

Municipal water use had remained constant at a level of about 240 million m³ per year until the end of last century and since then has been steadily increasing; a further increase toward 400 million m³ per year in 2020 is expected. Industrial use is expected to increase from almost 40
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Agricultural water use will remain constant at a level between 500 and 600 million m$^3$ per year. Agricultural use is climate dependent; in wet years agricultural use will increase, in dry years it will decrease.

Actual per capita municipal water use is not exactly known because available data on unaccounted-for water (WAJ Web site) does not differentiate between leakage losses and administrative losses. Assuming that leakage losses represent half of the unaccounted-for water, per capita municipal water use has been fairly constant during the last 10 years. It was 115 liters per capita per day in 1995 and 113 l per capita per day in 2005.

4.3.2 Key features of surface and groundwater

Surface water: The discharge of the Yarmouk River, traditionally the largest source of fresh surface water in Jordan, has been declining (see figure 4.6) from about 375 million m$^3$ per year 40 years ago to less than 100 million m$^3$ per year at present. This decline is expected to continue as confirmed by the data of the last two years. The main reason for this decline is the growing exploitation of surface water and
groundwater resources in the upstream areas, particularly in Syria, but also in Jordan.

*Groundwater basins and aquifers:* Table 4.2 presents the different groundwater basins and indicates the maximum sustainable yield and the actual water extraction from the 11 basins for each of the four main categories of water uses (municipal, industry, agriculture, and others) for 2005.

It is clear from the table 4.2 that overextraction takes place in all nonfossil groundwater basins except the smaller Sarhan, Hammad, and Jafr basins; the weighted average of the overextraction rate is 50 percent, with peaks of 70 percent and 143 percent in the Amman-Zarqa, and Azraq basins, respectively. Overextraction is leading to a rapid lowering

<table>
<thead>
<tr>
<th>Basin</th>
<th>Municipal</th>
<th>Industrial</th>
<th>Irrigation</th>
<th>Others</th>
<th>Total</th>
<th>Safe Yield</th>
<th>Rate of over-extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yarmouk</td>
<td>8.8</td>
<td>0.2</td>
<td>41.4</td>
<td>0.6</td>
<td>51.0</td>
<td>40.0</td>
<td>27%</td>
</tr>
<tr>
<td>Jordan River Side Wadis</td>
<td>24.4</td>
<td>0.0</td>
<td>1.8</td>
<td>0.0</td>
<td>26.2</td>
<td>15.0</td>
<td>75%</td>
</tr>
<tr>
<td>Jordan River Valley</td>
<td>7.4</td>
<td>0.3</td>
<td>20.5</td>
<td>0.5</td>
<td>28.7</td>
<td>21.0</td>
<td>37%</td>
</tr>
<tr>
<td>Amman-Zarqa</td>
<td>77.8</td>
<td>7.1</td>
<td>60.4</td>
<td>3.3</td>
<td>148.6</td>
<td>87.5</td>
<td>70%</td>
</tr>
<tr>
<td>Dead Sea</td>
<td>49.8</td>
<td>13.2</td>
<td>26.1</td>
<td>2.1</td>
<td>91.2</td>
<td>57.0</td>
<td>60%</td>
</tr>
<tr>
<td>North Wadi Araba</td>
<td>0.4</td>
<td>1.2</td>
<td>3.7</td>
<td>0.2</td>
<td>5.5</td>
<td>3.5</td>
<td>57%</td>
</tr>
<tr>
<td>South Wadi Araba</td>
<td>0.0</td>
<td>0.2</td>
<td>8.7</td>
<td>0.0</td>
<td>8.9</td>
<td>5.5</td>
<td>62%</td>
</tr>
<tr>
<td>Azraq</td>
<td>22.4</td>
<td>0.3</td>
<td>35.2</td>
<td>0.3</td>
<td>58.2</td>
<td>24.0</td>
<td>143%</td>
</tr>
<tr>
<td>Sarhan</td>
<td>0.0</td>
<td>0.0</td>
<td>0.9</td>
<td>0.1</td>
<td>1.0</td>
<td>5.0</td>
<td>−80%</td>
</tr>
<tr>
<td>Hammad</td>
<td>0.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
<td>0.8</td>
<td>8.0</td>
<td>−90%</td>
</tr>
<tr>
<td>Jafr</td>
<td>6.5</td>
<td>6.2</td>
<td>9.0</td>
<td>0.5</td>
<td>22.2</td>
<td>27.0</td>
<td>−18%</td>
</tr>
<tr>
<td>Mudawara and Disi</td>
<td>11.5</td>
<td>5.2</td>
<td>47.1</td>
<td>0.0</td>
<td>63.8</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>209.6</strong></td>
<td><strong>33.8</strong></td>
<td><strong>254.8</strong></td>
<td><strong>7.9</strong></td>
<td><strong>506.1</strong></td>
<td><strong>418.5</strong></td>
<td></td>
</tr>
</tbody>
</table>


*Note:* n.a. = not applicable.
of the groundwater table and subsequent deterioration of groundwater quality. This will be further discussed in section 4.4.2.

The historical development of groundwater extraction for different uses is presented in figure 4.7. The total amount of groundwater extraction has remained fairly constant at around 500 million m$^3$ per year. Groundwater extraction for municipal use increased from around 140 million m$^3$ per year in 1989 to around 210 million m$^3$ per year in 2005. Groundwater extraction for agricultural use (mainly on the highlands)
4.4 STATUS OF WATER RESOURCES QUALITY

This section provides an overview of current conditions and recent trends in water quality, based on the data that were available within the CEA preparation timeframe. The quantity and the quality of the data acquired are broadly sufficient to provide indicative information to policy makers, but the data set built for the study does not have the coverage of relevant variables across space and time that are needed to formulate more detailed recommendations for action at the specific project level (see box 4.1 for details).

4.4.1 Surface water

While overall quality of surface water appears to be acceptable, important problems of salinity and bacteriological contamination of a localized nature are apparent.

The data provided over the last four years by RSS for the MoEnv and the Jordan Valley Authority (JVA), together with the data from the
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Environment Monitoring and Research Central Unit (EMARCU) real-time observation network, are the most regularly measured and complete, and seem to be the best option for data analysis. Most of the relevant measurements started only in 2002 or later, however. The data available from the earlier periods are not complete and less adequate for statistical analysis.

Figure 4.8 and figure 4.9 show the historical behavior of the two most important parameters for water management, the electric conduc-
FIGURE 4.8 ELECTRIC CONDUCTIVITY IN SELECTED SURFACE-WATER MONITORING STATIONS, 1995–2007

Source: Combined data of MoEnv, WAJ, and JVA 2008.
Note: KAC = King Abdullah Canal.

FIGURE 4.9 E. COLI CONCENTRATIONS IN SELECTED SURFACE-WATER MONITORING STATIONS, 1995–2007

Note: KAC = King Abdullah Canal; KTR = King Talal Reservoir; MPN = most probable number.
activity and the *E. coli* concentrations for a selection of six stations, the locations of which are illustrated in figure 4.10.

**Surface-water salinity**

Figure 4.8 shows that the salinity of fresh-water resources (KAC tunnel, KAC Deir Alla, Wadi Hasa) increased only slightly during the period 1995–2007. On the contrary, the graph shows a clear increase in salinity of the water flowing into King Talal Reservoir (KTR) for the last four years.\(^1\) Obviously this increase has its consequences as well for the salinity of the KTR outflow and the salinity in the southern part of the KAC. The main origin or cause of this increase in salinity is not clearly known. Possible causes may include (1) a dry weather spell (less rainfall runoff to mix with wastewater effluent), (2) increased salinity of groundwater feeding the baseflow of the Zarqa River, and (3) increased discharge of saline industrial wastewater into the sewerage system.
Figure 4.8 also shows that with the exception of wet periods, such as 1996–97 and 2002–03, the salinity of the southern part of the KAC (KAC Zarqa junction) comes close to the salinity of the water flowing out of the KTR. Because of the lack of fresh-water resources in the northern part of the Jordan Valley, the water coming from KTR is no longer mixed with fresh water, as was the case in the early 1990s.

Although the overall salinity may not have increased much for most fresh surface-water resources, the impact of salinity on irrigation is considerable. This impact mainly is due to the repartition of different sources of fresh water and mixed wastewater effluent, which consequently has been changing toward a higher contribution from more saline water resources. This is well illustrated by the example of the Jordan Valley north of the Dead Sea (figure 4.11).

Figure 4.11 shows that the contribution of fresh-water resources is declining and the contribution of blended wastewater effluent (KTR) is slightly increasing.²

**FIGURE 4.11 WATER RESOURCES WITH DIFFERENT SALINITY IN THE JORDAN VALLEY, 1995–2007**

At the national level, expectations are that the contribution of fresh water will further decline. A realistic scenario will be that, in 2020, a maximum of 35 percent of the irrigation water will be fresh water and the average salinity will amount to 1,800 microsiemens μS/cm, coming close to the internationally accepted standard for irrigation water (1,500 mg/l ≈ 2,350 μS/cm).

The relatively high salinity of irrigation water has two important implications: (1) a number of high value added and salinity-sensitive crops (strawberry, beans, onion, banana) may not be grown, and (2) for the remaining, more salinity-tolerant crops, higher salinity requires more leaching water and hence lower output per cubic meter (for example, an increase in salinity from 1,000 μS/cm to 2,000 μS/cm might cause some 20 percent reduction of gross margins and even larger reductions in farm income).

Surface-water bacteriological pollution

Figure 4.9 shows the historical development of *E. coli* concentrations during the period 1995–2007 for five different stations. It is noteworthy that concentrations have reached high values during the period 1996–2000 in various stations. After the year 2000, *E. coli* concentrations have remained, with the important exception of the KAC Zarqa junction station, largely within the ambient standards for discharge of wastewater into streams, wadis, or water bodies (Jordanian Standard [JS] 893/2002) and also within the standards for reuse of wastewater for irrigation of fruit trees.

With the notable exception of the KAC Zarqa junction station, the observed water quality is well within the standards for reuse for irrigation of cooked vegetables. In particular, the *E. coli* concentration in KAC Zarqa junction is more than 10 times higher than the *E. coli* concentration at the outlet of KTR, although this is basically the same water source. This indicates strong contamination of the water on the way from KTR outlet to the observation point in the KAC. The connection between KTR and KAC is an open channel, and hence several types of wastes (cesspit sludge, household grey water, dead animals, and so on) are dumped in the canal (see figure 4.12).

The poor bacteriological quality at the KAC Zarqa junction has a number of important implications. Because water is used downstream for irrigation of the southern part of the Jordan Valley (about 8,000 ha), farm workers may be exposed to health hazards; and the quality
of vegetables grown in the area (tomato, aubergine, cucumber, and so on) may be negatively affected, although it was not possible to find data corroborating such hypotheses. To prevent further risks, authorities may want to consider building a pipeline from KTR to KAC.

Other pollutants
There is no indication of pollution with heavy metals, pesticides, and other organic pollutants in the surface waters; measurements of such pollutants, when done, yield results consistently below the applicable quality norms. Other chemical components of interest, mainly for irrigation, such as boron, do not exhibit values above the acceptable limits. It should be taken into account, however, that the present monitoring system is mainly focusing on measuring standard components and pollutants, such as chemical composition, nutrients, microbiological parameters, and physical parameters, and not on toxic pollutants. Few measurements have been done on toxic substances (pesticides, others) in groundwater and surface water. This is partly due to the limited laboratory capacity in Jordan; in particular, some of the chemical components that are considered in Europe to be priority hazards (whose emissions

![FIGURE 4.12 SECTION OF ZARQA RIVER WITH KING TALAL RESERVOIR AND JUNCTION WITH KAC](image)

*Source: Author.*

*Note: KAC = King Abdullah Canal; WWTP = wastewater treatment plant.*
should be completely banned) cannot be measured (or not with a sufficient microgram [μg] accuracy) in the Jordanian state laboratories (including WAJ, MoH, and RSS).

### 4.4.2 Groundwater

The available evidence indicates a simultaneous trend of declining water tables and increasing salinity in most aquifers, with resulting higher extraction costs (pumping, well replacement) and hence lower revenues for agriculture. Nitrates pollution appears mainly in the Amman-Zarqa basin.

To overcome the limitations of the available groundwater data (see box 4.1 for details), the status of the groundwater in Jordan and the development of water quality over the last 15 years have been evaluated by analyzing the water level and water quality data of 26 representative wells, which cover the most important aquifers and groundwater basins of Jordan. The wells and their locations are listed in Annex 1 in World Bank (2010).

As mentioned in box 4.1, of these 26 wells, only two have both water quality and water level measurements; the problem was overcome by choosing wells close to each other, which provided seven combinations of wells (one for each relevant groundwater basin), where water level and quality could be analyzed jointly.

**Salinity**

A trend analysis of water levels and electric conductivity was conducted for selected wells in the Amman-Zarqa basin (AL), the Dead Sea basin (CD), the South Wadi Araba basin (EA), the Disi basin (ED), the Azraq basin (F), and the Jafr basin (G). The level data provided for the Hammad basin was rejected due to doubts about its quality.

All selected basins, with the exception of the South Wadi Araba basin, show a marked clear decline of groundwater levels, accompanied by an equally clear increase in electric conductivity. Incidental checks with other observation wells in the same basins show that the picture is indicative for the general situation in the analyzed basins. Level changes are different in the various groundwater basins and on different locations, and increases in electric conductivity are more or less strongly related to the decline in groundwater level, but the trend is clearly visible in all but one of the investigated basins.
Because of the dearth of accessible data, it was not possible to quantify the trend properly for the complete area of all groundwater basins in Jordan. The measured changes in water level in some basins (35–45 m in the Amman-Zarqa basin and 60–70 m in the Dead Sea basin) and the measured changes in electric conductivity (in the worst observed case in the Amman-Zarqa basin, the electric conductivity changed from around 800 to around 5,400 μS/cm in just 25 years; the changes in the Dead Sea basin are less dramatic) are quite impressive and are reasons for due concern (see figure 4.13 for an illustration in the Amman-Zara basin). Groundwater resources are being depleted rapidly and indisputably because the quality of groundwater resources is undergoing a worrisome deterioration. This deterioration may spread over a large part of the available resources.

The average decline in the groundwater table from the 16 wells for which level data were provided has been 1.13 m per year. The average electric conductivity of the 12 wells for which quality data were pro-

**FIGURE 4.13 GROUNDWATER LEVEL AND ELECTRICAL CONDUCTIVITY IN THE AMMAN-ZARQA BASIN**

Source: Author.

Note: The trend lines are meant only to enhance the readability of the diagram; they do not suggest that future values of salinity or groundwater table level can be obtained by simple extrapolation.
vided was 760 μS/cm in 1975 and 1,660 μS/cm in 2005. The limited size of the sample does not permit a full-blown, statistically representative analysis at the national level, but the evidence shown indicates the magnitude of the problem, and its foreseeable future trend.

Because of the decrease in groundwater level and the increase in salinity, groundwater wells may become either unproductive, or salinity may render the abstracted water unusable. In its yearly report, the Water Authority of Jordan (WAJ 2006) reported approximately 100 private wells that needed rehabilitation (other than simple cleaning and replacement of screens). Of these wells, approximately 75 percent needed deepening as the dynamic groundwater level dropped below the bottom of the well. The loss of well capacity is stronger in the private sector than in the public sector, as public-sector wells are developed over the whole depth of the aquifer, contrary to most private wells, which are just drilled over the minimum possible length.

**Nitrates**

Additionally, an analysis has been made of the nitrate content in the different wells. In the wells analyzed for the Amman-Zarqa basin, nitrate contents can be significant and in some wells surpass the limits for drinking water quality (values up to 140 mg/l). In all of the other analyzed wells, nitrate contents are between 0 and 45 mg/l, with a geometric mean of about 10 mg/l, and hence are fully within the aforementioned limits and are relatively stable. Apart from the Amman-Zarqa basin, there is no reason for immediate concern.

With regard to the Amman-Zarqa basin, the map in figure 4.14 shows that some of the observed wells (stars on figure 4.14) are close to the As-Samra wastewater treatment plant (WWTP). Their high nitrate content is most probably caused by a leakage from the treatment plant. Further toward the east, the figure shows another well with high nitrate concentrations, but the satellite images do not indicate its source of pollution. The extent and the trend of the nitrate problem are not clear, but where the Amman-Zarqa basin contains semiconfined aquifers, and since it has more than 3 million inhabitants, the nitrate pollution should be a reason for concern and should be properly monitored.
4.5 POLLUTION SOURCES

4.5.1 Urban wastewater
Access to sanitation is relatively high (with some exception in rural areas), and the quantity of municipal wastewater has been steadily increasing. However, the quality of the treated water is a reason for concern: about 50 percent of total wastewater treated does not meet national quality norms for pollutants such as BOD and E. coli. The situation has improved with the establishment of new As-Samra treatment plant; further progress may be expected if the targets of the National Agenda are met, although the cost is likely to be high.

A rather large percentage of the urban population, around 94 percent, has access to sanitation (WHO, UNICEF 2003). For the rural area, the percentage is 85 percent. According to the same WHO/UNICEF report, around 63 percent of the total population has access to centralized public wastewater collection and treatment systems. This applies mainly to the urban population, however; only a limited percentage (3 percent) of the rural population is connected to sewerage networks. In rural areas, wastewater is discharged to septic tanks, cess-
pits, latrines, and so on, or directly to natural water bodies and the soil, if there is no form of sanitation.

Treated urban wastewater is in general discharged to open water bodies (wadis) (94 percent) and collected in reservoirs (85 percent) or is directly reused for irrigation close to the treatment plants (6 percent) (FAO/RNE and WHO/EMRO 2003). Most of the wastewater discharged to the wadis collects in the relevant dams or reservoirs, but a smaller yet significant part is pumped directly from the wadis for (legal and illegal) reuse in irrigation along the wadis. Water resources contamination is caused by (1) insufficient treatment of wastewater discharged to the wadis, (2) leakage of sewerage networks, (3) septic tanks with improper design (single chamber) and insufficient maintenance, (4) open-bottom cesspits that leak to groundwater, (5) direct and illegal discharge of wastewater (by the vacuum tankers) to adjacent water bodies and wadis, and (6) direct and illegal reuse of treated wastewater.

No data are available on the modality of sanitation for those areas that are not connected to central sewerage systems. It is believed that cesspits and latrines, because of their relatively low costs, are the most widespread systems in these areas.

Despite an average population growth of 2.5 percent, the total production of water for municipal uses (not including industry and tourism) has been fairly constant during the period 1995–2004, at a yearly level of approximately 240 million m$^3$. Only in the last two years has production increased. Background studies to this report estimate that a maximum of 70 percent of the municipal water use may return as treated wastewater, an amount equal to almost 200 million m$^3$ (year 2005). When water use increases (as population increases), more wastewater will be produced accordingly.

By mid-2007, Jordan had 22 functional municipal (public) wastewater treatment plants, with a total installed capacity of 312,000 m$^3$ per day. Fourteen of these plants were more than 10 years old. In total, the 22 mentioned plants treated about 107 million m$^3$ of wastewater in 2006. After the new As-Samra treatment plant has come into operation at the end of 2007, it is estimated that the amount of wastewater collected and treated should have increased to approximately 120 million m$^3$ per year, but the exact data on its performance are not yet available.

In addition to the 23 public plants currently in operation, at least 13 other (usually smaller) domestic wastewater treatment plants are op-
erating, mainly at or for hospitals, universities, Queen Alia airport, industrial estates, and so on. Their total installed capacity was of around 12,000 m³ per day in 2006: only a fraction (around 4 percent) of the capacity of the municipal plants.

The amount of wastewater collected and treated in the municipal WWTPs has increased steadily (see figure 4.15), and at a rate exceeding population growth: that is, from 14.3 m³ per capita per year in 1994 to 19.6 m³ per capita per year (which is equivalent to 54 l per capita per day, about half of the estimated per capita daily water consumption). The increase in per capita wastewater collected and treated briefly stagnated in the early 2000s, but its growth has been more significant during the last four to five years because of increased investments.

Data from 2005 and 2006 (MoEnv 2005, 2006) show that the quality of the effluent is generally unsatisfactory. According to JS 893/2002, the performance of all the older biofiltration (trickling filter) treatment plants is deficient with respect to BOD, suspended solids, and *E. coli*. Two
of the four relevant plants are largely overloaded, unacceptably shortening the reaction time; the other two work below design capacity, but it is unclear whether the design of the plants is optimal. Of the eight treatment plants that work with waste stabilization ponds, only two, Aqaba and New Aqaba are working well; the other six perform unsatisfactorily with regard to BOD (average of around 170 mg/l BOD₅), suspended solids, and E. coli (geometric mean of 37,000 MPN/100 ml). Two of these plants ([old] As-Samra and Mafraq) are heavily overloaded, but maintenance is deficient as well (ponds are not properly cleaned according to field visits made in November and December 2007). Of the nine activated-sludge treatment plants, eight produce effluent with good (<25 mg/l BOD₅) and one with reasonable (25–60 mg/l BOD₅) BOD contents (all meet the relevant standards). Three of the activated-sludge treatment plants do not reduce pathogens sufficiently; the average E. coli values of their effluent are considerably larger (geometric mean of 28,000 MPN/100 ml) than the norm. Also three of these plants do not respect the total suspended solids (TSS) norms. Table 4.3 gives a brief overview of the most important standards for wastewater discharge.

**TABLE 4.3 STANDARDS FOR WASTEWATER DISCHARGE FOR A SELECTED NUMBER OF PARAMETERS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Discharge to streams, wadis, and water bodies</th>
<th>Groundwater recharge</th>
<th>Cooked vegetables, parks, playgrounds and roadsides within city limits</th>
<th>Fruit trees, roadways outside city limits and landscapes</th>
<th>Field crops, industries crops and forest trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD₅</td>
<td>mg/l</td>
<td>60</td>
<td>15</td>
<td>30</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>TDS</td>
<td>mg/l</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/l</td>
<td>60–120</td>
<td>50</td>
<td>50</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Phenols</td>
<td>mg/l</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>Total N</td>
<td>mg/l</td>
<td>70</td>
<td>45</td>
<td>45</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>E. coli</td>
<td>MPN/100 ml</td>
<td>1,000</td>
<td>2.2</td>
<td>100</td>
<td>1,000</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: BOD = biological oxygen demand; N = nitrogen; TDS = total dissolved solids; TSS = total suspended solids.
Table 4.4 evaluates the share of treated wastewater that does not meet selected national standards: this is 45 percent in the case of BOD, and 60 percent in the case of *E. coli* (for cooking vegetables).

The Jordanian standard for BOD (60 mg/l BOD<sub>5</sub>) is less restrictive than the EU standard, which allows only 25 mg/l BOD<sub>5</sub>. In 2006, 70 percent of the treatment plants met the Jordanian standard for BOD, but only 45 percent met the EU standard for BOD.

When the new As-Samra treatment plant will fully replace the old one, more than 80 percent of Jordan’s treated wastewater would comply with the relevant standards. In the absence of recent measurements of the effluent quality of the new and old As-Samra wastewater treatment plants, however, it is difficult to assess the degree to which such quality targets are being attained.

The presence of high phenol concentrations in all treated wastewater is concerning. Phenols in (too) high concentrations can damage irrigated crops. It usually is considered to be an indicator of uncontrolled semidiffuse pollution from a multitude of industrial and commercial sources (iron industry, smithies, car wash installations). It also could be related to the washing out of the phenol in the air from vehicle exhaust gases or related to general burning of organic materials. No investigations are known for Jordan that determines the origin of phenols in wastewater. This warrants efforts for cause attribution and possible mitigation.

Looking forward, two avenues could improve the relatively poor quality of treated wastewater. First, the situation is likely to improve considerably once the new As-Samra activated-sludge treatment plant

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**TABLE 4.4 SHARE OF TOTAL WASTEWATER MEETING SELECTED WATER QUALITY NORMS**

<table>
<thead>
<tr>
<th></th>
<th>BOD</th>
<th>E. coli (for cooked vegetables)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share meeting norm</td>
<td>45%</td>
<td>61%</td>
</tr>
<tr>
<td>Share not meeting norm</td>
<td>55%</td>
<td>39%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Sources: Authors based on MoEnv 2005b, 2006a.*

*Note: BOD = biological oxygen demand.*
will be fully operational. The plant currently collects 40 percent of the wastewater of the Amman-Zarqa area, treats the wastewater up to modern standards (below EU norms), and is expected to reduce salinity of the wastewater reaching KTR by 14 percent, according to its design. Monitoring data are not available yet, but the new plant is expected to make a significant difference in Jordan’s wastewater situation and in its wastewater reuse potential. The violation of environmental norms will be reduced as the new treatment plant is supposed to deliver low *E. coli* concentrations in its effluent. This is important for the quality of water in the Zarqa River, which (as the largest perennial stream close to Amman) enjoys constant public attention.

Second, the situation might improve further by reconsidering the mix of treatment technologies currently in use (rather than only expanding the overall treatment capacity). At present, approximately 52 percent of Jordan’s wastewater is treated by conventional methods (47 percent activated sludge and 5 percent biofiltration) and 48 percent by using some form of waste stabilization ponds. The results of treatment with respect to effluent quality (average selected parameters in 2006) are summarized in table 4.5, sorted by type of treatment and concerning public WWTPs.

The effluent quality of activated-sludge and extended-aeration plants by and large meets applicable Jordanian standards, but other

<p>| TABLE 4.5 OVERVIEW OF MAIN EFFLUENT CHARACTERISTICS OF DIFFERENT TYPES OF TREATMENT PLANTS |
|---------------------------------------------|----------------|----------------|----------|----------|-------------------|----------------|
| BOD₅ | EC        | Phenol | TSS     | Total N | E. coli |</p>
<table>
<thead>
<tr>
<th>mg/l</th>
<th>μS/cm</th>
<th>μg/l</th>
<th>mg/l</th>
<th>mg/l</th>
<th>MPN/100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilization ponds</td>
<td>148</td>
<td>1,689</td>
<td>44</td>
<td>163</td>
<td>83</td>
</tr>
<tr>
<td>Activated Sludge</td>
<td>32</td>
<td>1,641</td>
<td>40</td>
<td>56</td>
<td>49</td>
</tr>
<tr>
<td>Biofiltration</td>
<td>63</td>
<td>1,476</td>
<td>44</td>
<td>85</td>
<td>71</td>
</tr>
<tr>
<td>Extended aeration</td>
<td>6</td>
<td>1,364</td>
<td>51</td>
<td>15</td>
<td>7</td>
</tr>
</tbody>
</table>

*Source: MoEnv 2006b.*

*Note: BOD = biological oxygen demand; EC = electrical conductivity; TSS = total suspended solids; MPN = most probable number; N = nitrogen.*
technologies raise important problems. On the one hand, the mostly older biofiltration (trickling filter) plants do not perform well with respect to BOD, TSS, total nitrogen (N), and \textit{E. coli} (the latter should at least be below 1,000 MPN/100 ml).

More important, with only a few exceptions, the performance of the stabilization ponds is dismal in general (particularly with respect to BOD and suspended solids, as well as with \textit{E. coli}, which such plants are supposed to tackle well). This poor performance mainly is due to overloading, but also due to inadequate design and lack of maintenance of these plants. The amount of suspended solids indicates that most of the BOD is in insoluble forms and that the treated water therefore is not directly suitable for irrigation. On the other hand, operations and maintenance (O&M) costs of the stabilization ponds are low, from JD 0.02–0.13 per m$^3$, versus JD 0.08–2.20 per m$^3$ for activated-sludge and biofiltration plants (WHO-CEHA 2005; data for the year 2001), mainly depending on the size of the plant.

In addition to poor quality of the treated water, waste stabilization ponds also are subject to considerable water losses due to evaporation and leakage. Such losses in the (old) As-Samra treatment plant are estimated by the WAJ at 35 percent, although theoretically it should be lower, rather around 15 percent (Kunz, Radke, and Jaar 2007). Activated-sludge treatment plants normally do not lose more than 5 percent of the treated water. The water-saving potential to be achieved by eventually replacing the stabilization ponds with activated-sludge treatment plants could be as much as 20 million m$^3$ per year. Such savings in general will lower the average salt content of the effluent (average around 1,035 mg/l, which is high according to international standards) by approximately 15 percent.

Because of poor performance on both counts (poor treatment quality and high evaporation losses), the general policy in Jordan is to abandon waste stabilization ponds and replace them with activated-sludge treatment plants. In general, this policy appears reasonable, although because of relatively high O&M costs (especially when energy prices are high) and frequent advances in treatment technology, it should be revisited periodically. Whatever technological improvement will be adopted, new treatment plants must not be overloaded and must be properly maintained and operated. Only under these conditions will it be possible to obtain effluents with considerable lower BOD, suspended solids,
and pathogen content. As a result, less eutrophication in receiving water bodies can be achieved, and as most effluent is used again for irrigation, performance of modern trickle irrigation systems will improve and the potential for reuse for (supplemental) irrigation will increase. Activated-sludge systems produce more sludge than waste stabilization ponds, and reuse of this sludge in agriculture (after composting) can be a valuable option. The sludge can be reused only if the industrial pollution is better controlled (preferably at source) to ensure that it is not loaded with heavy metals and organic toxic pollutants.

4.5.2 Industrial wastewater

As discussed in more detail in chapter 6, the mining, manufacturing, and construction industry contributes to some 20 percent of Jordan's GDP, employs 16 percent of the Jordanian workforce, and accounts for a sizeable portion of total exports. In 2006, Jordan had almost 13,000 industrial enterprises, of which 2 percent were medium and big enterprises, 6 percent were small enterprises, and 92 percent were microenterprises.

The likely impacts on human health and the environment in Jordan's industrial hot spots (especially along the Zarqa River) have raised concerns for the government, NGOs, and the general public for quite some time. Although analysis is limited to quantify those impacts, abundantly available literature on similar situations in other countries indicate that the cost of uncontrolled industrial pollution can be very high.

Table 4.6 provides indicative estimates of the distribution across sectors and disposal modes of industrial wastewater. Of the approximately 26 million m$^3$ of wastewater produced by industry in 2005, about 30 percent is treated before discharge. In terms of modality of disposal, 17 percent is released into the sewer network, 32 percent into irrigation canals, and a small fraction (6 percent) is disposed of using tankers or other methods. The bulk of industrial wastewater comes from mining activities, however, which are unlikely to constitute a major health hazard. Enterprises located in Zarqa account for 65 percent of the remaining wastewater.

In general, wastewater discharged from industries should comply with JS 202/1991, which is extremely lenient. It allows, for example, discharging water to the environment with up to 3,000 mg/l total dissolved solids (TDS) and is not linked to the quality and other characteristics of the receiving body. It sets rather lenient limits for heavy metals
and does not set limits on endocrine substances and other toxic organic materials. Moreover, the standard has intrinsic internal conflicts. For instance, it says that the quality of receiving water bodies should not be affected negatively and, at the same time, allows a TDS value in the effluent of 3,000 mg/l. The standard is obsolete and needs to be revised thoroughly. It applies only to discharges to the environment and does not apply to discharges to the sewerage system.

To better address different wastewater quality issues, it is useful to analyze the manufacturing enterprises that discharge in the public sewerage network separately from those that do not. Other industrial

<table>
<thead>
<tr>
<th>Type of Industry</th>
<th>Water Consumption (million m$^3$/year)</th>
<th>Wastewater (million m$^3$/year)</th>
<th>Share of Treated in Total Wastewater</th>
<th>Disposal of Wastewater</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sea</td>
</tr>
<tr>
<td>Mining</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead Sea Potash Company</td>
<td>10.8</td>
<td>10.8</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Other mining</td>
<td>9.6</td>
<td>4.8</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Aqaba Fertilizer Complex</td>
<td>3.2</td>
<td>1.6</td>
<td>100%</td>
<td>100%$^a$</td>
</tr>
<tr>
<td>Zarqa industrial zones</td>
<td>15</td>
<td>7.5</td>
<td>65%</td>
<td>0%</td>
</tr>
<tr>
<td>Other industrial zones</td>
<td>2.3</td>
<td>1.2</td>
<td>80%</td>
<td>0%</td>
</tr>
<tr>
<td>Cement</td>
<td>0.4</td>
<td>0.2</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Power generation</td>
<td>1.9</td>
<td>1</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>43.2</td>
<td>27</td>
<td>32%</td>
<td>46%</td>
</tr>
</tbody>
</table>

Sources: WAIJ 2006, MoEnv 2006, MoWI, PWA, HIS, 1998
Note: The table assumes that an average of 50 percent of water consumed by industry is returned as wastewater, except for the Dead Sea Potash Company.

$^a$ According to information provided by Aqaba Special Economic Zone Authority (ASEZA), in compliance with environmental protection regulation no. 21 and to the requirement of the international treaties signed by the Government of Jordan no wastewater of Aqaba’s phosphate company is disposed of in the sea.
activities of significance for water pollution include mining and power generation.

**Industries discharging into the public sewerage network**

Pollution from this group is of concern for at least three reasons: (1) considerable rates of discharges in the sewers without licensing; (2) significant rates of noncompliance with discharge regulations; and (3) inadequacies of those regulations.

As the entity in charge of the public sewerage network, WAJ is responsible for licensing industries that discharge into the network. The quality of all discharges needs to respond to the norms fixed in the “Instruction for disposal of commercial and industrial wastewater to the public sewerage system of the year 1998, Water Authority of Jordan.” This instruction does not have the status of a Jordanian standard but is similar in its setup (see box 4.2).

The WAJ licensed some 46 industries to discharge wastewater into the public sewerage system. These include 25 food industries, seven textile and clothing industries, four pharmaceutical industries, three cleaning industries, three chemical industries, two mineral industries, one leather tanning plant, and Jordan’s oldest large power plant, the Al-Hussein Power Station.

**BOX 4.2 INDUSTRIAL TREATMENT STANDARDS IN JORDAN**

Jordan does not have official pretreatment standards; the only legal instrument is the “Instructions for disposal of commercial and industrial wastewater to public sewerage network of the year 1998, Water Authority of Jordan.” This instruction falls short of being a standard; however, it contains clear instructions on prohibited substances (solid objects, limits for all relevant parameters such as inflammable or explosive substances, any toxic material that could interfere with the treatment process, solids or liquids with a pH out of the range of 5.5 to 9.5, liquids with a temperature higher than 65°C, and so on).

It also gives the maximum allowed concentrations for a number of substances and parameters, such as oil and grease, cyanide, phenol compounds, sulfuric compounds, chlorinated organic solvents, chemical cleaning compounds, heavy metals, and radioactive substances. Any commerce or industry discharging to the sewerage network will need a license and need to submit certain details on the treatment and production process. The relevant company can be obligated to install end-of-the-pipe treatment facility when the standards per this instruction are not being met.

*Source: Authors.*
Although the WAJ-licensed enterprises are considered to be the most important in this category, evidence suggests that they represent only a fraction of the total. In particular, a U.S. Agency for International Development (USAID)-financed study (CDM 2005) indicates that in Zarqa 96 enterprises discharge into the public sewerage network, which is a significantly larger number than the 46 licensed by WAJ. This number suggests that of the 5,000 enterprises in the area probably even more are discharging without a license.

WAJ reports that the minimum requirements mentioned in box 4.2 often are violated in the 46 licensed industries. As an example, percentages of noncompliance with aforementioned indicative pH standards are around 20 percent, noncompliance with ammonia is 33 percent, and noncompliance with suspended solids is 30 percent. Moreover, the higher-bound values occasionally reach numbers several orders of magnitude above what is acceptable. This is not an acceptable situation from an environmental and health standpoint and an effort by relevant agencies should be made to enforce simple rules and methods of treatment on industries. In this context, the situation may even be worse than indicated; for instance, dangerous substances completely banned by the European Union under its Water Framework Directive (meaning zero effluent concentration) are not measured or monitored (let alone tackled) in Jordan. Programs are under way to reduce industrial pollution at the source. Because monitoring data are lacking, however, it is not clear whether these programs have started to yield positive results.

Whatever the doubtless good intentions of the “Instructions,” these are meant to protect the sewerage network and the functioning of the public wastewater treatment plants. Although strict implementation of the “Instructions” would alleviate some environmental and health hazards, these “Instructions” are not explicitly meant to reduce pollution of the environment or protect water resources. A typical example is the salinity of wastewater discharged to the public sewerage network. The “Instructions” do not provide a limitation for salinity, although increased salinity would make the final effluent of the wastewater treatment plants less suitable for use in irrigation. The “Instructions” may need to be based on monitoring both the water usage of the facility as well as the effluent concentrations to avoid a situation in which the facility abides by the effluent standards simply by using more water to dilute the effluent.
Industries not connected to the public sewerage network

The companies in this group include large manufacturing enterprises (potash and fertilizers), three cement factories, and the Jordan petroleum refinery, as well as mining and power generation activities. In addition, the group includes a number of industrial estates assembling several enterprises. Considering that the industrial estates for which data are available (see table 4.7) are estimated to discharge some 0.7 million m$^3$ of wastewater (more than 10 percent of the total effluents discharged out

<table>
<thead>
<tr>
<th>Name</th>
<th>Number of Enterprises</th>
<th>Location</th>
<th>Water Consumption (m$^3$/year)</th>
<th>Treatment</th>
<th>Discharged/Reused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdullah II bin Al-Hussein Industrial Estate (AIE)</td>
<td>340</td>
<td>Sahab-Amman</td>
<td>700,000</td>
<td>Yes</td>
<td>Irrigation</td>
</tr>
<tr>
<td>Al-Hussein Bin Abdullah II Industrial Estate (HUIE)</td>
<td>11</td>
<td>Karak</td>
<td>275,000</td>
<td>Yes</td>
<td>Irrigation</td>
</tr>
<tr>
<td>Ma’an Industrial Estate (MIE)</td>
<td>3</td>
<td>Ma’an</td>
<td>255,000</td>
<td>Yes</td>
<td>n.a.</td>
</tr>
<tr>
<td>Al-Hassan Industrial estate (HIE)</td>
<td>76</td>
<td>Irbid</td>
<td>180,000</td>
<td>Yes</td>
<td>Irrigation</td>
</tr>
<tr>
<td>Aqaba International Industrial Estate (AIIE)</td>
<td>13</td>
<td>Aqaba</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Al Dulayl Industrial Park</td>
<td>n.a.</td>
<td>Al Dulayl</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Al Tajamout Industrial City</td>
<td>50</td>
<td>Sahab</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Jodan Cyber City Park</td>
<td>n.a.</td>
<td>Irbid</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Al Qastal Industrial Park</td>
<td>n.a.</td>
<td>QA airport</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Al Zay ready wear</td>
<td>n.a.</td>
<td>Al Ruseifa</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Al Karak Industrial Estate</td>
<td>n.a.</td>
<td>Karak</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

Note: n.a. = not available.
of the sewer network, excluding mining), industrial estates as a whole (including those for which discharge data are not available) are probably a nonnegligible component of this group.

Most of the industrial estates have WWTPs or plan to build one soon. Consolidating a number of industries into industrial estates has many advantages from the environmental point of view, because it becomes easier to control pollution (although for larger factories, control at source tends to be more cost-effective).

In the past, WAJ was responsible for the licensing and monitoring of some 150 industries not connected to the sewerage network and believed to be discharging industrial wastewater in other recipient media. A few years ago, this responsibility was transferred to the MoEnv. MoEnv, however, did not seem ready for this task at that time and only recently has started to make an inventory of all relevant Jordanian industries in the framework of an upcoming integrated environmental licensing. As a result, industries in Jordan are only partially stored in a MoEnv database; for the time being, this covers 130 industries in the Zarqa area and 20 in the Al-Hassan Industrial Estate (a small fraction of the total 20,000 establishments, but a more significant share of the 2,000 establishment with more than nine employees).

MoEnv started monitoring 20 larger industries (not discharging to the public sewerage network) on compliance with industrial wastewater discharge norms. Results of this monitoring have not yet been published. These will be tested on standard chemical and physical parameters, nutrients (N, phosphorous [P], BOD, chemical oxygen demand [COD], and so on), microbiological parameters, and heavy metals.

A considerable problem is reported for industries not connected to the public sewerage system that dispose of their wastewater using tankers. The USAID-financed study (CDM 2005) suggests that such wastewater disposal is fully uncontrolled. As far as not recycled on site, the wastewaters are either transported to one of the two sites in Jordan that receive industrial wastewater (Ein Ghazal pretreatment facility on the border of Amman and Zarqa, and the Al Ekaider waste disposal site, northeast of Amman close to the Syrian border) or are disposed of illegally.

Although the quantity and origin of the wastewater is registered at these sites, the quality of the disposed wastewater is never measured.
From Ein Ghazal, the water flows largely untreated (the plant basically removes larger solids only, hence primary treatment) toward the old As-Samra treatment plant. The Al Ekaider waste disposal site does not treat the waste at all; water is let into unlined basins where it either evaporates or joins the groundwater (Nawar 2006). As far as is known, the effect on the treatment process in As-Samra has not been investigated. Groundwater and soil in Al Ekaider are expected to be polluted, but no observations are available.

**Mining and power generation**

With a 2 percent share of GDP, phosphate mining is the single most important industrial branch in Jordan, and also is a large generator of wastewater (9.6 million m³ from the Eshidiya, Hasa, and Abiad, and Al-Ruseifa mining locations). Nevertheless, little information is available on the effluent quality, other than indication of contamination stemming from solid waste in Russeifa (now dormant).

Also of importance and by far the largest water user in Jordan is the Arab Potash Company. The company, operating since 1982, takes concentrated brine (the sodium chloride in the Dead Sea water is deposited during the evaporation process and potassium chloride remains in the brine) from specially constructed compartments in the southern part of the Dead Sea and processes the brine to potash, which is mainly used to produce fertilizers. The fresh water used for the processing is discharged to the Dead Sea.

The power sector is estimated to generate some 2 million m³ of wastewater per year (or 7 percent of the total industrial wastewater). A significant share of that (about 25 percent) comes from the Hussein Thermal Power Station; a fifth of its discharge is reverse osmosis (RO) brine water with a conductivity of 13,000 µS/cm (CDM 2006), channeled into public sewerage system and contributing significantly to the salt content of the As-Samra WWTP effluent. The station is upgrading its treatment plant to produce effluent up to JS 202/1991 and reuses or evaporates the remaining effluent. No information is available for the other power stations.

**4.5.3 Other sources of water pollution**

Two other sources contribute to a lesser extent to contamination of water resources. In agriculture, the per hectare use of fertilizers and pesticides is estimated to be relatively low (12 kg/ha in the case of pesticides)
in comparison to international averages. No strong evidence indicates residues of pesticides in the surface and underground water, or violation of the acceptable limits for drinking water supply. Given persistent rumors that pesticides are present in drainage water in the Jordan Valley, however, further scrutiny of the issue may be warranted.

In the case of solid waste, the fact that most disposal sites are not lined suggests that leachate may infiltrate into aquifers that provide groundwater for drinking and irrigation use. Evidence in the literature supports increased levels of dioxin and furan in human milk samples. A statistically significant relationship with the location of the landfill sites has been found (Alawi et al. 1996). A more thorough investigation of the impact of solid waste disposal practices on groundwater quality is justified.

### 4.6 INSTITUTIONAL SETUP OF WATER QUALITY MANAGEMENT

#### 4.6.1 Legal background

The effectiveness of Jordan’s water quality management is hampered by the lack a comprehensive and overarching legal framework.

Jordan’s system of water quality management is characterized by a large number of legal provisions (see annex 2 in World Bank 2010 for details) that often have been adopted on an ad hoc basis, that is, whenever a specific problem arose and needed to be solved. In general, the existing regulations are adequate, even though they may need some upgrading in individual cases. In particular,

» The Groundwater Control By-Law of 2002 is a bylaw with the character of a regulation. It is directed toward the control of extraction only, yet the chapters on groundwater protection are missing in this bylaw. It is advisable to include such chapters and give the bylaw the status of regulation, preferably under a to-be-launched Water Code that would give legal substance to such a regulation.

» The Criminal Code articles referred to in annex 2 in World Bank 2010 seem superfluous; penalties in the other legislation are sufficient.

» In general, most regulations are weak on reporting and self-monitoring, which are indispensable tools to control potential pollution.
A more systemic and far-reaching problem is the lack of a uniform framework law for water (Water Code) that should regulate such issues as property of water resources; restrictions to private rights; the definition of water uses; water rights and water use and discharge permits; cadastre of water users and polluters; protection of water resources, aquifers, and river banks; execution of construction works related to water resources; penalties; the role and rights of water users; institutional responsibilities for the implementation of the law and regulations; and so on. Such a law would make the institutional responsibilities of different government entities and their inherent tasks more clear and set a framework for adequate water (quantity and quality) management.

Apart from the aforementioned functions, a Water Code would be of great value to establish a planning framework for water resources quantity and quality management. This would include making an inventory of environmental pressures, defining the status of water quality, defining water (resources) quality objectives, and preparing planning documents (strategies and action plans) to improve water quality, and redefine roles and responsibilities of the three main institutions in charge of water management, namely, MoWI, WAJ, and JVA.

**Industrial discharges** are governed by the Industrial Wastewater Standard of 1991 and the aforementioned WAJ instruction for discharge of commercial and industrial wastewater to the sewerage system (and to some extent by the Reclaimed Domestic Wastewater Standard). The WAJ instruction should acquire the status of standard. The instruction adequately covers prohibited substances (inflammable and explosive materials, materials that block the sewerage system, and so on), ranges of physical properties (for example, pH), and allowable concentrations of a number of chemical substances that can be discharged to the public sewerage system. The instruction is far less precise when it comes to toxic and dangerous substances in the wastewater that can influence the treatment process or that otherwise will pass through the wastewater treatment plants and be emitted to the environment. It is mentioned that emissions should not harm the treatment process or otherwise endanger the environment, but this is not worked out quantitatively.

For the control of such substances, Water Quality Objectives (WQO) should be defined as mentioned in the section on the Water Code 4.6.1. Such WQO can be achieved by applying Best Available Technology (BAT) in industries with regard to effluent control process-
es. As discussed in section 4.7.1, the application of BAT should take place in the framework of Integrated Pollution Prevention and Control (IPPC), in which water, solid wastes, and air emissions are controlled in an integrated manner.

In terms of **standards**, the *Drinking Water Standards* are up to date; the *Reclaimed Domestic Wastewater Standards* are adequate. Where properly operated wastewater treatment plants with secondary treatment usually would produce effluent with BOD$_5$ values below 15–20 mg/l, the limit of 60 mg/l in the standard is unnecessarily high and discourages proper operation of the treatment plants. In particular, this is the case for the waste stabilization ponds’ treatment plants; field observations show that quite a few of these plants are neglected.

The required monitoring of the treatment process does not distinguish between large and small treatment plants; for small treatment plants, the costs of the required monitoring are prohibitive and could amount to JD 5 per m$^3$ wastewater treated. An adaptation of the monitoring requirements is necessary.

### 4.6.2 Institutions and responsibilities

At least five institutions have institutional attributions related to water quality management: the MoWI, the WAJ, the JVA, the MoH, and the MoEnv. The roles and responsibilities of the different ministries are summarized in table 4.8.

Table 4.8 clearly shows that several responsibilities overlap and some necessary responsibilities are not assigned to any of the mentioned entities. In particular, the presence of multiple black dots on any given row suggests that the responsibilities overlap and that they should be clarified or separated. The main areas of overlap include the following:

1. **The preparation of legal and regulatory documents.** This overlap of responsibilities has most probably resulted in not having a Water Code and a regulation for water resources protection.
2. **Licensing and control of licensing.** In the framework of IPPC, licensing should be under the MoEnv with obligatory consultations of MoWI bodies.
3. **Planning and implementation of measures** has some overlapping functions; these should be coordinated; there should be a National Master Plan for the Abatement of Water Resources Pollution with
**TABLE 4.8 INSTITUTIONAL RESPONSIBILITIES OF DIFFERENT MINISTRIES INVOLVED IN WATER QUALITY**

<table>
<thead>
<tr>
<th>Competences with respect to water quality management</th>
<th>Council of Ministers</th>
<th>MoWI</th>
<th>WAJ</th>
<th>JVA</th>
<th>MoH</th>
<th>MoEnv</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legislation and other regulatory aspects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare water (quality) legislation</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Elaborate regulatory documents</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Establish water quality standards and norms</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Exercise international co-operation</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td><strong>Water quality policy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare policies</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Approve policies</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Supervise implementation of policies</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Implement policies</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td><strong>Licensing and control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish limits of water use per user</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Issue licenses for water use</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Issue licenses for water discharge</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Establish boundaries of sanitary protection areas</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Control compliance with licenses and illegal discharge</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Take legal action in case of non-compliance</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td><strong>Planning and implementation of plans</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare plans</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Analyse the state of the environment</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Define water quality objectives</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Prepare list of measures</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Define priority measures</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Prepare implementation plan</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Approve plans</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
<tr>
<td>Supervise implementation of programmes</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
<td>ō</td>
</tr>
</tbody>
</table>

*Continued on next page*
one government entity in charge and full involvement of other entities.

4. **Overlapping monitoring.** It is not per definition wrong that all involved entities are executing part of the required monitoring, but for efficiency reasons, data should be properly exchanged, not measured twice or several times by different entities.

### 4.6.3 The monitoring system

An extensive overview of the water quality monitoring system is given in annex 2 in World Bank (2010). The main issues from the annex are briefly discussed here. Jordan has basically three types of monitoring: the **environmental monitoring** of the quality of water resources and of

<table>
<thead>
<tr>
<th>Competences with respect to water quality management</th>
<th>Council of Ministers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement plans</td>
<td>MoWI</td>
</tr>
<tr>
<td>Decide on incentives for pollution alleviation measures</td>
<td></td>
</tr>
</tbody>
</table>

#### Operation

- Operation of wastewater treatment plants
  - MoWI
- Operation of other emission measures
  - WAJ

#### Monitoring, data management en dissemination

- Plan and supervise monitoring activities
  - MoWI | WAJ | JVA | MoH | MoEnv
- Collect data and information
  - MoWI | WAJ | JVA | MoH | MoEnv
- Process and store data
  - MoWI | WAJ | JVA | MoH | MoEnv
- Synthesize data and prepare reports
  - MoWI | WAJ | JVA | MoH | MoEnv
- Disseminate information and promote public participation
  - MoWI | WAJ | JVA | MoH | MoEnv

---

**Source:** Authors.

**Note:** JVA = Jordan Valley Authority; MoEnv = Ministry of Environment; MoH = Ministry of Health; MoWI = Ministry of Water and Irrigation; WAJ = Water Authority of Jordan.

- ‡ the respective entity has full responsibility
- † the respective entity is involved
- u only for discharge to public sewerage system
- k should for discharge others than public sewerage system

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TABLE 4.8 INSTITUTIONAL RESPONSIBILITIES OF DIFFERENT MINISTRIES INVOLVED IN WATER QUALITY *(continued)*
pollution sources, including the monitoring of wastewater returning to the environment; the quality control monitoring implemented by the agencies responsible for water supply and sanitation; and the monitoring related to environmental health issues.

Environmental monitoring is executed by the entities that are responsible for the water resources, such as Higher Scientific Council (HSC), WAJ, JVA, and MoEnv. Part of this monitoring is outsourced to RSS, which has appropriate research capacity to do so. A certain overlap exists between the different monitoring programs; coordination between the different entities has just started and still needs to score effect. The monitoring system is rather simple in the sense that a limited number of parameters are measured every time monitoring takes place; frequencies are not adapted for different parameters, and the concept of baseline surveys followed by limited specific monitoring has never been applied. Moreover, the number of parameters is rather limited, up to a maximum of 20.

Quality control monitoring (of the production process) is executed by WAJ and other public or private entities responsible for the operation of the drinking water supply and sanitation system. Regarding water resources, some confusion exists within the responsible entities on whether certain monitoring belongs to environmental monitoring of water resources, environmental health monitoring, or quality control monitoring. A better demarcation between these types of monitoring seems necessary.

Environmental health monitoring is mainly the responsibility of the MoH. The MoEnv, however, also has monitoring elements in its program that come close to environmental health monitoring (control of drinking water at the tap and control of wastewater effluent) that should rather be the responsibility of MoH. A clear line is needed between environmental monitoring and environmental health monitoring.

The responsibilities for the different types of monitoring are presented in table 4.9.

Clear overlaps exist in monitoring of surface water resources, quality control monitoring, and environmental health monitoring. A simplified and more effective monitoring system could be considered, along the lines presented in table 4.10. This reform proposal is preliminary; it needs more investigation and, above all, discussions among the different monitoring entities.
### TABLE 4.9 PRESENT RESPONSIBILITIES FOR DIFFERENT TYPES OF MONITORING

<table>
<thead>
<tr>
<th>Object</th>
<th>WAJ</th>
<th>NGWA</th>
<th>Miyahouna</th>
<th>AWC</th>
<th>JVA</th>
<th>RSS</th>
<th>MoH</th>
<th>MoE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>1B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial wastewater</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban wastewater</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking water</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Wastewater treatment</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathing water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Source: Authors.
Note: AWC = Aqaba Water Company; JVA = Jordan Valley Authority; MoE = Ministry of Environment; MoH = Ministry of Health; NGWA = Northern Governorates Water Authority; RSS = Royal Scientific Society; WAJ = Water Authority of Jordan.

### TABLE 4.10 PRELIMINARY OPTIONS TO REFORM THE WATER QUALITY MONITORING SYSTEM

<table>
<thead>
<tr>
<th>Object</th>
<th>WAJ</th>
<th>JVA</th>
<th>RSS</th>
<th>MoH</th>
<th>MoE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water</td>
<td>basic network</td>
<td>additional network</td>
<td>EMARCU real-time</td>
<td>basic network</td>
<td>convention between WAJ and MoE needed</td>
</tr>
<tr>
<td>Groundwater</td>
<td>additional network</td>
<td>additional network</td>
<td>basic network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial wastewater</td>
<td>only to sewage network</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban wastewater</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued on next page
4.7 POLICIES AND MEASURES FOR WATER QUALITY MANAGEMENT

4.7.1 Policy instruments

Interventions to improve water quality can be classified in three broad groups (see table 4.11). First, interventions that reduce polluting concentrations by treating effluent water or controlling their disposal; these include the collection and treatment of wastewater from municipal and industrial discharges, the improvement of landfill management to prevent infiltration into groundwater of wastewater discharged from tankers, and the treatment of spring water.

Second, interventions that reduce concentrations by increasing the amount of water available for dilution. These include policies to increase supply (water storage, desalinization of seawater, conveyance schemes), as well as policies that encourage, through improved demand management, the reallocation of existing water for increased dilution. Third, “at-recipient” interventions that do not affect the quality of the water available for different uses, but reduce the exposure of potential users to contaminated water through behavioral change.

Water policies in Jordan have been using over time different mixes of these instruments, but with a strong focus on interventions to in-
crease supply (see box 4.3). Mainly motivated by the priority of reducing Jordan’s chronic water scarcity problem, these interventions tend to deliver water quality benefits. In several cases, however, water policies have not addressed explicitly the strategic linkages between water quantity and water quality.

This section discusses the potential for applying these different interventions in Jordan to introduce the discussion of their comparative merits (see section 4.7.2) through a simplified cost-benefit analysis.

**Wastewater collection systems and treatment plants**

The National Agenda envisages a total investment of JD 363 million for urban wastewater collection and treatment. This will allow connecting 12 percent more of the population to centralized sewerage systems (up from 58 percent to 70 percent of the population), and

### TABLE 4.11 TYPOLOGY OF POLICY INSTRUMENTS FOR IMPROVED WATER QUALITY

<table>
<thead>
<tr>
<th>Delivery mechanism for quality enhancement</th>
<th>Unit costs</th>
<th>Ease of targeting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Effluent removal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastewater collection and treatment</td>
<td>Reduction of polluting concentration through transformation of the load</td>
<td>High</td>
</tr>
<tr>
<td>Industrial pollution control</td>
<td>Same</td>
<td>High</td>
</tr>
<tr>
<td>Treatment of spring water</td>
<td>Same</td>
<td>Medium</td>
</tr>
<tr>
<td>Improved landfill management</td>
<td>Prevention of leachate infiltration into groundwater</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>B. Increased dilution</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobilization of additional water resources</td>
<td>Reduction of polluting concentration through increased water dilution</td>
<td>High</td>
</tr>
<tr>
<td>Water savings/ demand management</td>
<td>Same</td>
<td>Low to medium</td>
</tr>
<tr>
<td><strong>C. At recipient interventions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hygiene programs</td>
<td>Prevention of water-borne diseases through behavioral change</td>
<td>Low</td>
</tr>
</tbody>
</table>

*Source: Authors.*
BOX 4.3 OVERVIEW OF RECENT WATER POLICIES AND STRATEGIES IN JORDAN

Water policies in Jordan traditionally have been concentrating almost exclusively on what is perceived as the biggest problem: the balancing of scarce but relatively constant water resources and the ever-growing demand for water. A Water Strategy was adopted in 1997 by the Ministry of Water and Irrigation (MoWI) and supplemented with different water policies for irrigation, groundwater management, water utilities, and wastewater management.

The Water Strategy aims at securing a reliable supply of water (in quantity and quality terms) mainly for drinking water supply and irrigation in Jordan. In general this would be met through maximum augmentation of water resources, protection of existing water resources, and improvement of the distribution and allocation efficiency in both the water supply and the irrigation systems. It equally formulates proposals to ensure Jordan’s international rights on water resources shared with its neighbors.

The Groundwater Management Policy mainly aims at reducing abstraction from renewable aquifers to sustainable quantities. Some paragraphs address protecting the groundwater through protection zones, but the policy fails to make the link between water quantity and water quality and does not envisage an integrated quantity-quality management.

The Irrigation Management Policy details the long-term objectives laid down in the Water Strategy. A number of chapters set policies for the role of irrigated agriculture, its sustainability, the development of water resources, adaptation to modern technology, on-farm water management, irrigation water quality, administrative issues, public awareness, water pricing, regulations and research and development. With regard to water quality, it is stated that wastewater should be treated to the extent that is fully reusable in agriculture, and salinity should be adequately monitored.

The Wastewater Management Policy sets the framework for the development of adequate wastewater collection and treatment. It declares wastewater as a water resource to be used for irrigation and aims at treatment processes that enable unrestricted reuse of treated wastewater in agriculture. It provides directives for end-of-pipe treatment of industrial wastewater, charging wastewater treatment costs to the producer of wastewater, separation of collection systems, identification of point sources of pollution, use of river basin management approaches, and a number of other wastewater-related issues.

With respect to water quality management, the existing policies do not entail modern concepts such as Integrated Water Resources Management (IWRM) and Integrated Pollution Prevention and Control (IPPC). An upgrade of policies and strategies within the framework of a new Water Code, National Water Master Plan, and River Basin Management Plans is recommended.

Source: Authors.
produce an extra 20–25 million m$^3$ (treated) wastewater per year. At the same time efficiency of collection and treatment will be improved significantly (reduction of evaporation, leaking losses, and so on), which may deliver another 20 million m$^3$ per year. The investment therefore will be around JD 8–9 per m$^3$. Additionally, the considerable improvement to the wastewater effluent quality would improve the suitability for reuse in irrigation and reduce the adverse health effects.

Improvement of wastewater collection and treatment will increase the availability of water resources mainly available for irrigation. At this moment, approximately 120 million m$^3$ per year of treated wastewater is produced, this amount is estimated to increase to 200 million m$^3$ per year in 2025.

Connecting the aforementioned figure of 70 percent of the population to centralized sewerage systems, the options of collecting and treating wastewater in the conventional centralized way may have been largely exhausted. Because of economic feasibility, a maximum connection percentage for centralized sewerage and treatment systems in Jordan would be close to 75 percent.$^5$

**Industrial pollution control**

The prevailing direction on industrial pollution control is to promote centralized collection and treatment. It has long been proven, however, that control at source—through in-factory technology switch (cleaner production), or through end-of-pipe treatment—is typically more cost-effective and this should not be different for Jordan. It appears that existing plans to build centralized wastewater treatment plants for a number of more or less adjacent industries (CDM 2005) might have overlooked the potential of at-source treatment, which would address WTP issues and incentives (that is, incremental economic benefits) for industries.

Such pollution prevention needs a policy framework and technical regulations. Jordan is strongly advised to adopt the IPPC and BAT principles as they are used in Europe.$^6$ The advantage of using IPPC is that the effluent is not transferred from one sink to another; the advantage of BAT, provided it is constantly upgraded, is that—as industrial output increases—it avoids pollution increases in the same proportion. IPPC and BAT should be embedded in new industrial pollution-abatement regulations.
Without having more information on the existing industries, their outputs, their production technology and process, and their financial arrangements, it is difficult to predict the costs of introducing IPPC and BAT for the industrial sector. Further studies are needed, in particular to identify cases in which BAT might induce excessive costs, and where therefore exceptions may be warranted (provided that the resulting environmental damage is acceptable).

An important issue is to prevent the increase in wastewater salinity beyond what is technically necessary. This is of particular importance for Jordan as, due to the general water scarcity, all wastewater should be reused, mainly for irrigation. This is not an issue of quantities of water (industrial wastewater with high salinity is only a small fraction of the total amount of wastewater produced) but rather of quality. The salinity of the wastewater produced in the Amman-Zarqa area can be reduced by at least 10 percent, if desalination brines are not discharged to the sewerage system or open water bodies, but are disposed of in an alternative way. The extra costs of this disposal will be offset largely by the higher outputs from agriculture. BAT could include the avoidance of salinity accumulation and the use of process water desalination before discharging wastewater to the environment or to public sewerage systems.

**Additional treatment of spring water**

In a number of groundwater basins, groundwater is contaminated due to lack of proper sanitation and infiltration of domestic wastewater into the aquifer (the Jerash area is known for this, but the problem is not limited to this area). This manifests itself in insufficient bacteriological quality of spring water (for instance, inferred by the increased trends of *E. coli*). At the recipient side, the problem has two remedies and solutions: (1) tackling the sanitation issues through improved hygiene, in the framework of community action and participation; and (2) when this delivers insufficient results, the application of extra water treatment in the form of ultra- or nanofiltration. Such filtration would cost about JD 0.20–0.30 per m³, on top of the existing exploitation costs. In the Jerash Pilot Area of the USAID Pollution Prevention for Environmental Health Protection (P2EHP) project, the improvement of hygiene has proved to be cost-effective.
Upgrading of landfills
Relevant agencies need to take measures to ensure that landfills do not pose potential pollution risks. The Government of Jordan has started to upgrade the landfills as such. The new landfills will need protection against leakage into the soil and toward the groundwater, and groundwater observation wells need to be installed to validate the absence of such leakage. All newly planned landfills meet these conditions; the existing landfills that do not meet these conditions should be closed gradually.

Existing landfills should be closed for depositing wastewater trucked in by tankers (such as Al Ekaider waste disposal site). All wastewater should be treated properly before discharging it to the environment, before evaporating it, before discharging to the public sewer, or before reusing it in irrigation, under reigning systems of standards and instructions.

Exploitation of additional water resources
Water resources are scarce in Jordan, and maximum increase of water resources is an important instrument in the water policy that could have a positive impact on water quality as well. The possibilities to further increase the conventional water resources at an economically acceptable cost are limited. The most promising option is to further increase the quantity of quality treated wastewater, which over a longer period of time will yield 50–100 million m³ per year, depending on population growth. Another option is to develop the Red Sea–Dead Sea Canal, which probably would yield another 600 million m³ per year of fresh-water resources, but this option will take at least 15 years to realize. Furthermore, options are limited to desalinate brackish groundwater (60 million m³ per year) or desalinate water from Karameh dam (30–40 million m³ per year). When such measures are fully exhausted, desalination of seawater will be the only available augmentation option.

Water demand management
Where the development of new water resources has, with exception of large-scale projects such as the Red Sea–Dead Sea Canal, almost come to an end in Jordan, water demand management becomes an ever more important issue.

In irrigation, large savings on water (losses) are still possible, thus increasing the economic output per each cubic meter of water used. The formation and empowerment of Water User Associations (WUAs) and
the development and scaling up of the “Irrigation Advisory Services” are two key instruments toward reducing the irrigation-water demand without compromising the agricultural output.

Irrigation efficiency (output per cubic meter of water), particularly for seasonal crops, is still low, and experiences in a number of ongoing projects prove that it can be improved by 30 to 40 percent. Soil-less cultures can further improve irrigation efficiency and savings of as much as 60 percent are feasible.

Regarding economic performance (expressed as gross margin per cubic meter of water used), at present, the average is around JD 0.60. The National Agenda establishes for 2017 the fairly ambitious target of JD 5 per m³. Data collected from different types of farms in the Jordan Valley suggest that higher outputs indeed are feasible, at least JD 1 and in some cases more (JD 3–4 per m³).

Such improvements can be reached only through institutional changes that include among other things the formation of WUAs and efforts to increase farmers’ knowledge of the irrigation technologies through research and extension (R&E), and knowledge transfer. To increase the gross margin at a rate of 5 percent per year from the present JD 0.60 per m³ as envisaged here, an intensive R&E (coupling the notion of “Irrigation Advisory” with the notion of “Agronomic Advisory”) is needed—that is, at least one well-trained extension agent per 50 farmers. Assuming that Jordan has around 10,000 farmers, at least 200 extension agents are needed at an estimated annual cost of JD 4 million, including research and logistics. With approximately 400 million m³ of water used in agriculture, this would add up to JD 12 million per year.

With regard to drinking water supply, large savings are possible as well. The unaccounted-for water was still at 45 percent in 2005, and according to experiences in other countries, could be reduced to 25 percent over time, provided that the due investments are made in network rehabilitation, and O&M is improved. Where half of the unaccounted-for water may be administrative, a saving of 10 percent is feasible in the middle to long run.

It is estimated that a complete rehabilitation of leaking networks may request investments amounting to roughly 30 percent of the average investments in drinking water supply made over the last decade or so. In addition, O&M costs need to be increased by at least 20 percent to maintain properly what has been achieved with the rehabilitation.
Another option for water demand management is the in-house recycling of water resources. Separation of “black, yellow, and gray” water and the reuse of the gray water could (when applied to all households) generate water savings of about 50 percent. It is difficult, however, to determine the exact costs of such a measure. Given the large initial investment cost, the government would need to provide households with adequate financial or fiscal incentives.

4.7.2 A macroscale cost-benefit analysis of alternative options

Provisional cost-benefit analysis at the macroscale indicate that it might be possible to eliminate up to 80 percent of the social cost of water degradation by optimally combining hygiene programs, enhanced dilution via water savings, and wastewater treatment.

The evaluation of the cost environmental degradation conducted in chapter 3 indicates that poor water quality inflicts to society an annual cost of about JD 82 million per year (or 0.8 percent of GDP). This cost is likely to increase in the future, on account of population growth, dwindling surface water, and escalating cost of extracting groundwater of acceptable quality. For example, preliminary estimates conducted in the CEA background report indicate that over the next decade the annual degradation cost linked to increased groundwater and surface-water salinity might double with respect to the value estimated in the COED analysis (see chapter 3).

Because the options for improving water quality reviewed previously (section 4.7.1 above) differ widely in terms of unit costs and of their ability to deliver benefits in terms of human health, agriculture income, and so on, this section proposes a simplified evaluation of the optimal mix of interventions that could reduce over time the cost of water quality degradation.

A detailed analysis of specific interventions would have required an amount of data that currently is not accessible in Jordan (see box 4.1), as well as the use of dedicated water-modeling tools that go beyond the scope of a CEA. Instead, this section proposes a simplified analysis that could deliver useful, albeit approximate, insights to policy makers.

The proposed approach couches the problem in terms of a few parameters indicative of water quality conditions of relevance for human health and agriculture (BOD, TDS). It evaluates the optimal mix (featuring an aggregate benefit-cost ratio higher than 1) of a few key
interventions (hygiene programs, increased dilution via water savings, and treatment), which would reduce baseline concentrations toward the existing water quality norms, thereby reducing the cost of water degradation estimated in chapter 3.

More specifically, the macrolevel analysis includes the following elements:

- A mass balance of the pollutants load (product of flow and concentration) was carried out to obtain the average, across water bodies of different qualities, of in-stream concentrations of BOD and TDS. In the no-intervention baseline, those averages exceed the relevant quality norms, and this was assumed to explain the bulk of the water degradation cost evaluated in chapter 3.7
- A simple water-saving program (implemented through enhanced irrigation efficiency) was introduced in the analysis, using the unit costs discussed in section 4.7.1 above and assuming that the water resources thus “freed up” could become available to increase dilution (reducing average concentrations).
- The mass-balance approach was reapplied to the new composition of water flows resulting from the program, to estimate the resulting reduction in concentration.
- A simple, linear “dose-response” function was assumed to quantify the benefits obtained as a result of the decrease in concentration. As a first approximation, it was assumed that the reduction on the different types of social costs (health impacts, consumption of bottled water, decline in agriculture productivity, and so on) is proportional to the reduction in the gap between actual BOD and TDS concentrations, and their respective norms.
- Where concentrations after increased dilution still exceeded the norm, the residual loads were removed through treatment, using unit costs indicative of an upgrade from primary to secondary treatment technology, and giving priority to the population already connected to the sewer network.
- Finally, on account of the their low-unit (per household) costs and their ability to deliver results specifically in terms of reduced mortality and morbidity from poor water, sanitation, and hygiene, at-recipient hygiene programs were introduced in the analysis, adopting unit costs figures derived from international experience.
Results
The results of the analysis indicate (see figure 4.16) that a program supporting average water savings of 3 percent per year, implemented over a 10-year period and accompanied by at-recipient hygiene programs, could eliminate up to 80 percent of the 2006 cost of water degradation at favorable benefit-cost ratios (exceeding 1).

With a cost of some JD 50–60 million, such a program would save water losses (particularly from irrigation uses) for some 100 to 150 million m³ per year (a final target gradually achievable over 10 years) and would yield a “triple dividend”:

- Limiting the current mining of groundwater
- Enabling in-stream dilution through “water-quality arbitrage”, thus diluting salinity loads (TDS) and reducing the gap between actual concentration and TDS norms
- Enabling full attainment of BOD norms
At the estimated optimal solution (rate of saving of 3 percent of the irrigation water demand per year), marginal benefits (avoided COED) equal marginal costs (hygiene plus water savings), whereas:

- with lower rates of water savings per year (1 percent), the forgone benefits (a high residual cost of water degradation) will exceed the cost of the program; and
- with higher water savings per year (5 percent), the program costs will be prohibitively high and hence will not be offset by the accrued benefits (the reduced COED).

In the present analysis, the optimal combination of interventions includes hygiene and water savings, but not enhanced wastewater treatment, which if included would push the cost-benefit ratio above 1 (see figure 4.17). Adding water savings to hygiene reduces the cost-water degradation from 10 percent to more than 80 percent, at a small marginal cost (measured by the increase in the cost-benefit ratio). On the other hand, further reductions of the cost of degradation might be pos-
sible, but the required expansion of wastewater treatment would be too costly in comparison to the benefits accrued.

Caveats and follow-up steps
The exercise presented in this section is a simplification of reality. It does not take into explicit account the spatial dimension (or the political economy) of water management and water reallocation across uses. It relies on a limited amount of information on water quality and of its relationship with human health and agriculture income.

The main message, however, still holds. Along with ambitious (and costly) programs of water-supply increase and enhancement of wastewater treatment, the government should consider water savings as an effective alternative to deliver water quality benefits.

To provide policy makers with more specific and robust indications, this exercise could be enhanced and expanded along the following lines:

» A “water quality model” should be developed, calibrated, and validated to duly simulate the water quality processes in space and in time (especially for “nonconservative parameters,” such as BOD and \textit{E. coli} for which a simplified mass balance cannot be precise), and including a detailed simulation of the linkages with changes in the volume of different water bodies.

» The relationships between changes in polluting concentrations and impacts such as health, agriculture productivity, and cost of groundwater pumping need to be evaluated in more detail.

» The cost-benefit analyses could be expanded by using more precise information on unit costs, and by including an explicit algorithm (linear programming) to determine both the selection of alternative interventions and their “dosage” (how much water saving, how much treatment, how many households receiving hygiene programs, and so on), to maximize net social benefits with respect to a no-intervention baseline, and subject to the constraints of technology, water balance, and public funds available.

4.7.3 Institutional measures
Whatever the policy mix selected for improving water quality, it is important that this be supported by adequate action on the legislative, regula-
tory, and institutional front, ideally within an overarching management framework (Water Code) along the lines indicated in section 4.6.1 above.

In particular, water arbitrages and reallocation of water across uses requires an improved legal framework regulating use, particularly groundwater.

The implementation of the Underground Water By-Law 85-2002 has slightly improved the overexploitation of groundwater resources by approximately 20 million m³ per year. Because this is only a fraction of the total overexploitation, which is close to 140 million m³ per year, the impact on the decline of groundwater level and quality is minor. Some aquifers are nearing depletion and much of the groundwater in it is becoming unsuitable for drinking without expensive treatment. To avoid the escalating costs and management problems caused by groundwater overextraction a radical change in the groundwater-extraction policy is needed. This can be achieved in basically three ways.

The first is to radically banish groundwater extraction above the safe yield and hence reduce the present extractions to sustainable levels. This needs additional regulation (the present regulation prohibits new drilling and extraction but has no handle to reduce extraction to safe-yield levels) and strong enforcement. The formation and empowerment of WUAs can be a potent enforcement tool, although it might be more challenging in the highlands, where farms typically have individual groundwater resources.

The second is to let groundwater consumers pay not only the service and private-exploitation costs of water abstraction, but also (as a conservation signal) the scarcity and social cost of the water resource. This social cost is one order of magnitude higher than the current highest tariffs (JD 0.06 per m³). Such costs may be prohibitive for agriculture and therefore politically not viable.

The third is to develop and scale up the “Irrigation Advisory Services” to support the farmers on how to reduce the irrigation water losses (namely, nonbeneficial evapotranspiration plus nonrecoverable return runoff, seepage, percolation waters), thus rationing the on-farm groundwater diverted without compromising the crop output. This third option can provide a win-win solution from the farmers’ perspective, because saving the water losses could be translated in saved pumping costs (being a private gain).
None of these approaches will solve the groundwater overextraction in the highlands on its own. A well-targeted combination of the three may reduce the use of groundwater in irrigation on the highlands by as much as 60 percent. With the exception of the third option (which can be a “win-win pragmatic” remedy), the first two options are of a “normative” notion, hence essentially requiring stringent enforcement.

NOTES
1 The inflow of KTR is for the larger part treated wastewater originating from As-Samra WWTP, blended with rainfall runoff.
2 The proportion of fresh water for irrigation was 66 percent in 1995 and declined to 55 percent in 2007. Combined with the increase in salinity of the various sources, the average salinity of irrigation water was 1,630 μS/cm in 2007, compared with 1,310 μS/cm in 1995. Expectations are that the contribution of fresh water will further decline.
3 Statements in the National Action Plan 2007 on the increase of connection rates suggest that this is only 58 percent.
4 The total capacity of the new As-Samra WWTP is 267,000 m³ per day, enough to treat all wastewater from the Amman-Zarqa area. The plant is at the moment only using half capacity (two of the four production lines). The reason is not exactly known, but may be related to operational costs or other operational issues. It seems that the MoWI and WAJ have not yet established a clear policy on phasing out the old As-Samra WWTP.
5 The remaining wastewater, however, is by no means lost, but it could be captured and reused locally through decentralized approaches of wastewater separation, “gray water” treatment and reuse (so-called dual networks), and so on. These approaches can be developed through a decentralized modality involving a public-private partnership, with major participation of the end-beneficiary communities (benefiting from the reduced pollution or from the increased useable water). Recent studies in Germany indicate that this is an option for periurban areas as well; in this context, the Jordanian Government would be well advised to seriously study the issue of centralized versus decentralized and corporatized wastewater collection and treatment, in the form of a National Sanitation Master Plan.
6 The EU concept of BAT includes considerations on the affordability of the technology in the context of the country to which BAT is applied. In this sense, BAT in Jordan could mean something different from BAT in Western Europe or the United States.
7 On account of the limited information on its health impacts, pollution from industrial sources was not included in the analysis.
8 With an assumed cost of US$10 per household, and targeted on the basis of current levels household exposure to morbidity related to water, sanitation, and hygiene.
9 That “social cost” is as least as high as the cost needed to replace one cubic meter of groundwater with an alternative source such as desalinated seawater, brought to the same location, to which the damage caused by overextraction (including from increased salinity) should be added as well.
5.1 INTRODUCTION AND MAIN MESSAGES

The transport sector in Jordan accounts for a large share of air emissions (estimated at 80 percent for NO\textsubscript{x}; 20 percent for SO\textsubscript{x}, and 40 percent for TSP). By developing indicative estimates of emissions by fuel type, fleet component, and traffic location, for the reference year (2006) and for a no-intervention future baseline, this chapter identifies policy options for reducing the environmental impacts of road transport.

With a 7 to 10 percent annual growth of the vehicular fleet, a relatively large share (32 percent) of older technology (and thus higher emissions) vehicles, a low rate of replacement of old vehicles, and—pending implementation of recent reforms—low-quality fuels (high-sulfur diesel), Jordan’s transport sector is poised to remain a large emitter in the future, unless suitable policy actions are undertaken. Growth in vehicular emissions might even become more significant if demand (vehicle-kilometers) increase, or occupancy rates decrease: these are likely side effects of per capita income growth, as experience of member countries of the Organisation for Economic Co-operation and Development (OECD) suggests.

A simple traffic-emission model is used to estimate the total volume of road transport emissions, and indicates that the resulting social damage is in the order of JD 130 million per year. In addition, the model permits to identify Light-Duty Vehicles (LDV) and minibuses, as well as Heavy-Duty Vehicles (HDV) as the main sources of PM, NO\textsubscript{x}, and
SO₂ emissions (with contribution ranging between 60 percent and 90 percent of the total); whereas passenger cars appear to be the key source of CO and HC emissions (more than 80 percent).

These results suggest that to abate key pollutants such as PM, SO₂, and NOₓ, for which quantification of health impacts effects is readily obtainable, in physical terms (increased risk of premature mortality and of morbidity) and in monetary terms, policies should focus on higher emitting vehicles (LDV, minibus, HDV). In the short term, policies should seek to reduce emissions per unit of traffic, and in the longer term, to decouple growth of traffic from growth in population and per capita income.

Conversely, policies to increase the use of public transport or more generally to increase occupancy rates (number of passengers per vehicle-kilometer) will realize most of their environmental benefits in terms of decreases in other pollutants, such as CO and HC. Monetary estimates of damage for these pollutants are not available in the literature and thus are harder to evaluate in cost-benefit terms.

Recognizing that the government is developing a wider range of policies and actions to improve the environmental performance of road transport (including GAM’s recent establishment of a company to promote public transport), the CEA evaluates in simple cost-benefit terms a subset of policy options. In the short term, these policies could reduce “monetizable” emissions (PM, SO₂, and NOₓ). These options are as follows:

- Improve fuel quality by phasing out high-sulfur diesel. The government already adopted this option, but the precise phasing out schedule is still subject to uncertainty, so the analysis might help in the implementation phase of the policy;
- Improve vehicle maintenance through workshop certification and staff training;
- Establish the light rail Zarqa-Amman;
- Improve the environmental quality of the vehicle fleet through stringent environmental requirements to newly registered vehicles.

The results of the analysis suggest that a sequential adoption of these policies can reduce about 50 percent of the social cost of air pollution, which would occur in a no-intervention scenario, and that they
can do so in a fairly cost-effective manner (that is, with a cost-benefit ratio well below 1).

The analysis indicates margins are wide for further, cost-effective abatement interventions, such as fiscal incentives (for example, fuel taxation, road charging); and in the longer term, through reduced demand (per capita or per unit of GDP), for use of the higher polluting vehicles (LDVs and HDVs). Reduced demand for use of higher polluting vehicles could be achieved through modal shifts, improved logistics, and so on. These option are not further analyzed because of the lack of data on freight and passenger demand (ton-kilometers and passenger-kilometers), which represent a serious hindrance to the design and evaluation of transport policies, as well as to air quality management.

In terms of the other, “nonmonetizable” pollutants (such as CO), the CEA provides a preliminary evaluation of the emission reduction that can be achieved by increasing the use of public transport. Based on the goal of increasing the share of public transport in total traffic, which the GAM has indicated to be 75 percent for the year 2020, the CEA estimates (using 2006 data) that CO and HC emissions could be reduced up to 60 percent. Considering that the estimated current level of public ridership is about 40 percent, the proposed increase to 75 percent would represent a major change, which is likely to require high level of institutional, financial, and political commitment.

5.2 LAND TRANSPORT IN JORDAN

5.2.1 Key institutions
Transport in Jordan is to a large extent undertaken by private operators and private companies. Private car ownership is rapidly increasing, and private operators are present both in public passenger transport and in freight transport. The framework for the transport sector is strongly regulated by government.

At the state level, a number of institutions are responsible for transport research, legislation, and regulation, monitoring and enforcement, infrastructure planning and implementation, and public transport. Municipalities are responsible for municipal infrastructure and traffic management. The main actors in the transport sector and their functions are presented in table 5.1.
### TABLE 5.1 OVERVIEW OF KEY TRANSPORT SECTOR INSTITUTIONS AND THEIR FUNCTIONS

<table>
<thead>
<tr>
<th>Institution</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ministry of Transport</strong></td>
<td>– Devising the general policy for transport and overseeing its implementation in coordination and cooperation with all related parties.</td>
</tr>
<tr>
<td></td>
<td>– Regulating and monitoring the road freight transport sector and its services, as well as issuance of necessary permits for individuals and companies operating in the sector.</td>
</tr>
<tr>
<td></td>
<td>– Regulating and monitoring the freight transport by rail sector and its services as well as issuance of necessary permits for operating in the sector.</td>
</tr>
<tr>
<td></td>
<td>– Setting freight transports’ fares and tariffs until the sector was liberalized from the tariff system.</td>
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<tr>
<td></td>
<td>– Following up on the implementation of technical rules, and approved specifications, measurements and standards, in accordance with enacted legislation.</td>
</tr>
<tr>
<td></td>
<td>– Following up on the implementation of bilateral transport agreements concluded between the Kingdom and other states as well as international treaties to which the Kingdom is party.</td>
</tr>
<tr>
<td></td>
<td>– Representing the Kingdom at regional and international bodies concerned with transport issues, and keeping up with their activities.</td>
</tr>
<tr>
<td></td>
<td>– Preparing the necessary research and studies for developing the sector, and issuing periodic bulletins and reports on its activities.</td>
</tr>
<tr>
<td></td>
<td>– Establishing a databank for transport sector.</td>
</tr>
<tr>
<td></td>
<td>– Handing of all other functions related to the sector,</td>
</tr>
<tr>
<td><strong>Public Transport Regulatory Commission</strong></td>
<td>– Implementing the government’s public transport policy.</td>
</tr>
<tr>
<td></td>
<td>– Organizing public transport network.</td>
</tr>
<tr>
<td></td>
<td>– Granting licenses and cancelling them if the law is violated.</td>
</tr>
<tr>
<td></td>
<td>– Designating the locations for public transport facilities.</td>
</tr>
<tr>
<td></td>
<td>– Upgrading public transport services.</td>
</tr>
<tr>
<td></td>
<td>– Conducting studies to determine public transport needs.</td>
</tr>
<tr>
<td></td>
<td>– PTRC was established on 16/11/2001 under the Public Transport Temporary Law for Passengers No. (48) for the year 2001. The law was revised and became No.(39) for the year 2006.</td>
</tr>
<tr>
<td><strong>Ministry of Energy and Mineral Resources</strong></td>
<td>– Principal role of MEMR is to define and assist in implementing national energy policy and MEMR has the responsibility of securing the countries energy needs from different foreign sources.</td>
</tr>
<tr>
<td></td>
<td>– The procedural policy of MEMR is aimed at attracting private sector (international or local) involvement in the form of either direct investment or through the implementation of projects on a BOO or BOT basis.</td>
</tr>
<tr>
<td></td>
<td>– The main objective of MEMR is promoting and developing different energy resources and overseeing the energy sector operating companies (<a href="http://www.memr.gov.jo/menus.htm">http://www.memr.gov.jo/menus.htm</a>).</td>
</tr>
<tr>
<td><strong>Ministry of Public Works and Housing</strong></td>
<td>– Responsible for planning, designing and maintaining public, rural and agricultural roads, including ensuring road safety measures.</td>
</tr>
</tbody>
</table>
With respect to air emissions from the transport sector key regulation includes fuel quality requirements and vehicle emission standards. The fuel quality is regulated by the Ministry of Energy and Mineral Resources. The vehicle emission standards are regulated by Jordan Institution for Standards and Metrology and enforced through drivers and vehicle licensing directorate. In 2007–2009, the Ministry of Transport has adopted a new sector strategy that contains important provisions aimed at improving the sector’s environmental performance (see box 5.1).

### TABLE 5.1 OVERVIEW OF KEY TRANSPORT SECTOR INSTITUTIONS AND THEIR FUNCTIONS

<table>
<thead>
<tr>
<th>Institution</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqaba Special Economic Zone Authority (ASEZA)</td>
<td>Among other things attract and facilitates investments in infrastructure, ports, and so on in the Aqaba Special Economic Zone.</td>
</tr>
<tr>
<td>Jordan Transport Institute</td>
<td>Conducting transport sector research, particularly on traffic safety.</td>
</tr>
<tr>
<td>Ministry of Environment</td>
<td>Vehicle emission monitoring campaigns.</td>
</tr>
<tr>
<td></td>
<td>Road transport standards and regulations.</td>
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<td></td>
<td>Trainers program for Environmental Rangers.</td>
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<tr>
<td>Environmental Rangers</td>
<td>Enforcement of environmental regulation, including vehicle emissions.</td>
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<tr>
<td>Drivers and Vehicle Licensing Directorate</td>
<td>Drivers and vehicle licensing.</td>
</tr>
<tr>
<td></td>
<td>Vehicle inspection.</td>
</tr>
<tr>
<td>Municipalities (e.g., GAM)</td>
<td>Municipal infrastructure and traffic management.</td>
</tr>
<tr>
<td>Jordan Institution for Standards and Metrology</td>
<td>Responsible for standardization, metrology, conformity assessment, market surveillance, accreditation, information and related areas, including vehicle emission standards.</td>
</tr>
<tr>
<td>Aqaba Railway Corporation</td>
<td>Public rail operating corporation.</td>
</tr>
<tr>
<td>Jordan Hejaz Railway Corporation</td>
<td>Public rail operating company.</td>
</tr>
<tr>
<td>Civil aviation authority</td>
<td>Civil Aviation regulator.</td>
</tr>
<tr>
<td>Jordan Maritime Authority</td>
<td>Marine transport regulator.</td>
</tr>
</tbody>
</table>

Source: Authors.
Note: BOO = build, own, operate; BOT = build, operate, transfer.
The size and composition of the vehicle fleet is influenced by the costs of vehicles, including taxation. This includes import duty, sales tax, registration fee, and the annual license fee.

_Private passenger cars_ are heavily taxed, particularly through import duties (see table 5.2). Import duties range from 100 to 200 percent of the preduty value, depending on the value of the car and the specific accessories, including active and passive safety equipment, air conditioning, and other features. The sales tax depends on the size of the engine.

_Commercial HDVs_ are levied a customs duty of 30 percent of the estimated price and 16 percent of the total value, including customs duty as sales tax.

### 5.2.2 Road transport

**The vehicle fleet**

Jordan is experiencing a rapid growth in the vehicle fleet, and currently, the annual growth rate in the fleet is 7 to 10 percent.\(^1\) Car ownership

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**BOX 5.1 JORDAN’S NEW TRANSPORT STRATEGY AND THE ENVIRONMENT**

Jordan recently adopted a new transport strategy (2009–11) which contains a number of objectives of relevance for the improvement of the sector’s environmental performance, including the following:

1. Develop the institutional and regulatory framework for the road freight subsector
2. Promote the efficiency and quality of the trucking industry (logistics and operations)
3. Increase the share of public transport in total road traffic
4. Promote (including through incentives to public transport companies) the modernization of the bus fleet and evaluate technological options for clean public transport
5. Encourage the phase-out of small-scale public service to save fuel and reduce traffic congestion

As part of the implementation of the strategy, the government envisages several specific projects that are likely to generate important environmental benefits, such as the following:

- The establishment of a service center in the Amman Development Corridor, aiming at lowering congestion and reducing the entry of heavy trucks into downtown Amman
- The creation of a light rail system between Amman and Zarqa to promote mobility among these two key economic areas in an efficient and environmentally friendly manner

_Source: Government of Jordan 2008b._
is around 100 cars per 1,000 inhabitants, which is almost double than the average of comparable MENA countries (Morocco, Tunisia, Syria), although still quite lower than the OECD average (about 500 cars per 1,000 inhabitants in 2003). The composition of the vehicle fleet is presented in table 5.3.

The vehicle fleet in Jordan is relatively old; approximately one-third of the vehicles were made before 1990.

According to information provided by the Drivers and Vehicles Licensing Directorate, the withdrawal of old vehicles is very low, and old vehicles are being repaired and kept in an operational standard. Because of Jordan’s dry and warm climate, the technical life of vehicles virtually has no limit, and because repair and basic maintenance costs are low compared with the price of younger vehicle, cars keep being repaired.²

This means that even though the fleet is rapidly increasing the old cars generally are not being scrapped and are expected to be around for many years.

According to the Drivers and Vehicles Licensing Directorate, maintenance of vehicles is rudimentary. Many workshops are not qualified to undertake thorough maintenance of modern cars, and many mechanics lack formal training. Vehicles often are maintained only to keep them running, while proper adjustment of the engine is not undertaken. This has strong bearing on emissions.

### Road infrastructure
Little information is available on traffic volumes on the road network. The main road network in Jordan is functioning and allows for effi-

---

**Table 5.2 Passenger Car Sales Tax**

<table>
<thead>
<tr>
<th>Size of engine in cc</th>
<th>Tax in % of car value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1,000</td>
<td>0%</td>
</tr>
<tr>
<td>1,001–1,500</td>
<td>4%</td>
</tr>
<tr>
<td>1,501–2,000</td>
<td>7%</td>
</tr>
<tr>
<td>2,001–2,500</td>
<td>10%</td>
</tr>
<tr>
<td>2,501–3,000</td>
<td>13%</td>
</tr>
<tr>
<td>&gt;3,001</td>
<td>16%</td>
</tr>
</tbody>
</table>

*Source: PTRC 2007b.*
TABLE 5.3 VEHICLE FLEET AND AGE IN JORDAN, JULY 2007

<table>
<thead>
<tr>
<th>Fleet data</th>
<th>Passenger cars</th>
<th>Public transport minibuses</th>
<th>Other minibuses</th>
<th>Light duty vehicles</th>
<th>Heavy duty vehicles</th>
<th>Public transport Buses</th>
<th>Other buses</th>
<th>Motorcycles</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car model year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>142,284</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,963</td>
<td>144,247</td>
</tr>
<tr>
<td>Diesel</td>
<td>1,863</td>
<td>3,436</td>
<td>44,441</td>
<td>6,430</td>
<td>456</td>
<td>810</td>
<td></td>
<td></td>
<td>57,436</td>
</tr>
<tr>
<td>1990-1999</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>215,515</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>345</td>
<td>215,860</td>
</tr>
<tr>
<td>Diesel</td>
<td>2,143</td>
<td>3,952</td>
<td>77,464</td>
<td>15,006</td>
<td>249</td>
<td>442</td>
<td></td>
<td></td>
<td>99,256</td>
</tr>
<tr>
<td>&lt;1989</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>157,565</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>513</td>
<td>158,078</td>
</tr>
<tr>
<td>Diesel</td>
<td>1,332</td>
<td>2,457</td>
<td>63,077</td>
<td>25,672</td>
<td>345</td>
<td>614</td>
<td></td>
<td></td>
<td>93,497</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>515,364</strong></td>
<td><strong>5,338</strong></td>
<td><strong>9,845</strong></td>
<td><strong>184,982</strong></td>
<td><strong>47,108</strong></td>
<td><strong>1,050</strong></td>
<td><strong>1,866</strong></td>
<td><strong>2,821</strong></td>
<td><strong>768,374</strong></td>
</tr>
</tbody>
</table>

Source: Information provided by the Drivers and Vehicles Licensing Directorate 2007.
cient road freight transport north-south and between the main ports and border entries. Within the large cities, however, traffic is regularly congested during peak hours, indicating that the road capacity is reaching its limits.

It is not clear the extent to which the congestion problems are due to inefficient traffic management and regulation. The widespread use of small roundabouts and shortage of traffic lights is likely to cause cues in intersections even at fairly low traffic volumes. Improved traffic regulation and management might significantly increase the capacity of parts of the urban road network in the large cities.

Road transport

Road transport in Jordan is not monitored regularly. Based on vehicle fleet data and indicative information about the average annual kilometers per vehicle, road transport can be assessed in terms of vehicle kilometers per year (see table 5.4).

These estimates are based on assumptions on the annual kilometers per vehicle and therefore should be regarded as indicative. Passenger cars are assumed to drive 20,000 km/year, LDVs 30,000 km/year, public transport minibuses 150,000 km/year, other minibuses 40,000 km/year, public transport buses 110,000 km/year, other buses 60,000 km/year, and HDVs 60,000 km/year. These assumptions have been discussed with the vehicle inspection (passenger cars), GAM, the Public Trans-

<table>
<thead>
<tr>
<th>Model</th>
<th>Passenger car</th>
<th>Public transport minibus</th>
<th>Other minibus</th>
<th>Light-duty vehicle</th>
<th>Heavy-duty vehicle</th>
<th>Public transport bus</th>
<th>Other bus</th>
<th>Motor cycles</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 1990</td>
<td>7.156</td>
<td>601</td>
<td>296</td>
<td>3.657</td>
<td>1.286</td>
<td>78</td>
<td>75</td>
<td>23</td>
<td>13.171</td>
</tr>
<tr>
<td>≤ 1989</td>
<td>3.151</td>
<td>200</td>
<td>98</td>
<td>1.892</td>
<td>1.540</td>
<td>38</td>
<td>37</td>
<td>5</td>
<td>6.962</td>
</tr>
<tr>
<td>Total</td>
<td>10.307</td>
<td>801</td>
<td>394</td>
<td>5.549</td>
<td>2.826</td>
<td>116</td>
<td>112</td>
<td>28</td>
<td>20.133</td>
</tr>
</tbody>
</table>

*Source: Table 5.3 and authors’ calculations.*
port Regulatory Commission (PTRC), selected bus and minibus drivers (public transport buses and minibuses), and a large transport company (HDV).

Transport fuels
Most of the fuel for Jordan’s transport sector is produced at the Jordan Refinery. A minor share of gasoline and diesel is imported.

The domestic production has a fairly low quality, and only leaded gasoline and diesel with high sulfur content (0.85 percent) are produced (see table 5.5).

Oil products are priced according the following principles:

» Heavy fuel and jet petroleum are not regulated but priced according to market principles.
» Diesel, kerosene, liquid petroleum gasoline (LPG), and heavy fuel for electricity generation are subsidized.
» Petroleum products are regulated on a cost plus basis, meaning that production at the Jordan Refinery is cost plus based. The specific

| TABLE 5.5 CHARACTERISTICS OF ROAD TRANSPORT FUELS IN JORDAN, 2007 |
|-----------------------------|----------------|------------------------|----------------|
| Fuel                        | Quality          | Octane | Amount sold in 2006 (in tons) | Price, JD/liter | Comment                      |
| Gasoline                    |                 |       |                               |                |                             |
| Regular leaded              | 0.1 g lead/liter, 0.06% S | 87     | 517,000                        | 0.43           | Produced in Jordan           |
| Super leaded                | 0.2 g lead/liter, 0.026% S | 95     | 178,000                        | 0.604          | Produced in Jordan           |
| Unleaded                    |                 | 95     | 48,000                         | 0.64           | Imported                     |
| Diesel                      |                 |       |                               |                |                             |
| Normal diesel               | 0.85% S         |       | 845,000                        | 0.315          | Produced in Jordan           |
| Light diesel                | 0.05% S         |       | 510,000                        | 0.315          | Imported                     |

Sources: Ministry of Energy and Mineral Resources: meeting July 3, 2007 and “Energy 2007: Facts and Figures.” Lead (Pb) and sulfur (S) content: Jordan refinery laboratory tests, April and May 2007, provided by Ministry of Energy and Mineral Resources. Diesel fuel sales data for 2006 are provided by the PTRC.

Note: Differences in data sources result in differences in fuel sale estimates.
prices ensure that a cross-subsidy is provided from gasoline to the subsidized oil products.

Since March 2008, all fuel stations have phased out leaded gasoline and fuel price regulation has been abolished.

5.2.3 Rail transport
Jordan has two railways: the Jordan Hejaz Railway and the Aqaba Railway Corporation. Both are publicly owned.

Jordan Hejaz Railway is narrow gauged and runs a few weekly passenger trains between Amman and Damascus, as well as freight trains upon request. The company also offers tourist and school trains upon request.

The Aqaba Railway Corporation transports phosphate from Jordan’s three phosphate mines to Aqaba harbor.

Most of the rail transport takes place on the Aqaba rail, and the main activity concerns phosphate transport (see table 5.6).

The Ministry of Transport wants to vitalize the rail sector in Jordan. Several rail development projects have been investigated, including the following:

» New light rail between Zarqa-Amman for passenger transport between the three cities
» Upgraded rail from Amman to the Syrian border with a branch from Mafraq via Irbid to the Israeli border
» New rail from Zarqa to the Iraqi border
» Upgraded rail from Zarqa to Aqaba

<table>
<thead>
<tr>
<th>TABLE 5.6 ANNUAL PHOSPHATE TRANSPORT ON RAIL IN JORDAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mines</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>No. of trains/year</td>
</tr>
<tr>
<td>Phosphate 1,000 t/year</td>
</tr>
</tbody>
</table>

5.2.4 Public transport

Public passenger transport on the road is based on three modes of transport:

- Public transport by buses
- Public transport by minibus, which are buses with less than 30 passengers
- Service cars, which are ordinary passenger cars that operate defined routes and carry passengers on these routes according to fixed rates

These public transport modes operate lines in cities, between cities, or to destinations in neighboring countries. The designing of routes and the licensing of the operators of the individual is the responsibility of the PTRC. Bus fares for buses, minibuses, and service cars are regulated by the PTRC; however, a reform of the regulatory system for Amman’s public transport is being introduced. The number of public transport vehicles is presented in table 5.7.

5.3 AIR POLLUTION FROM TRANSPORT

Detailed estimation of the emissions of different pollutants from transport is a demanding task. It requires detailed mapping of transport and traffic patterns, and detailed information about emission factors from different vehicle categories and other transport modes, which are not available for Jordan. Such an estimation of emissions is outside the scope of this report, and a relatively simple model has been developed to provide a rough estimate of the air emissions from the transport sector.

The purpose of developing this model is twofold:

- To estimate the current air emissions from land transport
- To estimate the effects of selected policies on the reduction of emission levels

This chapter presents the calculation, followed by the main findings. This analysis complements previous estimations undertaken in Jordan in the context of the first national communication of the United Nations Framework Convention on Climate Change (UNFCCC) (the
second communication is being finalized), as well as other technical analyses (AFD 2006).

5.3.1 Estimation model of air pollutants from transport

A simple spreadsheet model has been developed to estimate emission of air pollutants from road and rail transport in the whole of Jordan and in the large governorates. The estimation of emissions is based on international emission factors, selected to obtain a fair representation for Jordan. The purpose of this exercise is to establish a tool that can link the activities in the transport sector, in terms of number and quality of vehicles and their use, to the air pollution from the sector, and also to provide indications of the emissions in the largest cities and governorates. Existing estimations of transport sector emissions (for example, for the national reporting under the UNFCCC) have been based on fuel sales and are not linked to the specific vehicle fleet and its activity. The linking of vehicle fleet and transport activities to emissions allows the model tool to provide estimations of the environmental impacts of selected policy options.

The model is kept as simple as possible for practical reasons, to ensure transparency and to allow for simple analyses of policy measures. The model structure is illustrated in figure 5.1.

<table>
<thead>
<tr>
<th>TABLE 5.7</th>
<th>NUMBER OF PUBLIC TRANSPORT VEHICLES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Service cars</td>
</tr>
<tr>
<td>Jordan total</td>
<td></td>
</tr>
<tr>
<td>Operating urban lines</td>
<td>591</td>
</tr>
<tr>
<td>Operating intercity lines</td>
<td>3676</td>
</tr>
<tr>
<td>Operating international lines</td>
<td>1075</td>
</tr>
<tr>
<td>Amman Governorate</td>
<td></td>
</tr>
<tr>
<td>Operating urban lines</td>
<td>349</td>
</tr>
<tr>
<td>Operating intercity lines</td>
<td>3211</td>
</tr>
<tr>
<td>Operating international lines</td>
<td>624</td>
</tr>
<tr>
<td>Irbid Governorate</td>
<td></td>
</tr>
<tr>
<td>Operating urban lines</td>
<td>154</td>
</tr>
<tr>
<td>Operating intercity lines</td>
<td>245</td>
</tr>
<tr>
<td>Operating international lines</td>
<td>193</td>
</tr>
<tr>
<td>Zarqa Governorate</td>
<td></td>
</tr>
<tr>
<td>Operating urban lines</td>
<td>55</td>
</tr>
<tr>
<td>Operating intercity lines</td>
<td>96</td>
</tr>
<tr>
<td>Operating international lines</td>
<td>185</td>
</tr>
</tbody>
</table>

The model allows assessment of the effects of changes in the following key parameters:

» Fuel quality (lead, sulfur content)
» Emission characteristics of the vehicle fleet, for example, reflecting the age of the fleet
» Growth rate of the vehicle fleet

5.3.2 Main assumptions

The existing gasoline cars generally are assumed not to be equipped with catalytic converters. Likewise, existing diesel vehicles are assumed not to be able to meet present EU emission norms. An important reason for this is the relatively low quality of diesel fuel and the leaded gasoline that dominated until March 2008. The different types of vehicles are assumed to drive annual distances indicated in table 5.8.

These assumptions are based on information provided in discussions with the Drivers and Vehicle Licensing Directorate on passenger cars,
GAM, and a number of selected bus and minibus drivers on the annual kilometers for public transport buses and minibuses, and on information from the Nabresco transport company for HDV annual kilometers.

Emission per kilometer driven is estimated on the basis of pollutant- and vehicle-specific emission factors (see annex 3 in World Bank 2010 for details). The age of a vehicle does not determine its emissions. To a large extent, emission also is determined by the level of maintenance of the vehicle.

In the estimation of emissions, vehicle models from 1990 onward (post-1990) on average are assumed to have the same emission factors as European vehicles from 1990 onward—that is, before catalytic converters became mandatory. Vehicles older than 1990 (pre-1990 models) are assumed to have 20 percent larger emission on average on selected emissions than the post-1990 models.

This relationship is assumed for CO, HC, and PM emissions and is founded on a simplified analysis of a selection of the Drivers and Vehicle Licensing Directorates monitoring data from vehicle inspection. Based on the monitoring results, the relationship between age and emission does not seem to be strong, but a linear regression of selected pollutants reveals a correlation. This correlation is illustrated for CO emissions monitored by vehicle inspection of gasoline passenger cars of different ages (0–35 years). The results are presented in figure 5.2.

The future air emissions from the transport sector include the emissions from the present fleet (minus cars that are scrapped) plus the emissions caused by newly registered vehicles. Emissions from these newly registered vehicles depend on the environmental requirements for these vehicles, for example, that all new vehicles should meet present EU standards.

### TABLE 5.8 ASSUMPTIONS ON ANNUAL MILEAGE BY VEHICLE TYPE

<table>
<thead>
<tr>
<th></th>
<th>Passenger car</th>
<th>Minibus</th>
<th>Light-duty vehicle</th>
<th>Heavy-duty vehicle</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Km/year</td>
<td>20,000</td>
<td>40–150,000</td>
<td>30,000</td>
<td>60,000</td>
<td>60,000–110,000</td>
</tr>
</tbody>
</table>

Source: Authors’ assumptions based on discussions with Drivers and Vehicles Licensing Directorate, GAM, and a number of selected bus and minibus drivers for public transport minibuses and information from Nabresco transport company.

Note: The categories Buses and Minibuses distinguish between public transport (high mileage) and other use (low mileage).
The methodology applied in this estimation is simple and the results are subject to uncertainty. Although data on the vehicle fleet are fairly detailed, Jordan traffic data and emission factors are lacking, giving rise to uncertainty. The results can be compared with a study undertaken by AFD in 2006. The AFD study assessed the air emission from transport in Jordan, using the Computer Programme to Calculate Emissions from Road Transport COPERT III model, which based estimated emissions on fuel consumption. Comparing the results of these two different methodologies (fuel consumption versus number of vehicle-kilometers) reveals the uncertainty involved. The results are presented in table 5.9.

5.3.3 Modeling results
The model estimates the fuel consumption and the emissions of selected air pollutants by using standard factors for fuel consumption and emissions for different vehicle types per vehicle-kilometer.
CHAPTER 5 | AIR POLLUTION AND ROAD TRANSPORT

Fuel consumption for road transport
The model calculations are based on a number of assumptions, and the results should therefore be used with caution. The realism of the model results, however, can be tested by comparing the real data on fuel sales with the estimated fuel consumption. This will indicate the reliability of the fuel consumption for road transport results, and to some extent the air emission results.

Table 5.9 presents actual sales of diesel and gasoline in 2006 in Jordan and selected governorates, and presents, for comparison, the fuel consumption in 2006 estimated by the COWI model.

The estimated fuel consumption seems to be fairly accurate compared with actual fuel sales for the whole of Jordan. The difference is larger when looking at individual governorates, partly because the fuel is not necessarily used in the governorate where it is sold (the vehicle may be on route to another city), and partly because exact data are not available on the number of vehicles operating in each governorate and their annual kilometers.

Air emission from road transport
Air emissions from road transport have been estimated using international emission factors and estimated transport in vehicle-kilometers per year for different modes of transport. Emission factors from vehicles in a driving circle are not available for Jordan. Only measurements on emissions from vehicles in idle mode are available, but such data provide

---

**TABLE 5.9 ACTUAL AND ESTIMATED FUEL CONSUMPTION OF ROAD TRANSPORT, 2006 (TONS/YEAR)**

<table>
<thead>
<tr>
<th></th>
<th>Amman Governorate</th>
<th>Irbid Governorate</th>
<th>Zarqa Governorate</th>
<th>Jordan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual sales</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel</td>
<td>719,092</td>
<td>161,805</td>
<td>170,289</td>
<td>1,440,581</td>
</tr>
<tr>
<td>Gasoline</td>
<td>456,766</td>
<td>81,844</td>
<td>66,454</td>
<td>717,063</td>
</tr>
<tr>
<td>Estimated consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel</td>
<td>667,807</td>
<td>160,274</td>
<td>133,561</td>
<td>1,442,860</td>
</tr>
<tr>
<td>Gasoline</td>
<td>364,833</td>
<td>87,546</td>
<td>72,967</td>
<td>729,665</td>
</tr>
</tbody>
</table>

*Sources: PTRC 2007; authors’ calculations.*
little or no information about the emissions from the vehicles when driving and the engine loaded.

The German Ministry of Environment published generally recognized emission factors for vehicles in European countries, specified according to the age and type of vehicle and the fuel used. These emission factors have been used for Jordan. To reflect the conditions in Jordan, the German emission factors for vehicles produced before 1990 have been used for the existing fleet. For the oldest 30 percent of the vehicle fleet, 20 percent higher emissions of CO, HC, and PM have been assumed.

For new vehicles equipped with catalytic converters, the European 2005 emission factors have been used. These emission factors assume that the new vehicles use unleaded gasoline and that diesel vehicles have access to low-sulfur diesel. Annex 3 in World Bank (2010) contains the specific emission factors used in the model. The estimated emission of selected air pollutants is presented in table 5.10.

<table>
<thead>
<tr>
<th>TABLE 5.10 ESTIMATED AIR EMISSION FROM ROAD TRANSPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO t/year</td>
</tr>
<tr>
<td>Author estimate</td>
</tr>
<tr>
<td>AFD 2006 Monitoring Program</td>
</tr>
</tbody>
</table>

Sources: Authors’ estimates; and AFD 2006.  
Note: CO = carbon monoxide; HC = hydrocarbons; NOx = nitrogen oxides; Pb = lead; PM = particulate matter; SO2 = sulfur dioxide; — = not available.

In addition to the overall volume of emissions, the model identifies the relative contribution, by pollutant, of each vehicle type. The results indicate (see figure 5.3) that LDV, minibuses, and HDV are the main sources of PM, NOx, and SO2 emissions (with contributions ranging from 60 to 90 percent of the total); whereas passengers cars are the key source of CO and HC emissions (more than 80 percent). This finding has important implications for the design of abatement policies, as discussed in section 5.5.

Because the calculated emissions rely heavily on the emission factors used, the specific results should be used with some caution. Comparison
with the AFD 2006 study indicates results within the same order of magnitude, but at the same time, uncertainties in results are significant.

5.3.4 Economic impact of air pollution

Estimation based on Heatco values

The economic impact of air pollution from the transport sector is not included in market prices—these costs are called external costs—and therefore are not included in GDP and other economic indicators. This does not mean that the costs are not real; it means that the costs have not been internalized in market prices and must be assessed separately.

The external costs are estimated by use of emission values, which attach an external socioeconomic cost to each ton of pollutant emitted. No emission values specific for Jordan have been identified, and other sources have been used. The main source on transport sector emission valuations used in this study is the EU Heatco study (Heatco 2006). The Heatco values include human health costs, loss of crop, and mate-
rial damage caused by air pollution. The values presented for European countries have been adjusted to Jordan based on GDP. World Bank estimates for 2004 GDP in Jordan and EU countries have been used.

The value of lead (Pb) pollution is not included in the Heatco study as Pb has been phased out in European gasoline for approximately 20 years. To include Pb emission, a Danish source on the value of Pb pollution from power plants has been identified and used. The results are presented in table 5.11 and suggest an annual value of some 140 million euros per year (or JD 130 million).

The socioeconomic costs of emissions from railway transport are estimated at 3 million euros per year, that is, less than 1 percent of the total cost of emissions from the transport sector.

These results are sensitive, among other factors, to the valuation coefficients used, and to the way in which European values are transferred to Jordan. Nevertheless, they are broadly consistent with the order of magnitude of air pollution damage estimated in chapter 3, although they are calculated using a different methodology. Considering that the latter results refer only to a subset of pollutants (PM, SO₂) and of geographic locations, the Heatco-based figures, once adjusted as appropriate and ex-

---

**TABLE 5.11 ESTIMATED EXTERNAL COSTS OF ROAD TRANSPORT AIR EMISSIONS, 2006 MILLION EUROS PER YEAR**

<table>
<thead>
<tr>
<th>Emission</th>
<th>Jordan</th>
<th>Amman</th>
<th>Irbid</th>
<th>Zarqa</th>
</tr>
</thead>
<tbody>
<tr>
<td>HC</td>
<td>3.0</td>
<td>1.5</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>NOₓ</td>
<td>13.8</td>
<td>6.3</td>
<td>1.5</td>
<td>1.3</td>
</tr>
<tr>
<td>PM Urban</td>
<td>83.7</td>
<td>39.7</td>
<td>9.5</td>
<td>7.9</td>
</tr>
<tr>
<td>PM Rural</td>
<td>15.6</td>
<td>7.4</td>
<td>1.8</td>
<td>1.5</td>
</tr>
<tr>
<td>SO₂</td>
<td>7.8</td>
<td>3.6</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Pb low value</td>
<td>0.3</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Pb high value</td>
<td>8.4</td>
<td>4.2</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Total costs, low Pb value</td>
<td>134.0</td>
<td>63.3</td>
<td>15.2</td>
<td>12.7</td>
</tr>
<tr>
<td>Total costs, high Pb value</td>
<td>142.1</td>
<td>67.3</td>
<td>16.2</td>
<td>13.5</td>
</tr>
</tbody>
</table>

*Source: Authors’ calculations.*

*Note: Pb low only include direct affects, Pb high include accumulative effects. HC = hydrocarbons; NOₓ = nitrogen oxides; Pb = lead; PM = particulate matter; SO₂ = sulfur dioxide.*
pressed in terms of purchasing power parity (see table 5.12), are similar, although some are 15 percent higher than chapter 3 estimates. This suggests that COED estimates likely are conservative, because they quantify the impact of all emission sources, not just transport.

<table>
<thead>
<tr>
<th>TABLE 5.12</th>
<th>SELECTED ESTIMATES OF AIR POLLUTION DAMAGE, 2006 (MILLION JD PER YEAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heatco values based on GNI (only road transport emissions)</td>
<td></td>
</tr>
<tr>
<td>All pollutants</td>
<td>127.89</td>
</tr>
<tr>
<td>PM, SO₂ only</td>
<td>107.10</td>
</tr>
<tr>
<td>Heatco values based on PPP (only road transport emissions)</td>
<td></td>
</tr>
<tr>
<td>All pollutants</td>
<td>306.00</td>
</tr>
<tr>
<td>PM, SO₂ only</td>
<td>256.26</td>
</tr>
<tr>
<td>Cost of air pollution (COED analysis, all sectors)</td>
<td>126.80</td>
</tr>
</tbody>
</table>

Source: Author calculations.
Note: COED = cost of environmental degradation; GNI = gross national income; Pb = lead; PM = particulate matter; PPP = purchasing power parity; SO₂ = sulfur dioxide.

5.3.5 Need for improved data
This study reveals a need for improved data on Jordan transport sector to enable more precise estimates of the air emissions from the transport sector. Such data also would allow for other important transport sector analyses (for example, on congestion and transport economics). The most important information concerns are as follows:

» Transport data, including traffic counting, data on modal split, and so on, and the development of transport models that can estimate transport and traffic in Jordan and in the large cities.

» Emission factors for Jordan, reflecting the specific conditions of the vehicle fleet in Jordan and monitored in realistic driving cycles. Specific Jordan valuation factors would be beneficial.

A developed transport modeling environment and preparation of realistic emission factors would enable municipal and governmental authorities to assess with higher precision the current emissions and the ef-
fects of alternative policies and measures—for example, to mitigate the emissions, improve public transport, and reduce congestion.

5.4 PROSPECTS FOR THE FUTURE

The Government of Jordan wants to reduce the air pollution from the transport sector, and the National Agenda outlines selected objectives. The objectives call for an improvement in diesel and gasoline quality in the coming years and for an increasing share of the vehicle fleet to have better emission performance. Furthermore, emphasis has been placed on reducing PM emissions.

<table>
<thead>
<tr>
<th>TABLE 5.13 SELECTED AIR EMISSION AND AIR QUALITY TARGETS IN THE NATIONAL AGENDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>CO Concentration in vehicle emission, pct volume</td>
</tr>
<tr>
<td>HC PPM in vehicle emission</td>
</tr>
<tr>
<td>Diesel S Sulfur level in PPM</td>
</tr>
<tr>
<td>PM Microgram per cubic meter in downtown Amman</td>
</tr>
</tbody>
</table>

Note: CO = carbon monoxide; HC = hydrocarbons; pct = per cubic ton; PPM = particles per million; PM = particulate matter; S = sulfur.

Key expected developments relevant to air emission from the transport sector are presented in this section.

5.4.1 Transport sector development

Based on the present 7 percent annual growth in the vehicle fleet, a simple scenario for the vehicle fleet in Jordan by the end of 2011 has been prepared. Table 5.14 presents key figures.
### TABLE 5.14 ESTIMATED VEHICLE FLEET IN JORDAN, 2011–12

<table>
<thead>
<tr>
<th></th>
<th>Passenger car</th>
<th>Public transport minibus</th>
<th>Other minibus</th>
<th>LDV</th>
<th>HDV</th>
<th>Public transport bus</th>
<th>Other bus</th>
<th>Motor cycles</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing vehicle fleet</strong></td>
<td>515,364</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,821</td>
<td></td>
<td></td>
<td>518,185</td>
</tr>
<tr>
<td>Gasoline</td>
<td>515,364</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,821</td>
<td></td>
<td></td>
<td>518,185</td>
</tr>
<tr>
<td>Diesel</td>
<td>5,338</td>
<td>9,845</td>
<td>184,982</td>
<td>47,108</td>
<td>1,050</td>
<td>1,866</td>
<td></td>
<td>250,189</td>
<td></td>
</tr>
<tr>
<td><strong>Vehicles registered 2007–11</strong></td>
<td>207,461</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,136</td>
<td></td>
<td></td>
<td>208,596</td>
</tr>
<tr>
<td>Gasoline</td>
<td>207,461</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,136</td>
<td></td>
<td></td>
<td>208,596</td>
</tr>
<tr>
<td>Diesel</td>
<td>2,149</td>
<td>3,963</td>
<td>7,4465</td>
<td>18,963</td>
<td>423</td>
<td>751</td>
<td></td>
<td>100,714</td>
<td></td>
</tr>
<tr>
<td><strong>Estimated vehicle fleet 2011-12</strong></td>
<td>722,825</td>
<td>7,487</td>
<td>13,808</td>
<td>259,447</td>
<td>66,071</td>
<td>1,473</td>
<td>2,617</td>
<td>3,957</td>
<td>1,077,684</td>
</tr>
</tbody>
</table>

*Sources:* Drivers and Vehicles Licensing Directorate; authors’ calculations.

*Note:* HDV = heavy-duty vehicles; LDV = light-duty vehicles.
The present vehicle fleet growth rate in Jordan indicates a rapid growth in road transport and thus in the emissions of pollutants from the transport sector unless changes take place.

5.4.2 **Fuel quality improvement**

The Government of Jordan wants to ensure that fuel quality is improved gradually over the coming years.

Since the fourth expansion of the Jordan Petroleum Refinery, all Jordan diesel and gasoline must meet the quality standards required for meeting EURO IV norms. Phase four is expected to be completed by 2012. In the meantime, fuel quality gradually will be improved, partly through liberalization of the marketing of petroleum products. On June 5, 2007, the Government of Jordan prioritized light diesel for the transport sector.

In March 2008, the present concession for the Jordan Petroleum Refinery Company was terminated and liberalization of the sector began to take place:

- Four competing petroleum product-marketing companies (purchase, storage, and wholesales) and one LPG company initially were allowed to import products and purchase products from the Jordan Refinery. Distribution of oil products was liberalized. More companies may enter the market after an interim period (three to four years).
- A strategic partner will be identified to modernize and develop the refinery following a tendering procedure. The strategic partner will be selected by December 2008.
- After licensing and modernization of the refinery, product quality should be improved during the four-year interim period.
- All filling stations started to offer unleaded gasoline only.

If these decisions are implemented according to plan, the quality of fuels gradually will improve, ultimately meeting the European standard. If sufficient low-sulfur diesel is provided at the filling stations, the improved quality would allow new diesel vehicle with particle filters to function properly in Jordan. Since March 2008, leaded gasoline has been phased out, allowing new gasoline cars with catalytic converters to function.
5.5 OPTIONS FOR POLICY REFORM

5.5.1 Key transport air pollution challenges
The main challenges for the reduction of transport air pollution in Jordan can be summarized as follows:

» *Fuel quality is poor.* The leaded gasoline and the high sulfur content in diesel causes emissions of SO₂, PM, and Pb, but also is an obstacle to cleaner vehicles because adequate operation of these vehicles requires unleaded gasoline and better diesel quality.

» *Rapid growth in vehicle fleet and traffic levels.* Jordan is experiencing a rapid increase in car ownership and in road traffic. In particular, Amman and other large cities will face increasing congestion and air pollution problems. This rapid increase in car ownership is taking place even though car taxation is high compared with most other countries. At the national level, car ownership is 100/1,000 inhabitants and it must be expected to increase with growing GDP. OECD experience suggests that a further effect of GDP growth might be the increase in passenger-kilometers or the reduction of occupancy rates, which will further increase air emissions from road transport.

» *Existing vehicle fleet is relatively old and has high emissions.* The average lifetime of a vehicle is long because of Jordan’s climate, relatively low maintenance and repair costs, and high costs for new vehicles. The renewal of the existing vehicle fleet will be slow (only around 3,000 to 4,500 vehicles are scrapped annually according to the vehicle inspection).

» *Low quality of car maintenance.* Most auto workshops are not staffed with trained mechanics and do not possess the necessary equipment and knowledge to ensure proper control and maintenance of vehicles. Only the basic maintenance is undertaken, ensuring that the engine works, but not that the engine is adjusted correctly to reduce fuel consumption and emissions.

» *Lack of awareness of air pollution.* The public awareness of transport air pollution is limited, and neither workshop or vehicle owners are aware of the importance of proper maintenance to reduce pollution. Increased awareness is a precondition for public acceptance and participation in mitigating measures, particularly as these often will come at a cost.
Transport management could be improved. Traffic management, particularly in Amman and in and between other large cities, could be improved to optimize the flow of the traffic and to reduce congestion. Improved public transport could also limit the growth of transport by private car.

5.5.2 Key policy options
The results of the traffic-pollution modeling reported in section 5.3.3 suggest that to abate key pollutants (such as PM, SO₂, HC, and NOₓ, for which quantification of health impacts effects is readily obtainable) in physical terms (increased risk of premature mortality and of morbidity) and monetary terms, policies should focus on higher emitting vehicles (LDV, minibus, HDV). In the short term, policies should seek to reduce emissions per unit of traffic, and in the longer term, to decouple growth of traffic from growth in population and per capita income.

A wide range of policy measures to meet those objectives could be considered. Recognizing that, with the new transport strategy, the government is developing a wider range of policy directions to reduce emissions from road transport (see box 5.1 for details), this section focuses on subset policy options that in the short term could reduce “monetizable” emissions (PM, SO₂ and NOₓ). These options are as follows:

- Improve fuel quality by phasing out high-sulfur diesel. This option has been adopted by the government, but the precise phasing-out schedule is subject to uncertainty, and the analysis might help in the implementation phase of the policy.
- Improve vehicle maintenance through workshop certification and staff training.
- Improve the environmental quality of the vehicle fleet through stringent environmental requirements to newly registered vehicles.

Improvement of fuel quality to meet international fuel quality standards
Implementation of the decisions to improve the fuel quality will reduce emission of selected pollutants and is a prerequisite for significant emission reductions in the long term.

Reducing the sulfur content in diesel will reduce the emission of SO₂, and the emission of PM from diesel vehicles will be reduced. Fur-
thermore, low-sulfur diesel is a precondition for the use of particle filters on diesel vehicles.

The widespread introduction of unleaded gasoline will reduce lead pollution and allow large-scale introduction of gasoline vehicles equipped with catalytic converters.

The government has established a four-year plan to ensure the gradual implementation of cleaner diesel during the period 2008–12. An important aspect of the plan is that even though high-sulfur diesel will continue to dominate for a period of time, low-sulfur diesel has been available at all filling stations during this period, and thus allows cleaner vehicles with particle filters to operate without restrictions on fuel supply. Unleaded gasoline has been available, substituting leaded gasoline, at all filling stations since March 2008.

Improvement of vehicle maintenance

To establish an auto workshop, staff are required to be trained and certified mechanics. High staff turnover, as well as changes in workshop ownership, however, undermines the formal staff qualification requirement. According to the Drivers and Vehicles Licensing Directorate and other sources many workshops are staffed with untrained mechanics and most workshops offer only rudimentary maintenance.

The key task of the workshops is to repair vehicle and keep them running, not to fine-tune the engine to reduce fuel consumption and emissions.

The objective of this proposed policy measure is to improve vehicle maintenance by upgrading workshops and improving the qualifications of the workshops’ staff. This will be obtained by introducing (1) a renewed workshop certification system and (2) mandatory training programs for workshop owners and mechanics. Certification and training will ensure that all registered workshops comply with minimum standards and that staff have sufficient qualifications to properly maintain and adjust the vehicles.

A detailed training program should be developed, but initially the program will last one week. Development and implementation of training courses could be undertaken within the framework of existing vocational training institutions.

The workshop certification and the staff training requirement should be mandatory, and compliance should be ensured within three
to five years. To ensure rapid implementation, the training courses could be offered for free during the first two years, after which time participants would be required to pay a fee.

**Improvement of the environmental quality of the vehicle fleet**

Most of the newly registered vehicles are used vehicles, imported from other countries. The new vehicles typically do not meet existing EU emission standard and are not equipped with catalytic converters or particle filters because these require better fuel quality.

In view of the rapid growth of the vehicle fleet, improved environmental performance of the newly registered vehicles is needed. It is difficult to improve significantly the environmental performance of the existing vehicle fleet, although some improvements can be obtained through the use of better fuels and better maintenance. It is easier to obtain significant improvements for the imported new vehicles. With the current growth rate, newly registered vehicles will account for a large share of the fleet—more than 50 percent in six years—and will be important contributors to air emission.

The objective of this proposed policy is to ensure that newly registered vehicles have lower emissions than the existing fleet to (1) slow down the growth of emission arising from the vehicle fleet growth, and (2) in the long term, reduce emissions if and when old vehicles are scrapped in larger numbers.

These objectives can be obtained by introducing strict environmental requirements on vehicles that are registered in Jordan. Only fairly new vehicles should be imported, for example, only vehicles less than 10 years old, and these vehicles should meet the EU norms valid for the model. This means that a 1997 car should meet the EURO II norms and a 2001 car should meet the EURO III norms. Generally, this standard could be controlled by testing whether the catalytic converter is functioning before a car is registered. A precondition for this policy measure is that sufficient amounts of low-sulfur diesel and unleaded gasoline are available to meet the demand from the newer vehicles.

To speed up the scrapping of the oldest vehicles in the fleet, a premium could be offered to vehicle owners who are scrapping vehicles more than 20–25 years old. This premium would provide an incentive to remove the oldest and probably most polluting vehicles. This option,
however, will be costly to the vehicle owners and may be difficult to implement politically. Therefore, it has not been analyzed further.

In addition to this first set of policies, others can be considered to reduce emissions via improved traffic management or through the reduced volume of traffic per capita or per unit of GDP. Based on the previous discussion (section 5.3.3 above), it is likely that these policies will yield much of their benefits in terms of the other, “nonmonetizable” pollutants (such as CO). This set of policies includes the following: (1) strengthening transport management and planning, and (2) promoting public transport.

*Strengthening transport management and planning*

Amman and other large cities are increasingly faced with congestion problems, particularly during peak hours. Congestion results in inefficient traffic flows and increased pollution. Energy consumption and emission in urban areas may be reduced by means of traffic management measures. For public transport, this mainly involves the introduction of bus priority measures, and for car traffic, optimization of traffic signal systems may have a substantial impact. The improvement of traffic flows through regulation of on-street parking, network reorganization, and improved signing and marking may contribute improved efficiency and reduced emissions. For example, the MoEnv assessed the effects on traffic of replacing roundabouts with underpasses and found the resulting reduction in emissions to be significant.

Based on international experience, bus priority measures may reduce energy consumption and emissions by around 5 percent (Gwilliam, Kojimand, and Johnson 2004), and optimization of traffic signals in urban areas may reduce energy consumption and emissions in road traffic by around 10 percent.

The current authority on road and road transport is distributed between government agencies and the municipalities. For instance, municipalities are responsible for road infrastructure development and maintenance, whereas public transport is the responsibility of the PTRC, which is a state body. This distribution may make it more complicated to develop and implement integrated transport planning, which includes issues ranging from infrastructure and traffic management to public transport provision.
Generally, with better traffic management, more efficient traffic flow, and larger shares of the passenger transport covered by public transport, energy consumption for transport is reduced. At the same time, if more capacity is available on the roads, more people tend to use their cars and thus increase car traffic. The net result of these effects can be estimated by traffic modeling, which currently is not available in Jordan and thus has not been assessed in quantitative terms.

**Promoting public transport**

Experience from other cities shows that the modal split between private cars and public transport may be affected by a number of measures, including the following:

- Improvement of the public transport (additional services, higher frequencies, public transport priority, improved service quality, improved correspondence between lines, efficient mass transit lines in main corridors, and so on)
- Restrictions and pricing of travel by private cars (parking restrictions, road/parking pricing, and so on)

To achieve significant modal shift, a comprehensive package of such measures is required. In some cities (such as Stockholm and London), a reduction in private car traffic has been achieved in the central areas of around 20 percent by a package of measures.

Several public transport rail projects have been developed. Particularly, the proposed light rail for Greater Amman Area might contribute to the transfer of passengers from car to rail. Potential is great, however, for improving the public transport. Experience from other cities shows that the development of high-quality public transport—combined with the supporting regulation—may result in a significant increase in the use of public transport. The energy consumption per passenger kilometer in public transport normally is substantially lower than in individual car traffic—typically around one-third—and cities with a high share of public transport consume substantially less energy in the transport sector. In addition, light rail or other electricity-based public transport do not contribute to the local in-street emissions and may have an important impact on urban air quality.

The GAM is preparing a master plan for the city that includes ambitious modal shifts from private cars to public transport. In April 2008,
the study team was informed of key objectives on this issue, namely, to reduce the private car share of passenger transportation from 60 percent to 25 percent and to increase public transport from 40 percent to 75 percent. Without the availability of a detailed and complex traffic model for Amman, it is not possible to assess in detail how such a modal shift could be obtained and what the effects in terms of traffic, congestion, and environmental impacts would be.

Such a major modal shift will require a strong package of measures, including strong restrictions on private car usage, to be successfully implemented. In the absence of any traffic modeling results about the master plan, the effect of attaining GAM’s targets on air emissions has been assessed through simple and indicative calculations (see table 5.15). Finally, significant emission reduction can be achieved through policies promoting public transport.

Information and awareness
Information and awareness of the air pollution from transport, and the social costs that this inflicts on Jordan, is important to ensure that the relevant actors are engaged in mitigating the problem and accept the policy actions taken by government.

Most policy measures to reduce the emissions from the transport sector will come at a cost to state governments, municipalities, industries, and households. To implement regulations and policy measures that create costs to the population or other stakeholders, it is important to ensure at least some understanding of the reason behind the policies. The effects of increased information and awareness have not been assessed. The main features of the policy options are summarized in table 5.15.

5.6 IMPACT OF POLICIES

The environmental impacts and costs and benefits related to the selected policy measures are discussed in this section and assessed in quantitative terms to the extent possible.

5.6.1 Environmental impacts of policies

The expected environmental effects of the selected policies are estimated by comparing a baseline situation in 2011–12 without any policies
### TABLE 5.15 SELECTED POLICY OPTIONS FOR REDUCING TRANSPORT SECTOR AIR POLLUTION

<table>
<thead>
<tr>
<th>Policy option</th>
<th>Implementation steps</th>
<th>Costs</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0. Improved fuel quality</strong></td>
<td>Time schedule for meeting EU fuel quality standard</td>
<td>Implementation of the planned upgrading of Jordan refinery</td>
<td>Increased costs for imported fuels, increased refinery costs</td>
</tr>
<tr>
<td><strong>1. Improved vehicle maintenance</strong></td>
<td>Establish plan and procedure for renewed auto workshop certification</td>
<td>Develop vocational training program, including curriculum for mechanics</td>
<td>Establish regular inspection procedure for control of workshop certification</td>
</tr>
<tr>
<td><strong>2. Improvement of the vehicle fleet</strong></td>
<td>Only allow import of vehicles meeting relevant EURO emission norms</td>
<td>Vehicles must meet reasonable emission standards to pass biannual inspection</td>
<td>Premium for scrapping of pre-1990 passenger cars</td>
</tr>
<tr>
<td><strong>3. Strengthen transport management and planning</strong></td>
<td>Traffic management plan for GAM for better traffic flow</td>
<td>Implementation of traffic management plan</td>
<td>Restriction on private car usage (parking and road charging)</td>
</tr>
</tbody>
</table>

Continued on next page
<table>
<thead>
<tr>
<th>Policy option</th>
<th>Implementation steps</th>
<th>Costs</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Promotion of public transport</td>
<td>Public transport plan for GAM, Assessment of present structure (service cars) Implementation of improved public transport network</td>
<td>Introduction of better quality buses and other public transport modes Purchasing and possibly subsidizing public transport equipment and usage</td>
<td>Reduced congestion and environmental costs, revenue from parking and road charges</td>
</tr>
<tr>
<td>5. Information and awareness</td>
<td>Develop a public awareness and information campaign about transport air pollution Information campaign on vehicle maintenance and pollution directed to vehicle owners and workshop Include environmental driver behavior in drivers licensing training courses</td>
<td>Costs of developing and implementing Information campaigns</td>
<td>Reduced environmental costs, improved vehicle maintenance</td>
</tr>
</tbody>
</table>

Source: Authors.
Note: GAM = Greater Amman Municipality; MoT = Ministry of Transport; — = no step.
implemented (business as usual) with the situation if the specific policy is implemented. In table 5.16, the 2006 emissions from the transport sector as estimated in this study is presented, followed by the 2011–12 baseline forecast. This time horizon has been selected because it is the time frame for the implementation of the single most important policy measure, that is, the improvement of the fuel quality.

<table>
<thead>
<tr>
<th></th>
<th>CO t/year</th>
<th>HC t/year</th>
<th>NOx t/year</th>
<th>PM t/year</th>
<th>SO2 t/year</th>
<th>Pb t/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>COWI estimate for 2006</td>
<td>160,000</td>
<td>37,950</td>
<td>62,160</td>
<td>5,450</td>
<td>24,240</td>
<td>122</td>
</tr>
<tr>
<td>No policy baseline (Business as usual)</td>
<td>224,000</td>
<td>52,080</td>
<td>85,270</td>
<td>7,380</td>
<td>32,270</td>
<td>171</td>
</tr>
<tr>
<td>Year 2011–12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0. Improved fuel quality</td>
<td>224,000</td>
<td>52,080</td>
<td>85,270</td>
<td>5,820</td>
<td>1,370</td>
<td>0</td>
</tr>
<tr>
<td>1. Improved maintenance of old vehicles</td>
<td>214,000</td>
<td>49,800</td>
<td>85,270</td>
<td>5,540</td>
<td>1,370</td>
<td>0</td>
</tr>
<tr>
<td>2. New vehicles and fuel quality comply with EU norms</td>
<td>167,000</td>
<td>37,000</td>
<td>73,900</td>
<td>4,300</td>
<td>1,000</td>
<td>0</td>
</tr>
<tr>
<td>3. Light rail Zarqa-Ammana</td>
<td>165,000</td>
<td>36,700</td>
<td>73,600</td>
<td>4,000</td>
<td>1,000</td>
<td>0</td>
</tr>
<tr>
<td>4. Promotion of public transport</td>
<td>Not assessed, see table 5.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Information and awareness</td>
<td>Not assessed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Author calculations.
Note: CO = carbon monoxide; HC = hydrocarbons; NOx = nitrogen oxides; Pb = lead; PM = particulate matter; SO2 = sulfur dioxide; — = not available.
a. Assessment of the effects of the light rail is based on CDM PDD, MoT of Jordan, 2005.

Each of the five suggested policies is presented, assuming that the preceding policy is implemented. This means that policy 2, Improved maintenance of old vehicles, is introduced after policy 1, Improved fuel quality. In this way it is possible to see the emission reductions obtained by each policy measure individually.
The emission reductions obtained by introducing the individual policies are estimated conservatively, that is, underestimating the potential emission reduction. This approach is taken because of lack of detailed information about the transport sector and to avoid overly optimistic policy assessments.

The specific assumptions used for the estimations presented in table 5.16 include the following:

- **Policy 0, Improved fuel quality**: all gasoline is assume unleaded, all diesel is assumed low sulfur (0.035 percent).
- **Policy 1, Improved maintenance**: Only the vehicles produced before 1990 are assumed to benefit from improved maintenance. In reality, younger vehicle models also might reduce emission if better maintained.
- **Policy 2, Improvement of the vehicle fleet**: Only the effect of introducing environmental requirements to newly registered vehicles is included. The possibility and the effects of speeding up fleet renewal, for example, by offering a premium to the scrapping of old vehicles is not considered.
- **Policy 3, Strengthen transport management and planning**: Only the effects of introducing a Light Rail System in Greater Amman Area (Zarqa-Amman) is included, as the specific effects of better traffic management have not been assessed.
- **Policy 4, Promotion of public transport**: Includes only a simplified assessment of the likely effects of reducing current car usage and increasing bus usage to reach 25 percent to 75 percent distribution of modes between cars and public transport.
- **Policy 5, Information and awareness**: The effects of this policy have not been assessed in quantitative terms. The importance of this measure should not be underestimated because awareness often is a precondition for acceptance and successful implementation of more specific environmental measures.

Using 2006 data, table 5.17 evaluates the likely effects of promoting public transport in Amman from the present share of 40 percent of the passenger transport to 75 percent of the passenger transport. The share of transport by private cars is reduced from 60 percent to 25 percent as indicated in Amman’s draft master plan. This is a simplified “what-if”
calculation and not an assessment of the objective or realistic phasing-in of the public transport. The modal shift will result in reduced car transport in Amman and increased bus transport. In the calculations presented in table 5.16 all new buses are assumed to meet European 2005 emission standards. Furthermore, energy consumption is reduced by two-thirds for each passenger-kilometer transferred from passenger car to public transport.

Table 5.17 indicates that significant reductions of the emissions can be obtained if a large share of the passenger transport is shifted from cars to buses, and if the quality of the new buses needed to meet the increased demand is of a high environmental quality.

Because traffic model data are not available, the specific results should be taken with caution and regarded only as indicative.

### 5.6.2 Costs and benefits of policies

The external costs associated with the emissions indicated in table 5.16 are presented in table 5.18.

The emission reductions obtained by the different policy measures will reduce the external costs caused by the emissions. The policy measures may give rise to other benefits, for instance, in the form of reduced maintenance costs for vehicles or reduced congestion in the large cities.

On the other hand, the proposed policies will have a cost side, in terms of public or private investment or operation costs.

The activities and the associated costs and benefits are briefly presented in table 5.19. To the extent that quantification of costs and benefits is outside the scope of this project, only qualitative indications are provided.
The first three policy options considered are easier to evaluate in cost-benefit terms, because they deliver much of their benefits in terms of reduction of pollutants for which monetary valuation coefficients are readily available (PM, NO\textsubscript{x}, SO\textsubscript{2}, HC). By combining the information on benefits (value of emission reduction, table 5.18) and costs (see table 5.19) of these options, it is possible to construct an abatement cost curve, which plots the cumulative cost-benefit ratio in relation to the share of baseline (no-interventions) emissions progressively eliminated.

The results of the analysis suggest (see figure 5.4) that sequential adoption of these policies can reduce about 50 percent of the social cost of air pollution that would occur in a no-intervention scenario and that

<table>
<thead>
<tr>
<th>TABLE 5.18 ESTIMATED COST OF EMISSIONS FOR DIFFERENT POLICY SCENARIOS (MILLION EUROS PER YEAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>COWI estimate for 2006</td>
</tr>
<tr>
<td>Year 2011/12</td>
</tr>
<tr>
<td>No policy baseline (Business as usual)</td>
</tr>
<tr>
<td>0. Improved fuel quality</td>
</tr>
<tr>
<td>1. Improved maintenance of old vehicles</td>
</tr>
<tr>
<td>2. New vehicles and fuel quality comply with EU norms</td>
</tr>
<tr>
<td>3. Light rail Zarqa-Amman</td>
</tr>
<tr>
<td>4. Promotion of public transport</td>
</tr>
<tr>
<td>5. Information and awareness</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations.

Note: HC = hydrocarbons; NO\textsubscript{x} = nitrogen oxides; Pb = lead; PM = particulate matter; SO\textsubscript{2} = sulfur dioxide; — = not available.
<table>
<thead>
<tr>
<th>Policy option</th>
<th>Costs, quantified</th>
<th>Other costs, not quantified</th>
<th>Benefits quantified</th>
<th>Benefits not quantified</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. Improved fuel quality (0.05% S in diesel and 0.005 g lead/l gasoline)</td>
<td>General assessment of additional costs for unleaded gasoline: 0.01–0.02 US$/l; 10–20 million JD/year fully implemented</td>
<td>General assessment of additional costs for low-sulfur diesel: 0.005–0.01 US$/l; 10–20 million JD/year fully implemented</td>
<td>Specific refinery upgrading costs in Jordan</td>
<td>Environmental benefits: JD 39–50 million per year fully implemented</td>
</tr>
<tr>
<td>1. Improved vehicle maintenance</td>
<td>Development of vocational auto workshop certification training courses and regular inspection of certified workshop: JD 0.2 million</td>
<td>Training courses: 1,500 participants a year, JD 250 (fee plus time) each: JD 0.4 million per year</td>
<td>Increased man-hours at workshop for improved service 0.5 man-hour per vehicle per year: JD 5 million per year</td>
<td>Environmental benefits by upgrading pre-1990 vehicles: JD 5.4 million per year</td>
</tr>
<tr>
<td>2. Improvement of the vehicle fleet</td>
<td>Higher purchase price for newer vehicles: Average JD 300 per imported passenger car and LDV, JD 1,000 per imported HDV: JD 18 million per year</td>
<td>Extension of the truck tax exemption statement. Premium for scrapping of pre-1990 passenger cars: State expenditure</td>
<td>Environmental benefits by importing only vehicles produced after 1997 and complying with EU norms: JD 31.7 million per year</td>
<td></td>
</tr>
</tbody>
</table>

Continued on next page


<table>
<thead>
<tr>
<th>Policy option</th>
<th>Costs, quantified</th>
<th>Other costs, not quantified</th>
<th>Benefits quantified</th>
<th>Benefits not quantified</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Strengthen transport management and planning</td>
<td>Prepare transport management plan for Amman and other large cities: JD 0.1 million</td>
<td>Prepare public transport plans for Amman and other large cities: JD 0.1 million</td>
<td>Prepare long-term infrastructure plan (road, rail, light rail): JD 0.1 million</td>
<td>Investment costs</td>
</tr>
<tr>
<td>4. Promotion of public transport</td>
<td>Purchase of new buses, operational subsidies</td>
<td>Regulation of private car usage</td>
<td>Reduced environmental costs</td>
<td>Reduced environmental costs</td>
</tr>
<tr>
<td>5. Information and awareness</td>
<td>Develop a public awareness and information campaign about transport air pollution: JD 0.1 million</td>
<td>Information campaign on vehicle maintenance and pollution directed to vehicle owners and workshop: JD 0.1 million</td>
<td>Include environmental driver behavior in drivers licensing training courses: JD 0.2 million</td>
<td>Implement campaigns:</td>
</tr>
</tbody>
</table>

Source: Authors.
they can do so in a fairly cost-effective manner (with a cost-benefit ratio well below 1).

The analysis also indicates wide margins (shaded area in figure 5.4) for additional cost-effective abatement interventions, such as fiscal incentives (fuel taxation, road charging). In the long term, these margins can be achieved through reduced demand (per capita or per unit of GDP) for polluting vehicles (LDVs and HDVs) and through modal shifts and improved logistics. These options were not analyzed further because of the lack of data on freight and passenger demand (ton-kilometers and passenger-kilometers), which represent a serious hindrance to the design and evaluation of transport policies, as well as for air quality management.

5.7 RECOMMENDATIONS

Based on the findings of this chapter’s analysis, the following key recommendations are in order:

» Improve information and data to allow better assessment of transport activities and transport emissions, particularly by
implementing monitoring and counting of traffic in key transport corridors and areas,
• developing new emission factors for Jordan vehicle fleet or assess existing emission factors for applicability to Jordan, and
• developing new valuation factors for emissions from Jordan’s transport sector or assessing existing valuation factors from other countries for their applicability to Jordan.

Focus pollution abatement efforts on the components of the vehicular fleet (LDV, HDV, and minibus) that are likely to contribute the most to core pollutants (PM, NOx, SO2).

Implement the five policies discussed in this chapter to achieve significant emission reductions. Most important, accelerate the phase-out of “dirty diesel.”

Increase awareness and information about transport sector air pollution: even though the benefits of these actions are not estimated, they likely are an essential precondition for other policy measures to mitigate transport sector air pollution.

Consider the environmental benefits that often go along with the benefits of reduced congestion and faster transport. These benefits play at least as important a role. It is outside the scope of this chapter study to assess these benefits, but experience shows that the largest benefits obtained by measures that increase transport sector efficiency through better public transport and better traffic management are reduced congestion and saved travel time. Reduced numbers of accidents can contribute significantly to the benefits of such measures.

Improve coordination between public authorities involved in the transport sector to help efficient transport planning and implementation of plans. Because more authorities are involved, cooperation is needed to ensure that plans are established within the relevant organizations, that these plans are implemented, and that continuity is provided.

NOTES
1 Information provided by the Drivers and Vehicles Licensing Directorate 2007.
2 Approximately 200–250 newly imported vehicles are registered daily, whereas only 15 vehicles are cancelled (Drivers and Vehicles Licensing Directorate 2007).
3 The German emission factors have zero emission for PM for gasoline cars. There are large uncertainties on PM emission from gasoline cars, but generally low or no emis-
sion factors are assumed. This may underestimate the real emissions of PM in Jordan, in view of the age of the present fleet.

Emissions may be exaggerated if vehicles produced after 1990 have better environmental performance even without being equipped with catalytic converters, and for diesel vehicles, even when using low-quality diesel.

Monetization is likely to rely on transferred estimates adjusted by use of PPP (see Gwilliam, Kojimand, and Johnson 2004, 159).

EVA, a nonlinear Eulerian approach for health-cost externalities of air pollution (Andersen et al. 2007, 18).

For example, a well-known EU study undertaken in the context of the Clean Air for Europe (CAFE) program (which focuses on air emissions in general, not only from the transport sector), provides a different set of coefficients. See http://ec.europa.eu/environment/air/cafe/activities/pdf/cafe_cba_externalities.pdf.

Table 5.11 transfers European values to Jordan taking into account differences in per capita GDP, but not differences in PPP.

Another option that could be considered is the use of compressed natural gas for transport. This normally will result in lower emission of most pollutants, including NOx, CO, CO2, and PM, whereas HC emission is likely to be at the same level or even higher than for diesel and gasoline vehicles. Due to data constraints, this opportunity is not assessed here.
6.1 SUMMARY AND KEY MESSAGES

Because of its current importance to Jordan’s economy (more than 22 percent of GDP), its fast rate of annual growth (12 percent in recent years), and the lack of an adequate regulatory and enforcement framework, the industrial sector is an important source of environmental pressure in Jordan, and is likely to become more so in the future, especially if the full implementation of trade agreements results in an increase of foreign demand for Jordanian industrial products.

Poor or not accessible monitoring data on polluting emissions makes it difficult to evaluate priorities for pollution abatement across sectors, locations, pollutant types, and enterprise size. To overcome this obstacle and provide policy makers with broad indications for action, this chapter proposes to apply international emission coefficients (obtained from the World Bank’s Industrial Pollution Protection System; see Hettige et al. 1995) to estimate the structure of industry’s pollution. The results are subject to the limitations of the methodology and to some data classification issues, but they are in line with the limited empirical evidence available. The following key findings should be used as first indications of areas of policy interest, but they should be revisited on the basis of Jordan-specific industrial emission data as soon as they become available:

1. The **bulk of pollution** originates from enterprises located in the Amman and Zarqa industrial districts; the relatively lower share of
total pollution in Irbid and Zarqa is associated with advanced forms of localized environmental degradation, which is no less important than Amman’s.

2. At the national level, most of the pollution comes from (larger) industrial enterprises (70 to 90 percent depending on the pollutant), but in Irbid, and particularly Zarqa, microenterprises are an important source of pollution, accounting for up to 60 percent of some emissions (for example, BOD, in Zarqa).

3. At the national level, the chemical, medical, and engineering and electrical sectors account for the larger contributions to most polluting emissions. The sector ranking, however, is different when specific pollutant types are considered. In particular, the food supply sector is estimated to be the top air and water polluter; the engineering and electrical sector has the largest share of heavy metal pollution; and the leather and garment sector is the top contributor to toxic emissions (particularly water). For virtually all pollutants, the “cleanest” sector is the packing and paper sector.

4. Pollution shares of industrial subsectors vary by location. The ranking of polluting industries per medium in Amman and Zarqa is similar to that at the national level. For Irbid, however, the ranking is different: leather is the most polluting industry of air and air toxics and a relatively important contributor to water pollution (BOD). This suggests that efforts to abate pollution should be site specific and take into account local conditions.

5. Mining is important in terms of air pollution. Because it is remotely located with respect to urban areas, it is difficult to determine its importance in terms of health impacts.

6. Projections of environmental pressures for 2012 and 2017 indicate that top four polluting industries will remain the same (chemical, medical, engineering and electrical, and construction sectors). Some of the lower rankings may change, however, with the plastic and rubber sector poised to become a more important polluter by 2017.

7. Because of large variations across sectors in unit abatement costs and relative contribution to total emissions, the cost of abatement policies is likely to be sensitive to the selection of target sectors. As an example, it is estimated that the cost of reaching a given abatement target for all pollutants (for example, 50 percent or better) can vary
by a factor of up to 3.5, depending on whether or not the optimal combination of abatement efforts across subsectors is selected.

8. A few national abatement cost curves are estimated to further illustrate the importance of carefully targeting abatement efforts. In the case of **air pollution**, some 80 percent of total emissions can be abated by focusing on the **food, chemicals, medical, and plastic** sectors, at a cost of $4,000 per ton or less; the unit cost of achieving the remaining 20 percent is estimated to be in the range of US$8,000–14,000. For **water toxics**, priority should be given to the **leather, food, construction, and furniture** sectors, which have the lowest unit abatement cost and account for 80 percent of total emissions. The level of abatement attainable at any given unit cost varies considerably from one industrial location to the other.

**Recommendations.** The government may want to consider the following recommendations (further details, including on implementing agencies) are provided in section 6.5 and in chapter 8). In the *short term*—

- WAJ may want to revise and strengthen—using a cost-of-regulation analysis—the standard for wastewater discharged from industries (JS 202/1991), in particular with respect to TDS, heavy metals, and endocrine substances and other toxic organic materials (see chapter 4 for further details).
- WAJ and MoEnv may consider enhancing the information and knowledge base on industry’s environmental impacts by strengthening existing emission monitoring systems. MoEnv in particular could consider introducing, where absent, stack emission monitoring for air pollutants in such priority sectors as food, chemicals, and leather and garments.
- MoEnv’s inspections could be focused on priority sectors for the different types of pollutants (such as those identified in this report), rather than being primarily complaint driven.
- MoEnv could prepare and issue pollution abatement guidelines, with priority given to top polluting sectors, such as food supplies (for air and water emissions), the engineering electrical sector (for heavy metal pollution); and the leather and garment sector (for toxic emissions).
In the *medium term*, it is recommended that—

» The MoEnv lead a concerted effort toward developing for each industrial district (Amman, Zarqa, Irbid), an **air and water pollution abatement plan**, which would aim at minimizing, by adequate selection of target industries, the cost of reaching selected environmental improvement objectives.

» To meet the targets of the pollution abatement plans, the government could consider a combination of (1) positive incentives (including soft loans and technical assistance) to encourage the use of cleaner production processes; and (2) gradual phasing-in of negative incentives (pollution levy for industrial emissions exceeding a given standard) to induce firms to meet effluent-ambient standards (for example, via end-of-pipe treatment). Initially, the levy could be linked to level of activity and employment, and later—once adequate monitoring capacity is in place—to emission levels.

» Revisit and modify the current structure of fiscal and trade incentives (tariffs), to ensure that some of the most polluting industries are not favored in comparison to other, relatively “cleaner” industrial activities.

» Finally, the establishment of new industrial activities should be subject to strict licensing requirements, in line with Integrated Pollution Prevention and Control (IPPC) principles, and discouraged in existing pollution hot spots.

### 6.2 INTRODUCTION

The industrial sector is one of the main pillars of Jordan’s economy. It accounts for 15 percent of the total workforce and—with about 22.5 percent of the GDP (JCI 2007)—is also the single largest contributor to GDP, followed by finance, real estate, and businesses (18.6 percent), transport and communications (18.1 percent), governmental services sector (14 percent), and the trade, restaurants, and hotels sector (11 percent). The last three decades witnessed a remarkable growth of the industrial sector, from less than 500 registered industrial factories—mostly small, family-owned enterprises—to about 20,000 establishments. Manufacturing is the main subsector, accounting for 19 percent of GDP.
Over the last decade, industry has been one of the main engines of growth: it grew by 21.4 percent in 2000 and 25.8 percent in 2006 (MoIT 2008). This growth is primarily due to the manufacturing sub-sector, which grew by about 12 percent per year—an extremely high rate compared with other countries in the region, such as Lebanon (4 percent), Morocco (4 percent), and Egypt (3 percent) (UNIDO database 2008). This growth was strongly supported by the government’s three-track policy, including protection of manufacturing enterprises by a combination of low tariffs on inputs and high tariffs on imported final products; substantial public expenditures to build and maintain infrastructure in support of small and medium industries, such as industrial estates, roads, power, and the Port of Aqaba; and encouragement of industrial exports by promoting bilateral agreements with neighboring countries.

Industrial development has been accompanied by several problems, however. Many production processes still lack the necessary technological and technical know-how, and it is common practice to import used or written-off machinery, plants, and spare parts from Europe and Southeast Asia. Management of companies and organizations in various sectors have little recognition of the importance of clean production, energy thrift, and environmental protection and of the economy’s vulnerability to the availability of commercial energy sources. **Industrial pollution has become an area of growing public concern in Jordan, especially with respect to air emissions from** the cement industry in Fuheis and Rashadeia, the oil refinery and power generation station near Zarqa, power plants, and phosphate and potash industries in Aqaba, among others. Indirect evidence indicates that industry is one of the main contributors to overall polluting emissions; as discussed in chapter 2, industrial activities are estimated to account for some 30 percent and 20 percent of national SO₂ and TSP emissions, respectively. In addition, localized forms of severe environmental degradation (air and particularly water) are largely the result of industrial activities, as in the case of Zarqa or Irbid.

Currently, pollution monitoring is either undertaken unsystematically or not at all, limiting understanding of the magnitude of the problem. In addition, institutional enforcement of environmental regulations in industrial activities is weak, being undertaken on a complaint basis, instead of being priority based. Since further expansion of the
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The industrial sector is likely to increase pollution levels even further, it will be increasingly important to provide policy makers with information on the overall magnitude of industry’s environmental pressures and on the relative contribution of different subsectors to total pollution (at the national and local levels), and to find cost-effective pollution control options. This chapter bridges this gap by proposing a methodology to quantify the main environmental pressures from industry at the national and local levels in Jordan; providing estimates of relative contributions to pollution; and proposing ways to evaluate cost-effective options for pollution reduction. As a first-time effort to quantify the environmental pressures at national and local levels, the estimates obtained are subject to several methodological and empirical limitations. As such, they should be regarded as indicative measures of environmental pressures, and perhaps more important, as illustrations of an overall approach to policy making based on priority setting and economic reasoning. The results obtained should be further refined and validated to better inform decision making.

The remainder of the chapter starts with an overview of the industrial sector and the associated policy context (section 6.3). It then provides indicative estimates of the current and projected pollution pressures from the main industries based on the Industrial Pollution Projection System (IPPS) model and analyses the most polluting subsectors, their relative ranking, and general trends; it estimates the pollution abatement costs and discusses the most cost-effective options for pollution reduction (section 6.4). Finally, it provides some recommendations to enhance industrial pollution control and reduce environmental pollution (section 6.5). This information should help decision makers to prioritize their monitoring activities and pollution abatement efforts, and promote a more efficient allocation of resources.

6.3 OVERVIEW OF THE INDUSTRIAL SECTOR

6.3.1 Sector description
The industrial sector consists of a heterogeneous mixture of manufacturing and conversion activities, ranging from transforming raw materials into refined products such as phosphate, cement, plastics, and glass, to those with highly finished end-products, such as food processing and
chemical industries. According to the Ministry of Industry and Trade (MoIT), the industrial sector currently counts about 20,600 establishments and employs around 190,100 workers. Amman, Zarqa, and Irbid account for about 82 percent of total establishments and 91 percent of the workforce employed by industrial enterprises nationwide. In terms of number of establishments, the bulk of Jordan’s industrial sector consists of small family-owned enterprises. During 1998–2006, employment in the sector grew by about 10 percent annually, with highest peaks exceeding 20 percent in 2003 and 2004.

The industrial sector in Jordan can be classified according to the nature of activity and the size of industry (see box 6.1).

Table 6.1 provides the distribution of the main industrial subsectors in Jordan (except for mining) in terms of number of enterprises, registered capital, employment, and exports. According to the JCI (2007), the industry has about 12,800 enterprises, with a total registered capital of JD 2.2 billion and about 176,000 employees. Microenterprises generally dominate the sector (87 percent), with the Engineering, Electrical, and Information Technology (IT) having the largest representation, followed by furniture and wood, and construction. As expected, industrial enterprises dominate in all the other aspects, with Leather and Garments leading in terms of employment (31 percent) and exports value (37 percent), and Engineering, Electrical, and IT in terms of registered capital (35 percent).

Jordan Chamber of Industry (JCI) does not provide any information on the mining sector, because it is not geographically in Amman, Zarqa, or Irbid, and it is not classified according to the same size categories. Thus, this sector cannot be compared with the others according to the criteria mentioned in table 6.1.

Mining is crucial, however, when assessing the overall volume of pollution loads, and more specifically air pollutants (see box 6.2).

6.3.2 Institutions and stakeholders

This section provides a summary of the main institutions and other actors with a stake in industrial development and policy. A broader discussion of the institutional, legislative, and governance framework relevant to the environment (including the roles of the general public, NGOs, and so on) is contained in the institutional assessment chapter of the CEA (chapter 7).
In Jordan, the national classification of industrial subsectors has been determined by a decree issued by the Jordan Cabinet on August 13, 2005, to cover all industrial enterprises operating in one or more industrial activity. This classification is different from the United Nations international standard industrial classification—the International Standards for Industrial Categories (ISIC)—that provides a standard set of economic activities to classify entities according to the activity they undertake. The ISIC categorizes industries into mining, transformational industries, and power-generating industry. The Jordanian industrial classification system combined some of the ISICs based on certain similarities. The result was the following national industrial categorization system:

1. Leather and Garments
2. Therapeutics and Medical
3. Chemical and Cosmetics
4. Plastic and Rubber
5. Engineering, Electrical Industries, and Information Technology
6. Furniture and Wooden
7. Construction
8. Food, Supplies, Agricultural, and Livestock
9. Packing, Packaging, Paper, Cardboard, and Stationeries
10. Mining

The Jordan Chamber of Industry’s Law for the year 2005 adopted a formal definition of the size categories of industrial enterprises working in industry solely based on the registered capital size and the labor size. The law defines and classifies enterprises according to the following types:

- **Industrial Enterprises**: any enterprise that employs 10 or more Jordanian employees subscribed to the Social Security Corporation, and has a registered capital of JD 30,000 or more.
- **Microenterprises**: any enterprise that employs less than 10 Jordanian employees subscribed to the Social Security Corporation or has a registered capital less than JD 30,000.

A committee with representation from the public and private sectors was formed to further study this issue based on the Trade and Industry Law No. 18 for 1998, and the Chamber of Industry Law No. 10 for 2005. This committee developed size categorization criteria that are based on the registered capital size and the labor size; however, it defined two additional categories. In September 2005, the Cabinet of Ministers approved the categories summarized below (MoIT 2008):

<table>
<thead>
<tr>
<th>Type of industrial establishments</th>
<th>Labor</th>
<th>Registered Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handicrafts</td>
<td>1–9</td>
<td>less than JD 30,000</td>
</tr>
<tr>
<td>Small</td>
<td>10–49</td>
<td>more than JD 30,000</td>
</tr>
<tr>
<td>Medium</td>
<td>50–249</td>
<td>more than JD 30,000</td>
</tr>
<tr>
<td>Large</td>
<td>more than 250</td>
<td>more than JD 30,000</td>
</tr>
</tbody>
</table>

**Sources**: MoIT 2008.
### TABLE 6.1 DISTRIBUTION OF INDUSTRIAL SECTORS IN JORDAN

<table>
<thead>
<tr>
<th>Subsector</th>
<th>No. of Enterprises</th>
<th>Registered Capital (million JD)</th>
<th>No. of Employees (000)</th>
<th>Exports Value (million JD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Industrial Micro</td>
<td>All enterprises % of total</td>
<td>Industrial Micro All enterprises % of total</td>
<td>Industrial Micro All enterprises % of total</td>
</tr>
<tr>
<td>Leather and Garments</td>
<td>244 864 1108 9</td>
<td>164 11 175 8</td>
<td>55 9 64 36</td>
<td>925 37</td>
</tr>
<tr>
<td>Therapeutics and Medical</td>
<td>53 46 99 1</td>
<td>162 3 165 7</td>
<td>6 0 6 3</td>
<td>255 10</td>
</tr>
<tr>
<td>Chemical and Cosmetics</td>
<td>188 207 395 3</td>
<td>314 10 324 15</td>
<td>11 1 12 7</td>
<td>297 12</td>
</tr>
<tr>
<td>Plastic and Rubber</td>
<td>116 151 267 2</td>
<td>52 7 59 3</td>
<td>4 1 5 3</td>
<td>32 1</td>
</tr>
<tr>
<td>Engineering, Electrical</td>
<td>323 4053 4376 34</td>
<td>769 28 797 36</td>
<td>25 9 34 19</td>
<td>459 18</td>
</tr>
<tr>
<td>Industries, and IT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furniture and Wooden</td>
<td>85 2556 2641 21</td>
<td>12 26 38 2</td>
<td>4 6 10 6</td>
<td>31 1</td>
</tr>
<tr>
<td>Construction</td>
<td>152 2002 2154 17</td>
<td>165 23 188 8</td>
<td>8 7 15 8</td>
<td>52 2</td>
</tr>
<tr>
<td>Food, Supplies, Agricultural,</td>
<td>334 798 1132 9</td>
<td>338 17 355 16</td>
<td>15 3 18 10</td>
<td>333 13</td>
</tr>
<tr>
<td>and Livestock</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packing, Packaging, Paper,</td>
<td>185 430 615 5</td>
<td>110 12 122 5</td>
<td>9 2 11 6</td>
<td>148 6</td>
</tr>
<tr>
<td>Cardboard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,680 11,107 12,787 100</td>
<td>2,088 136 2,224 100</td>
<td>137 38 176 100</td>
<td>2,531 100</td>
</tr>
</tbody>
</table>

**Source:** JCI 2007.

**Note:**
- a. JCI study did not provide details on the mining sector.
- b. Includes both Jordanian and non-Jordanian workforce.
Mining and quarrying contribute about 3.3 percent of GDP (year 2005). Mining is based on extraction of vast reserves of raw phosphates and potash and, more recently, on their semi-processing. Jordan’s main exports are mineral-based resources and their derivatives, such as fertilizers, bromine, and magnesia. They generate more than 30 percent of total export earnings. Exports of phosphates, potash, fertilizers, and related products amounted to $412 million in 2001. With production in 2001 of some 5.9 million tons, Jordan is the world’s third-largest supplier of raw phosphates.

Phosphate mining is controlled by a joint stock monopoly, the Jordan Phosphate Mines Company (JPMC), established in 1935. Production of rock phosphates averages about 3.7 million tons per year. Known reserves are adequate for decades of production at current or even higher levels. The phosphate export earnings of JPMC in 2001 reached $189 million. JPMC also achieved some success in developing downstream activities, such as fertilizer production. The Arab Potash Company (APC) has grown steadily since its inception in 1956, boosting its basic potash production (2 million tons in 2001), expanding its downstream activities and foreign exchange earnings ($192 million in 2001). Both as APC and through its holding company, Jordan Dead Sea Industries Company (JODICO), the company is developing fertilizers and chemical projects.

The mining sector is not geographically located in Amman, Zarqa, or Irbid and so could not be compared with the other sectors in terms of water, toxics, and metals pollution. The sector appears to be important in terms of air pollution. Using the IPPS methodology, the analysis estimated mining’s contribution to air pollution in terms of TSP, PM$_{10}$, CO, NO$_x$, SO$_2$, and volatile organic compounds (VOC) (see table 6.2). Mining appears to be the major polluter in terms of TSP, SO$_2$ and NO$_x$, and PM$_{10}$.

Mining is remotely located from major residential centers or human activities. Thus, it is difficult to determine how much the sector’s contribution to air pollution affects urban centers. Mining centers located relatively close to urban centers include Nippon Jordan Fertilisers Company (NJFC) in Aqaba, the Eshidiya mines (125 km northeast of Aqaba) and the Jordan Phosphate Complex (15 km south of Aqaba). Available data on employment by mine indicate that Eshidiya mines alone employ about 1,250 people, accounting for about 12.5 percent of total employment in mining at national level. On a proportional basis, it is possible to attribute a similar share of the total air pollution from mining as affecting the urban centers.

**TABLE 6.2 MINING’S RELATIVE CONTRIBUTION TO AIR POLLUTION COMPARED WITH OTHER SECTORS**

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Mining</th>
<th>Other sectors*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSP</td>
<td>65%</td>
<td>35%</td>
<td>100%</td>
</tr>
<tr>
<td>CO</td>
<td>2%</td>
<td>98%</td>
<td>100%</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>50%</td>
<td>50%</td>
<td>100%</td>
</tr>
<tr>
<td>NO$_x$</td>
<td>51%</td>
<td>49%</td>
<td>100%</td>
</tr>
<tr>
<td>VOC</td>
<td>3%</td>
<td>97%</td>
<td>100%</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>78%</td>
<td>22%</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Including Leather and Garments; Therapeutics and Medical; Chemical and Cosmetics; Plastic and Rubber; Engineering, Electrical Industries, and IT; Furniture and Wood; Construction; Food, Supplies, Agriculture, and Livestock; Packaging and Paper. 

**Source:** Authors’ calculations.
Ministry of Environment
The MoEnv has different departments in charge of inspection, legislations, policies, licensing, and permitting. Of main relevance to Industrial Pollution Control are the Directorates of Policy and Development, the Directorate of Monitoring and Assessment, the Directorate of Management of Waste and Hazardous Substances, the Directorate of Licensing and Guidance, and the Directorate of Inspections and Control.

The Cleaner Production and Best Available Technologies Unit, affiliated to the Licensing and Guidance Directorate is mandated to coordinate with the various directorates. This coordination supports licensing and permitting based on better technologies according to international practices resulting from applied research conducted by a variety of organizations. The department is responsible for verifying that permit applications contain proposed guidelines for the utilization of water, power, and other natural resources, including the proposed techniques to reduce waste generation and disposal, and prepare and avail documents related to cleaner production and the best available technologies from the relevant sources such as the EU, best available technique reference documents (BREF), United Nations Industrial Development Organization (UNIDO), U.S. Environmental Protection Agency (USEPA), and other. This unit represents the ministry on the management board of the Cleaner Production Program.

The Licensing and Guidance, Inspection, and Control and Monitoring and Assessment Directorates were established only recently based on the recommendations of the EU-Funded Institutional Support to the Ministry of Environment on Environmental Management and Legislation Project. They do not have the capacity or the necessary resources to function properly and play the role for which they were established.

Ministry of Industry and Trade
According to Government of Jordan’s law number 18 for 1998, the ministry takes on the responsibilities of regulating the industry by type, classifying it, registering it according to an internal regulation, and preparing the programs and studies that work on developing the industry and increasing its competitiveness. The ministry also regulates the internal and external trade, monitoring it and preparing the studies and the agreements that protect the interest of the country and the citizen.
The Industrial Development Directorate of the Ministry has no environmental responsibilities per se; however, it does set the industrial policy in terms of growth and development, which has a direct impact on industrial pollution.

_**Jordan Industrial Estates Corporation**_

The Jordan Industrial Estates Corporation (JIEC) is a quasi-governmental corporation established in 1984 with public and private ownership. Its role is to contribute to the development of small and medium industries (SMIs) by providing comprehensive and integrated industrial estates, to increase support and encourage the sector, and to increase investment opportunities in industry. One of its main goals is to promote Jordan’s industrial development by providing a suitable home for both local and foreign industries. JIEC owns and manages five industrial estates.

Given their pollution monitoring capacity, it is vital that the MoEnv better coordinate data management with the JIEC. It is evident that current coordination between the two entities is minimal. The Sampling and Analysis Section at the ministry could benefit significantly from the data available at the JIEC, and both entities could cooperate in formulating actions for industrial pollution control given the technical capacity that is available at the ministry.

_**Jordan Enterprise Development Corporation**_

Jordan Enterprise Development Corporation (JEDCO) was established by a decree of the council of ministers in 2003 to legally replace the Jordan Export Development and Commercial Centers Corporation. The overall goals of JEDCO are trade promotion, export development, and enterprises and companies development.

_**Jordan Investment Board**_

The Investment Laws of 2003 and Investment Promotion Law of 1995 established the Jordan Investment Board as a financially and administratively independent government body. The creation of this organization was the result of the government’s realization of the importance of increasing foreign direct investment to Jordan, and enhancing local investment in a bid to create new job opportunities, increase national exports, and address the need for the transfer of technology.
Industry Sector NGOs

The key nongovernmental players in the industrial sector are the various Chambers of Industry, namely the Jordan, Amman, Zarqa, and Irbid Chambers of Industry. In general, the Chambers of Industry are concerned with the sector from a private sector and investment context. Of all the chambers in Jordan, only one has referenced environmental issues in its mission statement. Being a key player in the sector, environment has to be given a more significant weight in the chambers’ roles and responsibilities and in terms of providing support to the MoEnv. The significance of the various chambers is that they could be an effective tool in the implementation of any industrial pollution control mechanism or policy to be adopted by the ministry. They can be viewed as the link between the government bodies and the industries, and they should be effectively utilized in the implementation of any national plans for pollution control.

Jordanian Association of Manufacturers of Pharmaceuticals and Medical Appliances

The Jordanian Association of Manufacturers of Pharmaceuticals and Medical Appliances (JAPM) was established in 1996 as a dedicated sector-specific association and is the representative body of the unanimity of manufacturers of pharmaceuticals and medical appliances, which is one of the key sectors of the Jordanian economy. JAPM is a voluntary nonprofit association that has a member base of almost all pharmaceutical companies in Jordan. The Jordanian pharmaceutical industry, which is primarily an export-driven industry, provides quality, safe, and effective pharmaceuticals at affordable prices for millions of people worldwide.

Jordan Furniture Exporters and Manufacturers Association

Jordan Furniture Exporters and Manufacturers Association (JFEMA) is a nonprofit association established with the core purpose of being the sole representative of the Jordanian furniture exporters and manufacturers on the local, regional, and international levels by delivering a wide spectrum of needed services, including the following: sector promotion and marketing, export readiness consultation, networking, workforce training, and maintaining information systems.
Jordan Investors Association of Amman Industrial Estate

Jordan Investors Association of Amman Industrial Estate was established as a private, independent nonprofit organization whose aim is to expand, support, and encourage economic, industrial, and investment opportunities at the industrial city, Sahab, and at other industrial cities.

6.3.3 National Agenda and policy context

The National Agenda (NA) outlines the government vision for Jordan’s economic development in the next decade. The NA’s first phase (2007–12) focuses on creating employment opportunities by promoting export-oriented and labor-intensive industries, education, infrastructure, and legislation regulating political life. The second phase (2012–17) focuses on gradually upgrading and strengthening the industrial base, and preparing the ground for the development of high value added sectors in the knowledge economy. The NA proposes target performance indicators for the development of the following subsectors: apparel, pharmaceuticals, minerals, iron and steel, furniture, food and beverage, tourism, health care, and IT services.

Overall, figure 6.1 suggests that 2017 will witness a sharp rise in the industrial sector output (2 times compared to the current situation), export value (2.8 times) and cumulative employment (1.5 times). Most of the increase in the sector output and exports are due to the development of the apparel subsector, while the surge in employment is mostly a result of apparel and tourism. In fact, while employment in most subsectors is increasing, it is declining in minerals and stagnating in iron and steel.

The National Industrial Policy (NIP), currently being prepared by the MoIT, aims at boosting the competitiveness of the industrial sector locally and internationally. The NIP goals are as follows:

- Develop the industrial sector by 7–9 percent annually, during the period 2008–12
- Increase the volume of exports by 10 percent
- Increase employment opportunities available in the sector by 8 percent annually

The NIP includes 11 axes meant to represent an integrated system of policies leading to a more sustainable economic development. One of
these axes specifically lays down a general environmental policy, aiming at the following:

» Preserving the environment
» Contributing to achieving sustainable development
» Urging industrial institutions to abide by environmental legislations, measures, and standards
» Adopting environment-friendly practices and policies
» Offering financial and technical support for these enterprises to implement the programs that would improve its environmental performance

The proposed mechanisms to achieve these objectives include (1) providing technical support in treating water and industrial waste, (2) providing the necessary legislative and institutional framework to benefit from the environment fund yet to be established, (3) laying down policies and legislations that enable the private sector to develop and implement programs and techniques to protect and improve the environment, (4) encouraging the establishment of clean development projects, (5) pro-
moting national industries’ competitiveness by adopting environmental practices and policies, (6) activating the role of the industrial sector in the national and environment trade committee, and (7) enhancing the participation of the industrial sector in various technical committees. No specific targets of improved environmental performance have been set by the proposed policy, and no institutional responsibilities have been defined.

**Trade Policy.** Jordan is a relatively high trade-protected country, compared with the average low-middle-income countries. Its average tariff level in the period 2000–07 was lower than in the rest of the MENA region (see figure 6.2); the average tariff on manufacturing has been more than two and half times and more than three times larger than the low-middle-income average in Jordan and in MENA, respectively. The manufacturing sector has enjoyed higher levels of protection than Jordan’s economy as a whole, with an unweighted average of 17 percent compared with 10 percent.

Manufacturing tariffs have been significantly higher (see figure 6.3) than the average in Jordan and in low-middle-income countries, in gen-

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**FIGURE 6.2 AVERAGE MFN IMPORT TARIFFS IN THE PERIOD 2000–07 (WORLD AVERAGE=100)**

![Average MFN Import Tariffs](chart.png)

**Source:** Calculation on Most Favored Nation (MFN) tariff data from UNCTAD 2008

**Note:** MENA = Middle East and North Africa.
eral, in sectors that account for two-thirds of Jordan’s manufacturing employment and exports (such as leather and garment, electrical products, and food), and probably for a large share of polluting emissions as well (see the estimates contained in section 6.4).

**FIGURE 6.3 AVERAGE MFN IMPORT TARIFFS IN JORDAN BY SECTOR IN THE PERIOD 2000–07**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Average MFN Import Tariffs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco products</td>
<td></td>
</tr>
<tr>
<td>Tanning and dressing of leather; tanning</td>
<td></td>
</tr>
<tr>
<td>Wearing apparel; dressing and dyeing</td>
<td></td>
</tr>
<tr>
<td>Furniture; manufacturing N.E.C.</td>
<td></td>
</tr>
<tr>
<td>Other non-metallic mineral products</td>
<td></td>
</tr>
<tr>
<td>Coke, refined petroleum products and coal</td>
<td></td>
</tr>
<tr>
<td>Fabricated metal products, except machinery</td>
<td></td>
</tr>
<tr>
<td>Electrical machinery and apparatus</td>
<td></td>
</tr>
<tr>
<td>Motor vehicles, trailers and semi-trailers</td>
<td></td>
</tr>
<tr>
<td>Rubber and plastics products</td>
<td></td>
</tr>
<tr>
<td>Food products and beverages</td>
<td></td>
</tr>
<tr>
<td>Paper and paper products</td>
<td></td>
</tr>
<tr>
<td>Radio, television and communication</td>
<td></td>
</tr>
<tr>
<td>Textiles</td>
<td></td>
</tr>
<tr>
<td>Machinery and equipment N.E.C.</td>
<td></td>
</tr>
<tr>
<td>Other transport equipment</td>
<td></td>
</tr>
<tr>
<td>Basic metals</td>
<td></td>
</tr>
<tr>
<td>Publishing, printing and reproduction of recorded</td>
<td></td>
</tr>
<tr>
<td>Wood and of products of wood and cork</td>
<td></td>
</tr>
<tr>
<td>Chemicals and chemical products</td>
<td></td>
</tr>
<tr>
<td>Medical, precision and optical inst</td>
<td></td>
</tr>
<tr>
<td>Office, accounting and computing machinery</td>
<td></td>
</tr>
</tbody>
</table>

As part of the government’s economic openness policy, the situation is poised to change. Jordan signed several trade agreements, including the Great Arab Free Trade Agreement (GAFTA), the Agreement on the Establishment of Qualifying Industrial Zones in Jordan, and the U.S.-Jordan Free Trade Zone Agreement. In spite of differences among these agreements, they all aim to establish free trade zones, reduce customs to the lowest levels, and broaden the scope of trade.

Implementation thus far appears to have been slow, but these agreements will create a new climate for the Jordanian industrial sector and will place it in a free competitive environment. Signing these agreements can be considered a success, but also will pose a number of challenges to establish the appropriate legislative environment, provide the sector with the necessary technical and financial support to restructure itself and face international competition, and enhance the sector’s environmental performance.

6.4 ESTIMATING INDUSTRY’S ENVIRONMENTAL PRESSURES

6.4.1 Methodology
Quantifying the pollutant loads from industry presented several problems. First, no complete list of pollutants emitted in Jordan is available. Therefore, this chapter estimates the pollution load for a selected group of air, water, and land pollutants for which sufficient information is available. Second, pollution monitoring is not carried out on a systematic and comprehensive basis. For example, except for the wastewater quality data taken by the WAJ and JIEC, available information is based on surveys rather than comprehensive field measurements. Third, monitoring equipment either is not available or obsolete and trained personnel on industrial sites is usually lacking. Fourth, the air quality data reported by the RSS and the MoH are ambient air measurements and not stack emissions. Although such readings can give indications of pollution in areas close to industries compared with more distant areas, they cannot be attributed to industry alone, as they represent the cumulative result of emissions from all sectors (for example, industry, transport, and so on).

Given the lack of a complete set of actual pollution measurements, this chapter uses the IPPS developed by the World Bank (Hettige et al. 1995)
to provide insights on relative priorities for pollution abatement. IPPS is a rapid assessment tool for estimating pollution loads to develop appropriate policies for industrial pollution control. The IPPS estimates and rankings provide the relative contribution of the industrial subsectors to the overall volume of pollution per medium (for example, air, water, land).

The IPPS model combines data from industrial activity (such as production and employment) with information on pollution emissions to calculate pollution intensity coefficients per unit of industrial activity. We apply this model to project the evolution of pollutant loads for 2012 and 2017, based on the estimated employment growth during these periods. The IPPS coefficients are available for the following pollutants:

- **Air pollutants.** SO$_2$, NO$_2$, volatile organic compounds (VOC), and particulate matter, both TSP and PM$_{10}$
- **Water pollutants.** BOD and TSS
- **Toxic substances:** released in air, water, and land
- **Heavy metals:** released in air, water, and land

To estimate the pollution load for each industrial subsector, this chapter uses employment data and the Lower Bound (LB) pollution intensities by medium, after merging the intensities of the major categories according to the ISIC code, to conform to the 10 major sectors in Jordan. An aggregated pollution load for air was estimated through a weighted average of four pollutants only, with weights reflecting relative contribution to health damages and other externalities, and obtained from the European Commission’s Clean Air for Europe (CAFE) Program—that is, SO$_2$ (with a weight of 16 percent), NO$_2$ (14 percent), VOC (2 percent), and PM$_{10}$ (68 percent). The aggregated pollution intensities were then used to estimate pollution loads using the formula:

$$PL = \frac{PI \times TEM}{1000 \times 2204.6}$$

where

- PL = Pollution load in tons/year
- TEM = Total number of employees
- PI = Pollution intensity in pounds per thousands employees per year
- 2204.6 = Conversion factor from pounds to tons
6.4.2 Classification challenges

Figure 6.4 shows the geographic distribution of polluting industries in Jordan. The quantification process was subject not only to data scarcity problems, but also to classification discrepancies. First, because the JCI categories do not include the power generation and the water and wastewater treatment plants, these subsectors were not included in the analysis. Because several power stations (such as Al-Hussein Thermal Power Station, Rihab, and Samra) are located in Zarqa, the estimates tend to underestimate the real pollution pressure in this region.

**FIGURE 6.4 GEOGRAPHIC DISTRIBUTION OF POLLUTING INDUSTRIES**

Sources: Map is prepared by the World Bank, location of polluting industries; authors.
The second problem is that some of the larger industries (for example, the Jordan Petroleum Refinery, Intermediate Petrochemical Industries, and others) are located in Zarqa but registered in the Amman Chamber of Industry. Ideally, the analysis should attribute their pollution to their actual location. This was possible only for some of these industries, however. Some large industries—such as the potash and the phosphate industries—could be removed from Amman estimates but could not be added anywhere else because of the lack of specific information. This resulted in underestimating pollution loads in areas where these industries are located.

Third, the JCI classification system for industries includes the refining sector as part of the chemicals and cosmetics sectors. To better understand the role of the refining sector, the IPPS was rerun after separating “petroleum refineries” (ISIC code 353) from “chemicals industries” (ISIC code 352). The estimated pollution load produced from the refineries was then added to the pollution loads in Zarqa area.

Fourth, for the reasons indicated in box 6.2, emissions from mining were estimated separately, and they are not included in these results. This should not be interpreted as implying that emissions from mining are unimportant (in fact, in the case of air pollution, they account for the bulk of it), but rather that on account of most mining plants’ remote location, they are unlikely to be part of priority-setting problems in the industrial hot spots of Amman, Zarqa, or Irbid.

### 6.4.3 Results: the estimated composition of industrial pollution

Table 6.3 presents the estimates of the relative contribution of each sector to pollution, by location and medium. These results analyze the structure of industrial pollution in a number of different ways and answer the following questions.

**What are the industrial locations that contribute the most to pollution?**

Enterprises located in Amman contribute the most to pollution (the unweighted average is 77 percent); Zarqa ranks second, and Irbid ranks third (see figure 6.5). This confirms that several highly polluting industries concentrate in Zarqa, resulting in shares of total emissions that are higher than the corresponding employment share. This result holds particularly true in the case of heavy metal emissions in air and land; and in general
in an unweighted average share of emission of 14 percent, compared with 9 percent of Irbid, in spite of the fact that the latter has a larger share in employment (about 17 percent against 13 percent of Zarqa).

The methodology used provides estimates of pollution *emissions* and not *concentrations*. Hence, the relatively smaller share of total pollution attributed to Zarqa and Irbid does not imply a lower priority for pollution control action in these areas. In fact, in these locations, environmental degradation is particularly serious in some situations that are linked to higher concentration of pollutants in air, water, or land, and that demand immediate policy attention.
<table>
<thead>
<tr>
<th>Region</th>
<th>Sectors</th>
<th>Water</th>
<th>Toxics</th>
<th>Metals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Air</td>
<td>BOD</td>
<td>TSS</td>
</tr>
<tr>
<td>Amman</td>
<td>Leather and Garments Industry</td>
<td>13%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Therapeutics and Medical Sector</td>
<td>14%</td>
<td>1%</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>Chemical and Cosmetics Sector</td>
<td>25%</td>
<td>2%</td>
<td>46%</td>
</tr>
<tr>
<td></td>
<td>Plastic and Rubber Sector</td>
<td>10%</td>
<td>1%</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td>Engineering, Electrical Industries, and</td>
<td>6%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Information Technology Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Furniture and Wooden Sector</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Construction Sector</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Food, Supplies, Agricultural, and</td>
<td>28%</td>
<td>92%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>Livestock Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Packing, Packaging, Paper, Cardboard, and</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Stationeries Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Region</td>
<td>Sectors</td>
<td>All Enterprises</td>
<td>Water</td>
<td>Toxics</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------</td>
<td>-----------------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>Zarqa</td>
<td>Leather and Garments Industry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>21% Air 4% BOD 1% TSS 14% Air 49% Water 8% Land 0% 0% 0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Therapeutics and Medical Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6% Air 1% BOD 11% TSS 5% Air 3% Water 6% Land 2% 5% 1%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical and Cosmetics Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>29% Air 3% BOD 57% TSS 29% Air 16% Water 33% Land 9% 25% 5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plastic and Rubber Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11% Air 1% BOD 22% TSS 11% Air 6% Water 12% Land 5% 9% 3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engineering, Electrical Industries, and Information Technology Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7% Air 2% BOD 1% TSS 17% Air 3% Water 17% Land 33% 11% 36%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Furniture and Wooden Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0% Air 0% BOD 0% TSS 1% Air 0% Water 0% Land 3% 0% 0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4% Air 1% BOD 5% TSS 18% Air 18% Water 20% Land 49% 48% 54%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Food, Supplies, Agricultural, and Livestock Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>21% Air 88% BOD 4% TSS 1% Air 5% Water 3% Land 0% 2% 0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Packing, Packaging, Paper, Cardboard, and Stationeries Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0% Air 0% BOD 0% TSS 3% Air 0% Water 0% Land 0% 0% 0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
### Table 6.3 Estimated Distribution of Pollution Pressures from Industrial Subsectors (continued)

<table>
<thead>
<tr>
<th>Region</th>
<th>Sectors</th>
<th>Air</th>
<th>BOD</th>
<th>TSS</th>
<th>Air</th>
<th>Water</th>
<th>Land</th>
<th>Air</th>
<th>Water</th>
<th>Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irbid</td>
<td>Leather and Garments Industry</td>
<td>73%</td>
<td>43%</td>
<td>10%</td>
<td>60%</td>
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<td>Cardboard, and Stationeries Sector</td>
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</tbody>
</table>

Source: Percentages calculated based on IPSS model.

Note: BOD = biological oxygen demand; TSS = total suspended solids.

a. Estimates of air pollution shares refer to a weighted average of four polluting emissions (PM	extsubscript{10}, VOC, NO	extsubscript{2}, SO	extsubscript{2}), using weights obtained from the EU Clean Air for Europe (CAFE) program.
What segments of the industrial sector contribute the most to pollution? Industrial enterprises account for the bulk of polluting emissions, ranging from 70 to 90 percent of the total, depending on the type of pollutant (see figure 6.6). This is not surprising, because they account for almost 80 percent of employment. In the case of heavy metal emissions into air and land, microenterprises account for some 30 percent of the total, which is considerably larger than their share in total employment.

**FIGURE 6.6 SHARE IN TOTAL EMISSIONS BY POLLUTANT TYPE AND SIZE OF ENTERPRISES**

![Figure 6.6](image_url)  
*Source: Authors’ calculations.  
Note: BOD = biological oxygen demand; TSS = total suspended solids.*

Does the contribution to pollution of micro enterprises vary across locations? At the national level microenterprises contribute relatively little to pollution (the unweighted average of shares across pollutant is less than 20 percent). In Zarqa, they play a much more important role, with an unweighted average close to 40 percent, and a significantly larger share (compared with the national average) of emissions of BOD, toxic pollutants in water, and ordinary air pollutants (see figure 6.7).
The larger role played by Zarqa's microenterprises in pollution is clearly linked to differences in its industrial structure, in which microenterprises generally account for more than 50 percent of total employment (the national average is about 20 percent); in the case of water toxic emissions, microenterprises in the top emitting sector (leather and garment) account for 40 percent of total emissions, compared with 10 percent at the national level (see figure 6.8).

**What are the sectors that contribute the most to pollution?**

The sectors that contribute most to pollution depend on the type of polluting emission being considered: different sectors will be the most significant contributors to air, water, or land pollution. Preliminary information on the overall environmental pressures exerted by different subsectors can be obtained by constructing a simple ranking index, normalized to vary between zero and one, which measures the frequency
of high-polluting rankings in the score of each subsector. The closer the index is to one, the higher the number of times a given subsector is among the top polluters for all media (air, water, land, and so on); the closer the index is to zero, the lower the number of times that the subsector is a significant polluter for the different media. Such an indicator can provide information on the overall polluting ranking of subsectors, but not on how much any subsector is more polluting than another (see figure 6.9).

Figure 6.9 illustrates the results of estimating such an overall ranking index. The chemicals, therapeutics, and engineering sectors tend to
have high polluting ranking across the different media; conversely, the food, furniture, and paper subsectors tend to have relatively lower pollution rankings in the different media.

In terms of contributions to the different media, figure 6.10 suggests that the food and chemical sectors are the top air and water polluters (accounting for some 50 percent and 75 percent of the total, respectively), that engineering and construction are the top emitters of heavy metals in the different media (with an unweighted average of more than 60 percent of the total); and that the leather, chemical, and therapeutic sectors are the most important contributors to toxic emissions (with an unweighted average of more than 60 percent of the total). Packing and packaging appear to be the cleanest industries across all media.
FIGURE 6.10 SHARE OF EMISSIONS FOR SELECTED GROUPING OF POLLUTANTS

Air

Heavy Metals

Continued on next page
FIGURE 6.10 SHARE OF EMISSIONS FOR SELECTED GROUPING OF POLLUTANTS

Water

Toxics

**Source:** Based on authors’ calculations.

**Note:** The charts present a weighted average of sector contributions to air emissions (see table 6.3 for details) and unweighted averages of contributions to toxic emissions (into air, land, and water), water pollutants (BOD, TSS), and heavy metals emissions (into air, land, and water).
Does the relative contribution to emissions of sectors vary across locations? By analyzing the differences in relation to the national average of pollution shares of the different subsectors (see figure 6.11), Irbid has a significantly different composition of pollution emissions compared with Zarqa and Amman. The standard deviation of emission shares across sectors (in regard to the national average) is particularly high in the case of air emissions, BOD, and toxic emissions (into air, land, and water).

![Figure 6.11: Standard Deviation of Pollution Shares by Pollutant and Location](image)

*Source: Based on authors’ calculations.*

In the case of air emissions (see Figure 6.12), most of the difference is explained by the much larger share (more than 70 percent compared with a national average of 20 percent) of emissions attributable to the leather and garment subsector.
Will the relative contribution of sectors to polluting emissions vary over time?

Table 6.4 presents the projected environmental pressures, based on the employment growth rates planned by the NA for 2007–12 and 2012–17. For the sectors for which the NA did not specify any figures, the average employment growth rate of the industrial sector as a whole was taken: 14.2 percent for the first period and 4.9 percent for the second period.

By applying the same aggregate ranking index to the projected evolution of polluting emissions, one can obtain information about the change in overall relative pollution importance of the different subsectors. Figure 6.13 suggests that the four top-ranking polluting subsectors will not change, which throughout 2017 will continue to be chemicals, therapeutics, engineering, and construction sectors.
### TABLE 6.4 INDUSTRY RANKING IN TERMS OF PERCENT OF POLLUTION AT NATIONAL LEVEL

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<tr>
<td>Engineering, Electrical, IT</td>
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<td>Furniture and Wood</td>
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<tr>
<td>Construction</td>
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<tr>
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TABLE 6.4  INDUSTRY RANKING IN TERMS OF PERCENT OF POLLUTION AT NATIONAL LEVEL (continued)

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</tbody>
</table>

Source: Authors’ calculations based on National Agenda (Government of Jordan 2005).
Note: BOD = biological oxygen demand; TSS = total suspended solids.
To validate the IPPS analysis, the IPPS estimates for BOD loads were compared with the measurements made by the JIEC of BOD loads at its WWTPs. JIEC has a biological water treatment plant (activated-sludge) in each estate to treat and reuse water in restricted agriculture (see table 6.5). The total biological load per day is approximately 2 tons per day, or about 720 tons per year, most of which is due to the high concentration of food enterprises. Given that the 47 enterprises employ about 5,000 people, this is equivalent to about 0.14 tons per employee. The IPPS methodology applied to the Food, Supplies, Agricultural, and Livestock Sector resulted in an estimated 2,637 tons BOD load associated to some 16,200 employees, averaging about 0.16 tons per employee. It thus appears that the actual measurements are in the same range as the IPPS estimates.

Some results also can be compared with estimates from other studies. For example, the 2002 study for “Tuba Hazardous Waste Treatment,
Storage, and Disposal Central Facility” estimated the hazardous liquid waste at 18,530 tons per year. For comparison, the aggregated liquid pollutants (BOD, TSS, water toxics [ToxWat], and water heavy metals [MetWat]) estimated using the IPPS are 17,500 tons year. Here, too, the IPPS estimates can be seen to be comparable.

### 6.4.5 Prioritizing pollution abatement efforts

The pollution estimates presented above provide a number of clues that can help the government prioritize pollution abatement efforts. Depending on the environmental quality objective at hand, the government could focus efforts on selected sectors and enterprise sizes. For example, reduction of water toxics emissions in Zarqa most likely will require action on the leather and garment subsector, with an emphasis on microenterprises.

Naturally, in addition to the relative share of emission by location and pollutant, an additional key element is the cost of abatement, which is likely to vary across types of emission and industrial subsectors. Here again, Jordan-specific unit abatement costs were not readily available within the CEA time frame. As a result, the IPPS abatement cost coefficients were used to obtain some preliminary indication on cost-effective strategies for pollution control.

A first type of analysis (figure 6.14) was undertaken to evaluate the overall cost of reaching a given environmental quality objectives under different abatement strategies. For illustration purposes, the quality objective was expressed as reduction by 50 percent of emissions across a subset of pollutants for which unit abatement costs available in the IPPS dataset (PM, VOC, SOx, NOx—combined in a single “air pol-

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**TABLE 6.5 BOD LOADS AT JIEC WASTEWATER TREATMENT PLANTS**

<table>
<thead>
<tr>
<th>Industrial Estate</th>
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<th>Designed Biological Load</th>
<th>Actual Biological Load</th>
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<tr>
<td>Abdullah II</td>
<td>670 m³/day</td>
<td>990 kg/day</td>
<td>1346 kg/day</td>
</tr>
<tr>
<td>Al-Hassan</td>
<td>500 m³/day</td>
<td>285 kg/day</td>
<td>255 kg/day</td>
</tr>
<tr>
<td>Al-Hussein</td>
<td>670 m³/day</td>
<td>450 kg/day</td>
<td>368 kg/day</td>
</tr>
</tbody>
</table>

With a simple linear programming model, the least-cost combination of abatement effort across subsectors was identified (the “best” strategy) and then was compared to a strategy that achieves the same objectives but at the highest cost. This “worst” strategy is up to 3.5 times (in the case of Zarqa) more expensive than the best strategy, suggesting a wide range of cost savings that could be seized by selecting “smarter” pollution abatement strategy.

To illustrate in more specific terms the importance of adequate selection of pollution control strategies, national- and local-level abatement cost curves for air pollution (weighted average of PM, VOC, SO$_2$, and NOx emissions, see figure 6.15) and water toxics (see figure 6.16) were estimated.

In the case of air pollution, at the national level, some 80 percent of total emissions can be abated by focusing on the food, chemicals, medical, and plastic sectors, at a cost of $4,000 ton or less. The unit cost of achieving the remaining 20 percent is estimated to be in the range of US$8,000–14,000 (two to three times more expensive). To confirm
the location-specific nature of optimal abatement efforts, for Irbid only, some 30 percent of total emissions can be abated for costs in the lower
end of the range (US$2,000–4,000 per ton). Higher levels of emission reduction are likely to cost considerably more than the average national cost. The abatement cost curve for Amman lies below the national curve, suggesting more potential to abate at lower costs.

For water toxics, priority should be given to the leather, food, construction, and furniture sectors, which have the lowest unit abatement cost and account (at the national level) for 80 percent of total emissions. In Irbid, lower cost abatement undertaken in the leather sector would reduce some 90 percent of emissions; less than what could be obtained in Amman (about 60 percent).

Such abatement cost curves, which could be refined on the basis of field surveys of actual abatement cost and developed in greater detail (at the level of single subsector, if technology is highly variable from one firm to another), represent a useful tool for decision making. The actual level of pollution control could be determined on the basis of an estimate of the marginal cost of pollution, so that the optimal level of abatement would be the one at which marginal benefits equates marginal cost. Alternatively, given a fixed abatement budget (public or private), the optimal strategy would be to finance pollution reduction projects along the abatement cost curve (that is, selecting first the projects, or sectors, as in the case illustrated above, with lower unit abatement cost), until the budget is exhausted.

6.5 **RECOMMENDATIONS**

As a rapidly growing, insufficiently monitored, and incompletely regulated sector, industry is likely to increase, in the absence of adequate policy action, its impact on Jordan’s air, water, and soil. The government may consider the following actions to help industry improve its environmental performance.

6.5.1 **Short term**

» *Information base.* Enhance the information and knowledge base on industry’s environmental impacts. This would include the upgrading or expansion of existing emission monitoring systems (for example, the water emission monitoring system managed by WAJ and the MoEnv); as well as gradually introducing, where absent, stack emission monitor-
ing for air pollutants and starting with sectors that are likely to contribute the most to air pollution, such as food, chemicals, and leather and garments. Key implementing agencies would be MoEnv and WAJ.

Standards. As discussed in the water quality chapter, WAJ may want to revise and strengthen the standard for wastewater discharged from industries (JS 202/1991), in particular with respect to TDS, heavy metals and endocrine substances, and other toxic organic materials (see chapter 4 for details). The process of introducing new quality norm (to be led by WAJ in partnership with MoEnv and with the Chambers of Commerce) should be based on a “cost of regulation” analysis to evaluate the cost that different industries would incur to meet the proposed standards.

Inspections. The MoEnv could scale and focus its inspection efforts, adopting—if necessary through amendments to the inspections regulations—a strategic approach that would target priority sectors for the different type of pollutants, rather than being primarily complaint-driven.

Guidelines. MoEnv could prepare and issue pollution abatement guidelines, with priority given to sectors that are important contributors to total pollution, such as food supplies (for air and water emissions), the engineering and electrical sector (for heavy metal pollution), and the leather and garment sector (for toxic emissions).

6.5.2 Medium term

Pollution Abatement in Priority Industrial Sectors

This report has provided preliminary indications on pollution abatement priorities across sectors, pollution types, locations, and enterprise size. Using such indications as starting point, the MoEnv, in partnership with the MoIT and with the Chambers of Industry could establish a targeted and location-specific program to support pollution abatement, which could entail the following steps:

» Consolidate the information already available on the concentrations of different pollutant types (and integrate it with rapid assessment where lacking) to define a list of hot spots in each industrial districts of Amman, Irbid, and Zarqa.

» Estimate current ranges of emissions by pollutant type, based on information already available in the MoEnv, WAJ, and other insti-
tutions, to be integrated as needed by targeted surveys to ensure representativeness across locations and industrial subsectors.

- Undertake a rapid assessment (based on environmental audits or other tools) of the average and marginal abatement cost by pollutant type and sector.
- With those elements, define, for each industrial district, an air and water pollution abatement plan, which by adequate selection of target industries would reduce the cost of reaching selected environmental improvement objectives (reduce by 50 percent emissions of toxic substances in water by a target year).

The objectives of the pollution abatement plan could be attained through a number of different means, including the following:

- Enhanced enforcement of existing standards for emissions of different pollutants, such as the WAJ instructions for disposal of industrial wastewater into the public sewerage network (see chapter 4 for details) or JS 1189/2006 (air emissions from stationary sources), as well as expansion of standards (based on a cost-of-regulation analysis) to currently unregulated pollutants, industrial subsectors, or manufacturing process.
- Provision—through the Environmental Fund being implemented by the MoEnv or other sources—of grant or concessional financing to pollution abatement investments meeting priority requirements (in terms of location, target pollutant, industrial subsector) defined in the pollution abatement plan.
- Promote pollution abatement through a combination of (1) positive incentives (including soft loans and technical assistance) to encourage the use of cleaner production processes; and (2) gradual phasing-in of negative incentives (pollution levy for industrial emissions exceeding a given standard) to induce firms to meet effluent and ambient standards (for example, via end-of-pipe treatment). Initially, the levy could be linked to level of activity or employment, and later, once adequate monitoring capacity is in place, to emission levels. For water pollution, the levy could be charged by WAJ (in the case of emissions in the sewerage network) or by MoEnv (for emission into other recipients).
- Establish a program of voluntary compliance, possibly to be associated with tax deductions for enterprises meeting the objectives of
firm-specific environmental improvement plans (to be certified by an independent third party).

» Setting up a color-coded system of mandatory disclosure of selected polluting emissions, with the aim to create public pressure towards improved environmental performance of noncomplying enterprises.

Either of the programs suggested above (voluntary compliance and mandatory disclosure) could be led by the MoEnv in partnership with the Chambers of Commerce.

» Revisit and modify the current structure of fiscal and trade incentives (tariffs) to ensure that some of the most polluting industries are not favored in comparison to other, relatively “cleaner” industrial activities. This process should be based on a comprehensive assessment undertaken by MoEnv in partnership with the Chambers of Commerce, MoIT, and Ministry of Finance.

Licensing of new industrial establishments
To prevent further environmental deterioration in industrial hot spots, licensing of new industrial establishment should be subject to strict licensing requirements, in line with IPPC principles, as laid out in the EU program “Institutional Support to the Ministry of Environment,” and carefully weighing environmental costs against employment or income benefits.

For some particularly serious situations (such as parts of the Zarqa industrial district), the government could consider establishing a moratorium on new licenses, until certain targets of environmental improvements are met.

NOTES
1 According to MoIT, the industry involves about 190,100 workers. The source of discrepancy between the JCI and MoIT estimates is twofold: (1) the MoIT databases include electricity and water related industries while the JCI’s does not; and (2) all enterprises must register with the MoIT, but not necessarily with the chambers of commerce, suggesting that the JCI’s figure is an underestimate.
2 In the manufacturing sector, in 2007 (that is, three years from the 2010 phase-out deadline), MFN tariffs were on average some 50 percent of their 2000 level.
3 Pollution intensities have initially been calculated with data available in the United States from the U.S. Manufacturing Census and the U.S. Environmental Protection Agency (USEPA). The basic calculation took manufacturing information on output value,
value added, and employment, and then matched it with the USEPA database on pollution releases on a plant-by-plant basis. Pollution intensities were calculated as the total amount of releases divided by the manufacturing indicator (output value, value added, or employment). The employment-based indicator (kilograms of pollutant per unit of employment) has been shown to be the most stable across different technologies and across both industrial and developing countries (Dasgupta et al. 2002).


These are therapeutics and medical (1.3 for 2007–12 and 1.6 for 2012–17), engineering (1.7 and 1.8), furniture and wood (1.9 and 1.1), and food industries (1.9 and 1.1).

It represents the total load of waste oil from refineries collection, emulsions, halogenated oils, wastewater organic pollutants, laboratory wastes, flammable wastes, solvents, halogenated solvents, chemical waste, and oil from army and public transport.
7.1 INTRODUCTION

This chapter evaluates Jordan’s capacity to address key environmental challenges and undertake policy actions to enhance environmental sustainability across sectors, through the following:

» Assessing the environmental governance system in Jordan based upon the World Development Report 2003 (WDR) framework (see box 7.1 for details).

» Benchmarking Jordan’s environmental governance system and institutional capacity in regard to comparator countries, and with a particular emphasis on international systems (such as the World Bank’s) as yardstick for the EIA process.

» Developing recommendations for improving the effectiveness of governance structure and strengthening the institutional capacity as needed.

The methodology for conducting the institutional assessment included reviewing key documents and legislation, and holding consultations with stakeholders during a two-week field visit, with additional follow-up e-mail interviews conducted in the ensuing few weeks. A Public Environmental Expenditure Review (PEER) was undertaken to evaluate the amount and composition of resources for environmental protection, and a review of environmental assessment process was carried out.
This chapter is structured as follows. Section 7.2 sets the stage by presenting an overview of the main governmental institutions responsible for environmental protection and the laws and regulations under which they operate.

Section 7.3 analyses the ability of institutional setting to pick up signals from society about environmental needs and problems through monitoring of environmental quality, public disclosure of information, and participation of the general public, NGOs, and the private sector in environmental management.

Section 7.4 discusses the mechanisms for balancing interests, including environmental standards in effect in Jordan, environmental management at the subnational level, horizontal and vertical coordination issues between institutions, and the ability of sector strategies to reconcile environmental and development objectives.

The last function of institutions—executing decisions—is reviewed in Section 7.5. The section presents the results of the PEER for Jordan. It also discusses the human and financial resources of the ministry of environment, examines the role of judiciary in the institutional setting, and reviews the environmental assessment process in Jordan and benchmarks it against two widely accepted systems of environmental assessment: the World Bank and the European Union.

Section 7.6 contains the conclusions and recommendations of the institutional assessment component of the CEA.
CHAPTER 7 | INSTITUTIONAL CAPACITY ASSESSMENT

7.2 LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

7.2.1 Legislative framework
Jordan has an extensive web of laws and regulations pertaining to environmental protection and management. Jordan’s first law pertaining to environmental protection was issued in 1995, and established the General Corporation for Environmental Protection (GCEP), an autonomous body reporting to the ministry of municipal and rural affairs and the environment. In 2003, Interim Law No. 1/2003 was issued and led to the replacement of GCEP by the MoEnv, and it was ratified in 2006 as Law No. 52 with a few modifications (see box 7.2 for an overview of Law No. 52/2006).

Before 1995, environmental matters were regulated by sectoral legislation pertaining to agriculture, health, water, and energy. The majority of these articles stayed in force after issuance of Jordan’s environmental protection laws. By legal tradition in Jordan, the articles of a new law supersede those of a previous one unless the older is a special law. For example, articles in Agriculture Law No. 44/2002 regulate the protection and utilization of forestry resources; Public Health

BOX 7.2 ENVIRONMENTAL LAW NO. 52/2006

The Environmental Protection Law No. 52/2006 sets the definitions and outlines the main responsibilities and functions of the Ministry of Environment (MoEnv). According to the law, the ministry is responsible for setting Jordan’s environmental protection policy, monitoring activities, coordinating national efforts for environmental protection, and preparing environmental contingency plans. Article 7 of the law assigns the MoEnv with the environmental monitoring and inspection responsibilities, and grants its employees the right to enter any facility for inspection needs. Articles 8, 9, and 10 relate to marine environment. Article 13 sets the requirements for conducting environmental impact assessment for projects.

The law also calls for the establishment of environmental protection fund (articles 16 and 17); sets fees for violation of its provision, terms for delegation of authority, and the operation of environmental nongovernmental organizations in Jordan. Finally, it lists the regulations that should be issued in accordance to the law. Of the required 12 regulations set by law; the following regulations have already been issued: marine and coastal environment; environment protection from pollution in emergency cases; air protection; nature reserves and national parks; management, transport and handling of harmful and hazardous substances; management of solid wastes; environmental impact assessment; and soil protection.

Source: Environmental Protection Law No. 52/2006.
Law No. 54/2002 assigns the ministry of health with the responsibility to monitor and regulate potable water and wastewater treatment and disposal; and the Municipalities’ Law No. 14/2007 assigns the municipalities with the responsibility of solid waste collection.

The multiplicity of legal provisions governing different elements of environmental agenda attributes responsibilities to different actors, and this weakens the system as a whole. Inconsistencies and rapid changes in the regulatory framework indicate a response-driven management style. Most of the regulations and institutions reflect a sectoral approach in environmental management, while environmental management policies do not always complement policies within other sectors. In the case of ASEZ, the environmental legal framework is clearer because of the special status of the ASEZ law and the memoranda of understanding (MOUs) between ASEZA and various national agencies.

Overlap in roles and responsibility is significant, especially in the domains of water and air quality. The historical sedimentation of legislation on environmental matters has led to a situation in which multiple agencies carry out similar or related activities in the same domain. The point can be graphically illustrated by computing a simple “attribution dispersion index,” normalized to vary between zero and one. The index is based on a review of the applicable laws and regulations, conducted to identify the attribution of water and air quality functions to different government agencies. When all agencies are involved in any given function, dispersion is highest, and the index is equal to one. When the function is concentrated in only one agency, there is no dispersion, and the index is equal to zero.

Figure 7.1 and figure 7.2 illustrate the results of the analysis for water and air quality, respectively. In the case of water quality, the dispersion of roles for monitoring, sanctions, and standard settings is high; in the case of air quality, the dispersion of roles for monitoring and regulation is high. On the other hand, no dispersion exists in the case of water service provision (the sole responsibility of WAJ) and no dispersion exists in the case of air quality standard setting (which is attributed to the MoEnv).

Upgrading the legal framework is under way, but the process should be extended beyond the scope of action of the MoEnv. The MoEnv recently conducted a legal framework gap analysis and a legal master plan was developed with assistance from the European Union to enhance Jordan’s environmental legislative framework. The gap analysis
noted weakness in the quality of existing legislation, including conflicting articles, deficient internal structure of laws, insufficient use of proper and precise legal language, and noncompliance with fundamental rule-of-law principles. A review of the regulations confirmed the need for a legal upgrade, as most of the regulations proved general in nature and lacking the specificity required to enable transparent and predictable enforcement.

The legal master plan sets a time frame for a number of relevant regulations to be issued by the MoEnv, including the following: updated environmental impact assessment, strategic environmental assessment (SEA), access to environmental information, environmental liability and integrated permitting, among others. It presents a schedule for drafting the regulations based on their priority and available resources. The planned regulations reflect the identified legal gaps and are anchored in the NA and the MoEnv’s environmental strategy implementation plan. If properly developed, they would result in stronger environmental management framework; however, most of the tasks in-
cluded in the legal master plan have medium or high priority, which may not make for a simple sequencing of activities and prioritization of regulatory efforts.

The issuance of the above regulations will require coordination with the relevant institutions. Moreover, the ministry of environment has initiated public consultation on its most recent regulations that are in draft form, and it would be desirable to continue such practices as additional regulations are prepared. Jordan should strive toward achieving integrated environmental legislative system, through the introduction of framework legislation such as a water code (see chapter 4). Such a step will require coordinated effort by the government agencies with responsibilities in water management.

7.2.2 Institutional framework
The MoEnv was established in 2003 as Jordan’s lead institution for environmental management, with one of its responsibilities to coordi-
nate national efforts to protect the environment (see box 7.2 for details of the MoEnv’s responsibilities as per Environmental Protection Law 52/2006). The coordination and policy-setting responsibilities are not precisely defined, and reliance is made on issuance of regulations to further define these responsibilities, especially in terms of the processes to be followed for coordination and policy-setting purposes.

**In spite of Law 52/2006 attributing to the MoEnv’s primary responsibility for environmental protection, many other agencies retain their environmental responsibilities and structures.** Environmental sections and departments are present in a number of institutions, such as the MoWI, WAJ, and MoH, among others. Full advantage is not being made of these departments for wider environmental mainstreaming, and environmental issues could be concentrated within these departments and fail to reach other areas of the agencies’ work.

**Institutions that do not have dedicated environmental departments often resort to naming environmental focal points, whose responsibilities often are not sustainable.** Those government agencies that do not have a dedicated environment section or department (such as ministries of industry and trade, tourism and antiquities, transport, education) resort to naming a focal point for environment—whose responsibilities often include serving as liaison with institutions on issues that pertain to both their respective agencies’ mandate and the environment. In several cases, the responsibilities of environmental focal points need to be clarified or strengthened.

### 7.3 PICKING UP SIGNALS

The first function of institutions according to the WDR (World Bank 2003c) framework is picking up signals on environmental issues and priorities. As illustrated in figure 7.3, this entails a circular process of exchange of information between stakeholders, in particular between citizens and the government. Both acquire information on environmental conditions, either through direct observation or by means of scientific monitoring. Citizens need access to data collected by the government to improve their understanding of environmental issues, so that they can provide feedback on priorities and voice their concerns.
This section looks at the institutional framework in Jordan in terms of its ability and effectiveness in picking up signals, through monitoring (using as examples air and water quality) and from society, by discussing the roles of the general public, NGOs, and the private sector in environmental management. Good practices established by the WDR (2003c), as well as Aarhus Convention for Access to Information, Public Participation, and Justice are used as international benchmarks for public participation, while monitoring practices are compared to EU and other international experiences.

### 7.3.1 Water quality monitoring

Water quality monitoring suffers from some confusion over types of monitoring as well as overlap in responsibilities on the ground. Monitoring is performed at different levels and for diverse purposes by the institutions involved, which shows clear overlap in monitoring of surface water resources. The different types of monitoring (environmental, quality control, and health monitoring) have been discussed in chapter 4, along with the significant degree of overlap in roles and responsibilities among institutions.
Overlap in responsibilities leads to some gaps in environmental monitoring of surface-water and groundwater resources. Despite the large involvement of all potential monitoring entities, the monitoring of surface-water resources has some shortcomings, including deficiencies and overlaps in the monitoring program that consume scarce funds. For example, repetition in monitoring of well-known standard chemical and physical parameters does not contribute to additional gains in water resources management and protection, as well as a lack of flexible measurement of toxic parameters, such as heavy metals in reservoir sediments and toxic organic components. Also, monitoring of the environmental status of surface waters (biodiversity, saprobic indexes), which may be of interest for a limited number of water resources, is not carried out. Finally, groundwater quality monitoring is not well integrated with quantitative monitoring.

Dissemination is limited of monitoring program results, and the multiplicity of agencies and databases further complicates access to information by the general public. The JVA and WAJ publish annual reports with aggregated results of their monitoring efforts, and some monitoring results are channeled through the department of statistics. The MoEnv and MoH offer limited dissemination of information to the general public. Requesting information from the monitoring agencies is made more difficult by the lack of a harmonized database for environmental monitoring, thus data are kept in varying formats at the monitoring institutions.

### 7.3.2 Air quality monitoring
Several types of monitoring for air quality are performed to various degrees and in different locations by various institutions. See table 7.1 for an overview of the monitoring responsibilities for ambient air quality and air emissions, as well as air quality monitoring in ASEZA.

Air quality monitoring is limited in scope and geographic extent. Chapter 3 suggested that air quality is one of the top environmental issues facing Jordan. Despite the relatively large number of institutions nominally in charge, actual air pollution monitoring focuses primarily on ambient air quality in industrial and vehicular traffic hot spots and has limited coverage over space and time, particularly in Amman, which has few air monitoring stations with sparse records and short time-series. The MoEnv with support from the French Development Agency is embarking on developing a network for air quality monitoring. This
would be an excellent opportunity to review the institutional responsibilities on the ground (who is doing what in terms of monitoring) to avoid overlaps and ensure cost-effectiveness of resources used.

### 7.3.3 General public

The public in Jordan shows interest in environmental matters; however, its ability to access information and participate in decisions on the environment is limited. According to the World Values Survey, the general public in Jordan has a positive attitude toward environmental protection. As illustrated in figure 7.4, approximately half of the respondents (51 percent) elected to give priority to environmental protection even if it resulted in slower economic growth, a higher proportion than in comparator countries in MENA and the Mediterranean regions.

Access of the public to environmental information and public participation in Jordan is improving but falls short of meeting the Aarhus Convention standards (see box 7.3).

**Right to seek information from public authorities**

In 2007, Jordan issued an access to information law, though it deviates from best practices established by the Aarhus Convention. Law No. 47/2007 gives the right to every Jordanian to access information available with the public sector. The law sets a time limit of 31 days for a response following the submission of the information request, defines categories of information that may not be accessed, and calls for issuance of regulations pertaining to the different articles of this law, which are still to be issued. Unlike the Aarhus Convention, which explicitly states
that no justification for the information access should be requested, the law requires that requests for information be justified.

**BOX 7.3 THE AARHUS CONVENTION AS BENCHMARK FOR ACCESS TO ENVIRONMENTAL INFORMATION**

The Aarhus Convention provides the framework for benchmarking Jordan’s access to information and public participation progress, which are discussed in this section. The convention’s access-to-information pillar consists of two portions: (1) the right of the public to seek information from public authorities and the obligation of public authorities to provide information in response to a request, and (2) the right of the public to receive information and the obligation of authorities to collect and disseminate information of public interest without the need for a specific request.

The public participation pillar is divided into three parts: (1) participation by the public that may be affected by or is otherwise interested in decision making on a specific activity; (2) public participation in the development of plans, programs, and policies relating to the environment; and (3) public participation in the preparation of laws, rules, and legally binding norms.

The MoEnv has plans to develop an access to information law that may provide an opportunity to bring access to environmental information closer to best practice established by the Aarhus Convention. The legal master plan document, developed by the MoEnv to guide its legal upgrading effort, acknowledges the benefits of public participation toward environmental management, as well as the right of the MoEnv to prepare an access to information regulation according to its environmental law and separate from Law No. 47/2007. It notes that any such regulation will refer solely to the information for which the MoEnv is a holder (this will exclude environmental information held by other ministries, such as MoWT’s water quality data).

**Obligation of authorities to collect and disseminate information**

The availability of publications varies across environmental themes and institutions, and requires strengthening. Several institutions issue regular publications detailing their work and providing environmental information, such as the WAJ’s annual report, and the Department of Statistics’ environment in figures booklet with data provided from relevant institutions. The MoEnv has not issued such publications, and publications detailing air quality data and real-time data availability are limited, although ASEZA is implementing a monitoring program that will include provision of real-time information to the public on air quality through monitors in downtown Aqaba.

**Public participation**

Jordan’s approximation of the Aarhus Convention has shortcomings in regard to the three components of the public participation process. Regarding the first part of the public participation pillar, the institutionalization of the EIA process has provided more opportunities than previously available for public participation. As discussed in section 7.5.4 on environmental impact assessment, the process has its limitations because public consultations are limited to the scoping sessions, which are often by invitation, and scoping statements or EIS are not disseminated, although it is a legal requirement in ASEZA.

Public participation in the development of plans, programs, policies, laws, and regulations is increasing; however, it requires institutionalization. A few recent examples of public participation in the development of policies and legislation stand out, for example, the GAM and MoEnv
recently resorted to posting their key documents and legislation on the internet for public comment, and the Legislation and Opinion Bureau launched a site in 2007 for gathering feedback on legal drafts. The MoEnv recently developed its internal procedures for developing and updating environmental strategies, which could be a good entry point for public consultation—for example, by including the requirement within the procedures for disclosing the drafted new or updated policy for public consultation and comment.

### 7.3.4 NGOs

**Jordan’s public has confidence in its environmental movement**, as indicated by the results of the World Values Survey, with more than 60 percent of respondents indicating confidence in the environmental movement (see figure 7.5), a larger share than in comparator countries such as Iran, Morocco, or Spain. This suggests the existence of a favorable climate for further expanding the work of NGOs. Key conditions

![FIGURE 7.5 PUBLIC’S CONFIDENCE IN ENVIRONMENTAL MOVEMENT](image)

need to be met, however, to enhance the NGO effectiveness in contributing toward Jordan’s environmental agenda, such as capacity, funding, and most important, access to information and public participation (as discussed in section 7.3.3). In addition, NGOs may be strengthened by institutionalizing their relationship with the MoEnv through more systematic outsourcing of activities such as awareness raising and education campaigns.

**Jordan has a varied environmental nongovernmental sector and significant grass-roots environmental activity.** Jordan has 18 environmental NGOs that vary in their size, capacity, membership, and environmental theme of choice. Most of these NGOs work at the national level, although a few also work with local communities. In addition, many community-based organizations are involved in environmental issues as evidenced by data from the United Nations Development Program – Global Environment Facility (UNDP-GEF) Small Grants Program, which, since its inception in Jordan in 1992, funded 145 projects with an average financing of $30,000. Of these, 53 percent were implemented by local cooperatives.

**Jordan’s nongovernmental sector contributes toward the environmental agenda.** NGOs in Jordan work toward raising environmental awareness, mobilizing funds, and providing technical assistance to communities and industries. In recent years, NGOs played a role in mobilizing public opinion to influence policy. Some NGOs are represented on government committees such as the EIA technical review committee. The Royal Society for the Conservation of Nature (RSCN) is mandated by the government to manage nature reserves.

**The MoEnv is reaching out to NGOs.** Even though all of the NGOs are registered with the Ministry of Interior, the MoEnv issued special regulations that mandate licensing environmental NGOs as such and regulates their operation. In recent steps, the MoEnv has been holding regular meeting with representatives from NGOs working in the environment. Although positive, any such relationship with NGOs should be institutionalized to ensure its sustainability.

**Academia and the research sector in Jordan also contribute toward its environmental agenda; however, their participation needs to be institutionalized.** Academia and research institutions contribute toward the environmental agenda through their research facilities, and some institutions have MOUs to provide services to government agen-
cies. They often are represented in various committees established by the government, which allows them to contribute to strategic and policy setting; however, this process is not always consistent.

**Media contribute toward promoting awareness on environmental issues in Jordan.** The daily newspapers regularly publish articles pertaining to environmental issues as well as press releases submitted by environmental agencies. The most prominent topic is water; however, air pollution, biodiversity, climate change, and other environmental issues are represented.

### 7.3.5 Private sector

Private sector entities are showing increasing interest in the environment, but they are likely to be a small minority. For example, the JIEC, home to more than 450 industrial enterprises, set environmental objectives within its institutional strategy and issued an environmental guide for its industries. The number of ISO 14001 certifications and the number of enterprises participants in the UN Global Compact also have increased. An ISO survey showed that, by December 2006, 39 establishments in Jordan had been ISO 14001 certified (ISO 2007), and nine entities in Jordan are participants in the Global Compact. Nevertheless, the ratio of ISO 14001–certified establishments compared with the total number of establishments in Jordan is small. Similar comparison across the region places Jordan in the middle ranking, with Morocco, Qatar, and Tunisia leading in the ratio of ISO 14001–certified enterprises (see figure 7.6).

Studies indicate deficiencies in the legislative framework, lack of incentives, and limited environmental awareness efforts as main factors contributing toward limited environmental initiative by the private sector. A study conducted within the chemical sector in Jordan showed that environmental regulation had a negative effect on firms’ adoption of environmental innovation strategies, and an assessment of corporate environmental responsibility in Jordan indicated an absence of pressures on firms from the media, stakeholders, and consumers to improve their environmental performance (Hindiyeh 2007; Eiadat et al. 2008).

Tariffs on environmental goods are higher in Jordan than the world and developing country averages; however, they are lower than the overall national average. Because most developing countries
typically depend on imports to increase their use of clean technologies, import tariffs might be a significant factor in determining the private sector’s attitude toward investments in environmental protection.

In 2005, Jordan average tariffs for environmental products averaged 7 percent, whereas those for climate-friendly technology were 12 percent, against an overall average of 8 percent for Jordan’s total imports. While Jordan’s tariffs on environmental goods followed the overall national trend of decreased tariff protection (see figure 7.7), they remain higher than the average for developing countries (5 percent), OECD (1 percent), and the world (3 percent). In the MENA region, Jordan ranks in the middle range, charging lower tariffs than Algeria and Morocco, but higher tariffs than Egypt and Tunisia.

Further decrease in tariffs on environmental products might remove barriers toward wider adoption of clean technology by Jordan’s private sector. Additional incentives, however, are likely to be necessary to affect private sector behavior in a significant manner (through regulation or market mechanisms). The use of nonpunitive instruments (such as

![FIGURE 7.6 ISO 14001 CERTIFICATIONS AND GLOBAL COMPACT PARTICIPANTS/10,000 ESTABLISHMENTS](image)

*Sources: United Nations 2008. Data for the number of establishments are extracted from UNIDO: INDSTAT3 ISIC Rev.2 database.*
using public disclosure of performance of the polluter by NGOs and media) may improve private sector performance and encourage implementation of environmental management systems (EMS).

### 7.4 BALANCING INTERESTS

This section analyzes the ability of Jordan’s institutions and organizations to balance competing interest in environmental management. First, it looks at standards that summarize in a few numbers trade-offs between environment and development objectives. Next, it discusses the ability of institutions in charge of different sector development agendas to cooperate toward better environmental sustainability (thereby balancing diverging interests), particularly by looking at the way in which sector strategies address environmental concerns.

#### 7.4.1 Environmental standards

Jordan Institute for Standards and Metrology (JISM) is the main agency responsible for issuing standards in accordance to the Stan-

![FIGURE 7.7 TARIFF TRENDS IN JORDAN](image-url)
Technical committees consisting of relevant agencies and experts are established by JISM to develop specific standards, and the draft standards are shared with all relevant organizations for comment before final approval. Affected sectors are represented in the technical committee, such as representatives from the industrial sector being part of committee for setting standards on air emission limits. The committee approach contributes toward balancing interests of different parties; however, draft standards are not published for public feedback.

Several environmental standards cover issues pertaining to water and air quality in Jordan. Four main standards pertain to water and wastewater:

3. Jordanian Standard 202/1991. Industrial Wastewater. (This standard sets norms for the release of industrial wastewater to the environment.)

In addition to these four standards, although not a formal standard, WAJ issued instructions for disposal of commercial and industrial wastewater to the public sewerage system (1998).

Two sets of standard apply to air quality:

1. Jordanian Standard 1189/2006: maximum allowable limits of air pollutants emitted from stationary sources. These standards set emission limits for TSPs by type of industry as well as gaseous substances, and define acceptable measurement methods.
2. Jordanian Standard 1140/2006: Ambient air quality standards provide limits for ambient air quality for particulates (TSP and PM$_{10}$) as well as gaseous substances ($SO_2$, CO, $NO_2$, $H_2S$, and Pb).

A comparison between Jordanian ambient air quality standards and those of other countries, shows that Jordanian standards are comparable in terms of stringency with those of China, Europe,
Japan, and the United States. Figure 7.8 shows a comparison of ambient quality standards for main parameters with selected countries. The index used for comparison is based on ranking of individual parameters according to stringency—that is, for a parameter that is the most stringent in the group of countries, the index takes the value of one; if the standard is the least stringent, the index takes the value of zero.

The overall unweighted average for Jordan is 0.4; that is, 60 percent of the norms analyzed are less stringent in Jordan than in the other countries considered. Jordanian standards, however, are quite stringent for pollutants with strong health impacts, such as Pb, PM$_{2.5}$, and CO. Jordan's standards tend to be less stringent for SO$_2$ and NO$_2$ at 94 percent percentile rank (indicating that 94 percent of standards compared are stricter than those of Jordan). The implications that can be drawn

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**FIGURE 7.8 JORDAN AIR QUALITY LIMITS NORMS IN RELATION TO COMPARATOR COUNTRIES**

Sources: European Commission 2004 (with modifications); Jordanian Standards JS 1140: 2006.

Note: CO = carbon monoxide; NO$_2$ = nitrogen dioxide; PM$_{2.5}$ = particulate matter smaller than 2.5 micrometres; PM$_{10}$ = particulate matter smaller than 10 micrometres; SO$_2$ = sulfur dioxide.

1 = Jordan standard is most stringent of the group, 0 = Jordan's standard is the least stringent.

Standards used for comparison: China, European Union, Japan, the United States, and the World Health Organization (residential, commercial, and industrial areas).
from the exercise are as follows: (1) in establishing air quality standards, Jordan seems to have accorded high priority to the environmental health impacts of air pollution; and (2) it is not clear, however, that the implications in terms of cost of compliance for emitting sectors (that is, transport, power, industry) have been taken into account in the “balancing interests” process.

**Although the standards for air and water quality are adequate, monitoring and enforcement systems require improvement.** As discussed in the sections on water and air monitoring, overlapping institutional responsibilities lead to deficiencies in monitoring. Such overlap exists in the enforcement of the standards. The standards themselves do not specify the institution that is responsible for monitoring and enforcement; rather these responsibilities are specified in relevant institutional and sectoral laws. Standards for air and water quality have been updated periodically since their introduction; however, they need to be responsive to new developments and country needs.

**Fragmentation at the national and regional levels results in no single institution being able to take enforcement actions effectively.** The directorate of inspection and enforcement as well the environment regional directorates conduct separate inspections, issue warnings, and enforce temporary closure through the environment rangers. In view of lack of measuring equipment and inspection manuals, inspections are based on ad hoc complaints and usually are conducted visually. Inspection at the national and local level resulted in temporary closure of 66 installations in 2007 and 13 in 2006 for small and medium enterprises for lack of compliance.

**Jordan’s legislative framework focuses on command and control instruments to achieve these standards, with limited opportunity for use of economic and community-based instruments.** The use of economic and community incentives has been instrumental for attaining environmental quality in a number of countries (Czech Republic, Denmark, Sweden, Switzerland, and the United States). Evidence suggests that economic instruments have lower costs to industry (in the United States, NO$_x$ and SO$_2$ trading schemes resulted in 40 percent emissions’ reduction and in savings estimated at 43 percent of the compliance costs that would have been incurred under a uniform plan), and minimal impacts on significant competitiveness effects. EU experience suggests that good legislation is the start in lowering emissions, although
a number of other drivers contribute toward lower emissions as well, including voluntary agreements; best practice; integrated technology; and resource consumption and economic considerations.

### 7.4.2 Institutional coordination

Another dimension of the “balancing interest process” is the ability to reconcile sector development priorities with the objective of managing the resulting pressures on the environment. One way to look at it is to examine the coordination of government entities on environmental topics; the second is to look at how sector ministries internalize environmental concerns into their activities.

Concerning coordination, the issue is of particular significance in Jordan, on account of the high dispersion of environmental responsibilities across institutions, discussed in section 7.2 above and illustrated in figure 7.9, which shows the index of dispersion of themes across agencies. The index answers the question: “how many agencies are working on a particular theme?” If all agencies are involved on a given theme, the index scores 100 percent (that is, the maximum dispersion of agencies across this theme), if only one agency is working on a given theme, then the index scores 0 percent (that is, minimum dispersion).

Water resources and water quality, followed by air quality and hazardous material, seem to be the most dispersed themes across the reviewed institutions. The high dispersion of water theme across agencies may reflect the importance that is accorded by the government toward this theme. At the same time, it increases the need for coordination between the institutions to ensure a cost-effective resource use and decrease any areas of overlap.

**Current mechanisms for coordination largely rely on interagency committees and MOUs.** In the face of such a strong need to harmonize actions of many different actors, the environment protection law assigns to the MoEnv coordination of the national environmental protection effort. In practice, institutional coordination in Jordan mostly has taken the form of multiagency committees established for specific purposes (for example, updating a strategy). Given that they are by definition temporary, committees do not guarantee long-term institutional commitment. In terms of the specific tasks, their effectiveness largely depends on the skills, commitment, and, in particular, the level of seniority (and hence of decision-making authority) of the persons attending.
MOUs might formalize cooperation arrangements for environmental protection, thereby increasing its stability and effectiveness. Their use could be expanded, although they are unlikely to guarantee the same type of institutional coordination incentives that would derive from legislation or regulation.

### 7.4.3 Environmental and sectoral strategies

Strategies might be important vehicles for integrating environment across sectors, to the extent that they include a solid analysis of the problem, a shared vision and objectives, targets for enhanced environmental performance, and allocation of resources to reach such targets. This
section briefly reviews selected strategies, first, those explicitly aimed at promoting the environmental agenda, and second, the sector strategies that have important implications for environmental sustainability.

Environment Strategies

Environmental strategies developed by Jordan over the past 20 years have been instrumental to articulate the country’s vision and objectives; their impact on the ground remains to be evaluated. The initial strategies (National Environmental Strategy, 1992, and National Environmental Action Plan, 1995) tried to identify and list the environmental issues facing Jordan and guide the government’s environmental policy. Jordan also developed a number of strategies and action plans as a result of its global commitments, such as the National Agenda 21 (2001), National Biodiversity Strategy and Action Plan (2003), the National Strategy and Action Plan to Combat Desertification (2006), and National Implementation Plan for Persistent Organic Pollutants (2006). A main issue that faces Jordan is setting priorities across the various issues identified in the various environmental strategies.

In 2007, the MoEnv through a process of internal deliberations and consensus, developed its Environmental Strategy Implementation Plan 2007–10 (ESIP), which builds on the ministry’s strategic objectives and its functional areas, it links and derives its programs and activities from the NA and the previously developed environmental strategies and efforts. For each of the seven strategic objectives of the MoEnv, the ESIP spells out policies, programs and activities for each policy, and performance indicators. Outcome-based targets are not set, however, and the performance indicators are more output than outcome based, which is a result of the ESIP project-based approach.

Sector development strategies

Most sector strategies acknowledge the importance of environmental mainstreaming, but few of them define measurable targets, assign responsibilities, or create defined institutional coordination mechanisms to address environmental concerns. Sector development strategies have direct and indirect impacts on the environment; balancing interests would require that they take the environmental dimensions into consideration. Many of Jordan’s recent strategies recognize the significance of the linkages between sector development and the en-
environment. Most strategies typically set the general direction and define broad action plans, but they do not set measurable targets and indicators for environmental mainstreaming. A notable exception is the NA, which sets specific targets for environmental quality; however, for some parameters, the indicators and targets might be too ambitious and may require a revision.

7.4.4 **Mainstreaming environment into sectoral development**

Previous sections have argued that, to date, efforts to integrate the environment into the development process have had limited results: coordination mechanisms tend to be ad hoc, and sector strategies define principles rather than specific instruments for mainstreaming.

In the face of limited results of previous environmental mainstreaming efforts, Jordan would benefit from more systematic and formalized processes, such as SEA. As Jordan is facing increased environmental challenges, integrating environmental concerns into national development plans and sector strategies is gaining utmost urgency. The MoEnv, as the agency legally designated with the protection of Jordan’s environmental resources, needs to find ways to work closely with other sectoral institutions, for many of which environment is not a main priority in comparison to their direct areas of influence and work.

**SEA has been identified as a tool for mainstreaming environment and ensuring public participation in the development of strategies and plans.** SEA is a legal requirement in many EU countries, with the term widely being used to refer to a systematic process to analyze the environmental effects of policies, plans, and programs. SEA could be used in combination with other tools to achieve optimal results in mainstreaming environment.

**The MoEnv is developing with assistance from the European Union an SEA Framework.** This framework would enhance the environmental mainstreaming process and further strengthen the role of MoEnv as a coordinating institution for environmental protection and promoting sustainability. Applying the SEA promotes integrated environment and development decision making and increases and formalizes coordination across sectors, thereby helping Jordan move away from its ad hoc approach to environmental integration, which currently characterizes much of the interaction between the MoEnv and other ministries.
Application of SEA system in Jordan would bring it in line with the international best practices, established by the Aarhus Convention. The SEA process gives expression to the requirement of the convention for public participation with regard to plans, programs, and policies. It also meets the provisions of the SEA protocol to the United Nations Economic Commission for Europe (UNECE) convention on EIA in a transboundary context, a protocol that is open to all UN members.

The MoEnv should take the lead in applying SEA system in Jordan and should build demand for environmental quality to enhance its application. Building demand for environmental quality could be achieved through systematic monitoring, analysis, and public disclosure of environmental information and establishment of indicators with associated monitoring and evaluation that could be monitored easily on a regular basis and that would be relevant within the Jordanian context to establish continuity and have the ability to monitor changes in quality over time. Efficient application of SEA in Jordan requires capacity development within the MoEnv and the country to carry out the SEA, data availability, and funding.

7.5 EXECUTING DECISIONS

Executing decisions is the last function of environmental institutions, which follows the picking up signals from society and balancing interests. Decisions are executed through regulations, taxes, and enforcement. This section discusses the executing decisions aspects of the environmental management framework in Jordan. First, it presents the results of the PEER to assess the volume and composition of public resources assigned to execute environmental protection decisions. Second, it discusses the resources assigned to the MoEnv and the constraints to their effective use. Next, it analyzes the effectiveness of the EIA process, because this is a key vehicle for executing decisions on environmental quality. Finally, the role of the judiciary in enforcement and conflict resolution is discussed.
The enabling environment: the quality of public sector action

The effectiveness of environmental management in any country is influenced by its broader institutional and governance framework. In Jordan, the quality of public sector action compares well with the rest of the MENA region, thereby creating a favorable context for environmental management.

According to a recent World Bank study on structural reform indicators (World Bank 2008b), Jordan fares well on the two aggregated governance indicators: quality of public administration and public sector accountability. Figure 7.10 shows that Jordan has the highest score in the region (34 percent) in terms of public sector accountability (against a MENA average of 20 percent), and scored 54 percent, well above the MENA average of 47 percent, in terms of quality of public administration.

The performance of Jordan’s public sector as a whole represents an opportunity for improved environmental management. It also points to the need for getting the relatively younger environmental institutions up to speed with the rest of the public sector.

7.5.1 Public Environmental Expenditure Review (PEER)

Jordan’s PEER is significant, but it is concentrated on wastewater management. A review of the public environmental expenditure (PEE), which was conducted for the first time in Jordan in the context of this CEA, shows that total PEE during the period 2002–06 amounted to an average of 0.8 percent of Jordan’s GDP at real prices, and 2.3 percent of total government spending (see table 7.2). Annex 4 in Wold Bank 2010 provides the PEER methodology.

Differences in classification systems warrant caution in cross-country comparison; however, the first indications from the PEER exercise would suggest that Jordan’s PEE as percent of GDP compares well to the European Union. For a selected group of EU countries in 2005, the PEE represented 0.5 percent of GDP (Eurostat 2008), although some countries showed a higher PEE as percent of GDP, such as Denmark, which from 1994–2005 had PEE of more than 1 percent of GDP (see figure 7.11). In spite of the fact that efforts were made to organize the Jordan PEER as much as possible in accordance to EUROSTAT guidelines, a full-fledged comparison would require that all public expenditure be classified according to the Classification of Environmental
Protection Activities (CEPA) nomenclature, which is mirrored partially by the way in which environmental expenditure is defined by the Government Financial Statistics Manual adopted in 2001 by the Government of Jordan.

In spite of the array of environmental priorities identified in environmental and sector strategies, a large share of public environmental expenditure is related to wastewater management. Figure
TABLE 7.2 TOTAL PEE PROPORTION IN GDP AND TOTAL PUBLIC EXPENDITURE

<table>
<thead>
<tr>
<th>Variable</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP at market prices (JD billion)</td>
<td>6.879</td>
<td>7.354</td>
<td>8.32</td>
<td>9.231</td>
<td>10.409</td>
</tr>
<tr>
<td>Inflation rate as measured by percent change in GDP deflator</td>
<td>0.9</td>
<td>2.1</td>
<td>3.1</td>
<td>3.2</td>
<td>5.18</td>
</tr>
<tr>
<td>Deflated GDP (JD billion) using GDP deflator</td>
<td>6.818</td>
<td>7.203</td>
<td>8.070</td>
<td>8.945</td>
<td>9.896</td>
</tr>
<tr>
<td>Total PEE at market prices (JD billion)a</td>
<td>0.042</td>
<td>0.090</td>
<td>0.071</td>
<td>0.076</td>
<td>0.075</td>
</tr>
<tr>
<td>Deflated PEE (JD billion)</td>
<td>0.042</td>
<td>0.088</td>
<td>0.068</td>
<td>0.074</td>
<td>0.072</td>
</tr>
<tr>
<td>Percent of public expenditure of the GDP (percent)</td>
<td>0.61%</td>
<td>1.23%</td>
<td>0.85%</td>
<td>0.83%</td>
<td>0.72%</td>
</tr>
<tr>
<td>Total government expenditure at market prices (JD billion)</td>
<td>2.396</td>
<td>2.810</td>
<td>3.181</td>
<td>3.539</td>
<td>3.912</td>
</tr>
<tr>
<td>Deflated government budget (JD billion)</td>
<td>2.375</td>
<td>2.752</td>
<td>3.085</td>
<td>3.429</td>
<td>3.720</td>
</tr>
<tr>
<td>PEE as percent of government spending</td>
<td>1.7%</td>
<td>3.2%</td>
<td>2.2%</td>
<td>2.2%</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

Source: Central Bank of Jordan, Monthly Statistical Bulletins, different issues.

Note: GDP = gross domestic product; JD = Jordanian dinar; PEE = public environmental expenditure.
a. PEE includes central government finance, public independent institutions, municipalities, and Greater Amman Municipality.

FIGURE 7.11 PUBLIC ENVIRONMENTAL EXPENDITURE AS PERCENT OF GDP IN SELECTED EU COUNTRIES

7.12 indicates that expenditure classified as wastewater management accounts for 40 percent of the period’s total PEE; however, the actual share is likely to be higher. Because of differences in the level of details applied by different ministries to the classification of their expenditure, the Ministry of Planning and International Cooperation (MoPIC), which accounts for 24 percent of total PEE, classifies 90 percent of its own PEE as NEC (not otherwise classified). Casual inspection of the MoPIC’s detailed budget data suggests that most of the expenditure handled by the MoPIC (which consists of loan or grants from international development agencies) is related to wastewater treatment.

**Figure 7.12** TOTAL PUBLIC ENVIRONMENTAL EXPENDITURE BY DOMAIN, 2002–06

![Bar chart showing expenditure distribution by domain](chart)

**Sources:** Calculation based on records of the MoF (2006b), GBD (2000–07), GAM (2002–07), and CVB (2000–07.)

Average expenditures for 2002–06 show that the WAJ has the highest proportion of environmental expenditures (41 percent), where expenditure is mainly on wastewater networks and treatment (see figure 7.13). For the reasons summarized above, the real share is likely to be higher, as the PEE attributed to the MoPIC (24 percent) typically is executed by the relevant sector agency, which in the case of
wastewater treatment is the WAJ. Average annual expenditure for GAM formed 20 percent of all Jordan's average PEE, of which more than 90 percent is on solid waste management. The ministry of environment and ASEZA accounted for 2 percent each of total Jordan's PEE.

These results contrast with data from the European Union, where major expenditures are on non-core domains. Non-core domains include energy, transport, agriculture, civil protection, consumer protection, and urban areas. Wastewater constitutes less than 10 percent of total PEE.

PEE contribution to research and development is low at less than 1 percent, leading to a more limited role of research institutions in the environmental policy setting. In contrast, the average contribution
of EU member states in 1997 to research and development formed 8 percent of all expenditures on environmental domains (Eurostat 2008).

The vast majority of the environmental expenditure in Jordan (87 percent between 2002 and 2006) is capital expenditures. In other words, the majority of environmental expenditure in Jordan is intended to lay the ground for future prosperity, because current expenditure generates “well-being” in the present, while capital expenditure lays the groundwork for future prosperity.

The results of cost of environmental degradation identify the issues of air quality and water quality as priority environmental issues. This does not contradict the results of the PEER, because the high expenditure on environmental protection can be related with low environmental quality (the situation makes expenditure necessary) and also with high environmental quality (that has improved over time as a result of PEE). As such, it is possible that the reason behind the low share of solid waste and wastewater in the total cost of degradation is the relatively high amount of public spending in these areas.

Jordan’s PEE is in line with the government national priorities as indicated in the NA and in the different plans of the key agencies such as the MoWI, MoEnv, and GAM.

Interpretation of PEER results
The first PEER conducted in Jordan in the context of the present CEA should be considered as an initial step toward a system of more structured (and internationally comparable) accounting of national efforts for environmental protection. Such a comprehensive system could provide important information on the adequacy and effectiveness of resources mobilized for the environment, but in addition to the PEER, it should include the following:

» An estimate of private expenditure for the environment: not all efforts to improve environmental quality are (or should be) undertaken by the public sector. End-of-pipe or process investments undertaken by industries to reduce air or water emissions are obvious examples.

» A set of headline indicators of environmental quality at the national level, measured at regular intervals, made available to the public, and presented in easily understandable ways: even if cause-effect relationships might be difficult (or inappropriate) to establish, a trend of
increased environmental expenditure (private and public) accompanied by deteriorating or not improving environmental quality would provide broad indications that public or private efforts should be scaled up, restructured in terms of composition across themes, or improved in terms of quality or cost-effectiveness. The present PEER already indicates the following:

» Jordan’s public expenditure as percentage of GDP is sizeable, especially considering that it is at the high end of the range of EU PEE: this confirms the government’s commitment to improving environmental quality (although it does not demonstrate the cost-effectiveness of the intervention financed).

» The large share of PEE assigned to wastewater management suggests that the government has given priority to treatment as a strategy to improve water quality. Options (such as water-saving policies) with lower unit costs and multiple social dividends could be explored to increase the environmental benefits per JOD spent.

» Looking at the results of the COED analysis, the national government and GAM will need to scale up their efforts to improve air quality. Although good progress can be made with interventions at zero or low cost for the public budget (for example, in the case of transport, better regulation of vehicular inspection and fleet quality), it is likely that, at least in the early stages, the process of reducing emissions will need to be incentivized and sped up with public funds. Ultimately, the mix between public and private funds will be the result of political decisions, but some reallocation or environmental spending in favor of air quality management might be unavoidable.

7.5.2 Resources available to the MoEnv

The MoEnv has demanding tasks but limited resources to carry them out. The current institutional setup requires a great deal of coordination across ministries to improve environmental quality. In the face of a sizeable amount of public funds mobilized for environmental protection (section 7.5.1 above), the effectiveness of their use is likely to depend on the ability to coordinate different actors, and more generally, to provide overall policy direction to government action on the environment.
Does the MoEnv, as the entity charged with those coordination and policy direction functions, have enough human and financial resources to carry them out effectively?

Since its establishment in 2003, the MoEnv underwent an institutional capacity development and reform process. The MoEnv institutional review recently conducted with EU assistance (2006–07) identified several priority areas for further institutional growth and effectiveness, including strengthening its leadership and management role and the core functions of the ministry, building capacity of new directorates, reorganizing and strengthening regional directorates, and cooperating with local government, private sector, and NGOs.

The ministry is in the process of implementing those actions, and it is too soon to expect tangible results. The constraints imposed by resources available are significant.

In particular, MoEnv is understaffed when compared with countries with similar GDP per capita. A cross-country review of staffing levels at ministries of environment (see figure 7.14) shows that, after

**FIGURE 7.14 COMPARISON OF MINISTRIES OF ENVIRONMENT STAFFING LEVELS PER UNIT OF DENSITY**

Sources: Authors based on World Bank data, CEAs for Bangladesh (World Bank 2006a), Pakistan (World Bank 2006b), El Salvador (World Bank 2006c), Colombia (World Bank 2007a), and Peru (World Bank 2007f); New Zealand Ministry of Environment (New Zealand Government 2008); and EU Institutional Strengthening project for Jordan (Ministry of Environment 2008).

Note: The figures are expressed in terms of number of staff per unit of density (population/land area).
controlling for relevant factors such as per capita GDP, population, and land areas, the MoEnv in Jordan is highly understaffed. This is particularly striking if one considers that the staffing levels in the comparator countries are typically inadequate as well.²

The institutional strengthening component of the EU capacity-strengthening project reviewed the staffing levels at the MoEnv and recommended to increase staffing levels by 50 employees to reach 150 staff. The ministry received approval for recruiting 31 additional staff, which to some extent will ease the understaffing.

The MoEnv budget for capital expenses has increased, as well as its predictability, since it is based on NA action plans. A review of the MoEnv budget for 2007—10 shows that the MoEnv devotes a significant portion of its budget to environmental quality monitoring, support of the environmental rangers department, waste management, protection of biodiversity, pollution abatement, and wastewater management issues.

Internal coordination within MoEnv could be improved. Another constraint that hampers MoEnv effectiveness is the limited internal coordination among units within the ministry, particularly among the licensing, monitoring, and inspection directorates, as well as between the regional directorates and headquarters.

To improve coordination, the MoEnv instituted planning and monitoring meetings that allow for directors of different directorates to share information. Additional steps that could be undertaken to improve coordination include the following: (1) issuing internal processes that provide details of coordination linking more units horizontally; (2) including detailed coordination requirements in staff job descriptions; (3) increasing and involving to a larger extent regional directorates in MoEnv activities; and (4) promoting the formation of task forces involving multiple directorates to better address issues and tasks that cut across strict unit boundaries (for example, air quality).

7.5.3 Environmental management at the subnational level

Environmental management framework in Jordan is centralized, with most of the decisions emanating from institutions located in Amman. ASEZA is an example of local-level environmental management, as it has powers comparable to those of the MoEnv.
Limited resources and centralized processes contribute toward weak local environmental management capacity at the governorate and municipal levels. In Jordan’s governorates, environmental management is undertaken by the regional directorates of the MoEnv, local municipalities, and the environmental rangers’ regional directorates. MoEnv’s six regional directorates have a limited role in environmental management at the local level because of the lack of staff and need for additional capacity and equipment, including information technology and monitoring and inspection equipment. For example, Zarqa Governorate’s regional directorate—a major industrial hot spot—has 5 staff, Balqa has 7 staff, and Irbid has 11 staff.

Capacity of municipalities varies in terms of environmental management. Municipalities are responsible for solid waste collection, pest control, public health, slaughterhouse monitoring, and management of urban green areas. Different municipalities vary in their environmental management capacity: GAM has an environmental department and an environmental section in each of its 27 districts, and it is responsible for operating Jordan’s largest solid waste landfill, whereas smaller municipalities have limited environmental capacity due to lack of staff and resources.

Establishment of environmental rangers will strengthen the environmental management framework and the enforcement capacity, but it makes the need for coordination and environmental legislation review more acute. The environmental rangers department, which forms a separate division under the public security directorate, was established in 2006 and currently has 400 staff. An MOU between MoEnv and the public security directorate governs the operation of environmental rangers, and it will stay in force until a law or regulation governing their operation is issued. Because the environmental rangers are responsible for the implementation of all environmental legislation—not specific to the environmental protection law—it is essential that legal articles are revised to eliminate any potential conflict or contradiction.

Coordination should be strengthened between regional directorates of different ministries and local NGOs. Coordination of MoEnv directorates in governorates with governorate-level authorities and municipalities seems to be rather limited. The MoEnv could assist with the capacity development for the municipalities.
7.5.4 EIA review

The EIA is a key tool to ensure that decisions taken at the legislative and regulatory level are executed and built into the design and implementation of development projects. The purpose of the EIA review conducted as part of the CEA is to (1) assess the current status of EIA procedure and practice in Jordan; (2) carry out a diagnostic review of the national EIA system, determining the similarities and difference between the national EIA system on one hand and the World Bank and the European Commission on the other; and (3) propose recommendations and an action plan to improve the national EIA system to make it compatible with the World Bank EIA requirements.

The reason for comparing Jordan’s EIA system with those of the World Bank and the European Union is motivated by the intention to benchmark Jordan’s system against two widely accepted EIA systems at the international level. Additionally, the comparison measures the acceptability of the national EIA system to be applied on the ground using the 11 operational principles approved by the World Bank Board of Directors in Operational Policy 4.00 for the use of country systems (see box 7.4). A complete report on this assessment is included in annex 5 in World Bank (2010).

The legal basis for EIA is established in Environment Protection Law No. 52/2006. It is implemented through its EIA Regulations

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**BOX 7.4 THE WORLD BANK POLICY ON THE USE OF COUNTRY SYSTEMS**

The World Bank’s environmental and social policies are designed to avoid, mitigate, or minimize adverse environmental and social impacts of projects supported by the Bank. The specificity of these policies creates difficulties for borrowers attempting to mainstream them within their own legal and administrative frameworks and their own development programs. In 2002, recognizing the importance of country ownership and institutional capacity building, the Bank shifted its focus toward increasingly integrating environmental and social safeguards into country systems to facilitate their application and build local capacities. In 2005, the Operational Policy (OP) 4.00: Piloting the Use of Borrower Systems to Address Environmental and Social Safeguard Issues in Bank-Supported Projects was approved. Over the past two years, the Bank piloted the use of borrower systems in Bank-supported projects, and initial results indicate successful application of country systems for environmental assessments for three cases in Egypt and for one in Tunisia.

Source: OP 4.00.
No. 37/2005 and its five annexes. These require the project proponent to hire a national consulting firm to conduct the EIA and prepare an EIA report. It assigns full authority to the MoEnv through its department of licensing and guidance (which includes the EIA section) to arrange for screening, control, and follow-up on the EIA process and its implementation. The approval of an EIA is a prerequisite for any subsequent license or permit by any or all other relevant authorities that may be required before construction. All development projects, regardless of EIA classification, must adhere to the Jordanian standards for air emission, water, and wastewater reuse, and industrial and municipal discharges. The essential elements of the Jordanian procedures are summarized in table 7.3.

The results of the equivalence assessment showed that many features of the Jordanian EIA system are compatible with the World Bank EA Policy (OP 4.01) and the EC EIA Regulation No. 97/11. These features are (1) screening, (2) scoping; (3) the EIA report content, (4) the content of the environment management plan (EMP), (5) provisions for appeal; and (6) requirements for monitoring and follow-up. The assessment showed that the parallel EIA system established by ASEZA is similar to OP 4.01 and includes provisions for public consultation and disclosure of EIA reports.

Significant and moderate gaps exist between the national EIA system and the Environment Assessment Policy (OP 4.01). The significant differences are that the national EIA system does not (1) assess indirect, cumulative, and associated impacts; (2) use regional or sectoral environment assessment; (3) require the involvement of the stakeholders (affected groups and NGOs) and continued consultations throughout EIA preparation; and (4) carry out disclosure and accessibility of the EIA reports to the public. Moderate gaps also exist, such as the following: (1) addressing transboundary and global concerns is not required; (2) requirements for compliance with international agreements is not included in the EIA regulations though Jordan is signatory to a number of international treaties and conventions; (3) national standards and guidelines do not explicitly reflect international good practice (such as the World Bank’s Pollution Prevention and Abatement Handbook); and (4) and there are no requirements for the use of independent advisory panels for highly risky and contentious projects.
### TABLE 7.3 SUMMARY OF THE JORDANIAN EIA PROCEDURES

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Initial Filing and Screening** | – The Project Proponent completes a Project Information Form (PIF) of the intended project and submits it to the Ministry of Environment for screening.  
– An Interministerial Central Licensing Committee reviews the PIF, and after conducting site surveys, determines whether the project is classified as—  
  - Category I projects for which an Environmental Impact Assessment (EIA) report is required  
  - Category II projects for which an initial EIA is only required  
  - Category III for which no environment analysis is required  
– The decision is publicly displayed for two weeks. |
| **Scoping** | – The ministry issues legally binding guidance on the scope of the Assessment  
– Proponent prepares the terms of reference (ToR), after a mandatory public consultation.  
– An Interministerial Technical Review Committee (TRC) reviews and approves the ToR. |
| **Technical Evaluation** | – A complete EIA is submitted to the Technical Evaluation Committee (TEC), which evaluates—  
  - Its general conformity to the ToR  
  - The methodologies used, the scientific validity and legal value of the evidence presented  
  - The soundness and compatibility of the impacts with respect to environmental protection, the content of the environment management plan (EMP), standards, and other references  
– The TEC reports its finding to the minister of environment. |
| **Decision and Approval** | – The minister reviews the committee’s report and notifies its decision to the proponent and publishes it within 45 days. After this period, or if no decision is posted, the EIA is deemed to have been accepted.  
– If the EIA is rejected, the proponent has 15 days to appeal to the minister of environment who establishes a three-person independent committee to review the decision. |
| **Licensing** | – Upon approval of the EIA report, the proponent receives an environment license to proceed. |
| **Monitoring** | – The Ministry of Environment is required to follow up on the implementation of the Environment Management Plan and to report the results of monitoring. |
| **Disclosure of EIA** | – The ministry can make available to the concerned parties and upon their request the (nonconfidential) information related to the EIA. |

*Source: Author based on information in EIA Regulations no. 37/2005.  
Note: a. As per the EIA Regulation No. 37/2005, the Technical Review Committee consists of the representatives of the following agencies: ministries of environment, planning and international cooperation, municipal affairs, health, agriculture, industry and trade, energy and mineral resources, water and irrigation, tourism and antiquities, and public works and housing, in addition, to representatives from NGO and academia.*
The MoEnv is developing a set of new regulations to improve its overall EIA process and content through a new organizations structure, is reviewing its EIA executive regulations, and enacting new regulations for environmental compliance and control. The EIA system suffers from administrative, technical, and management shortcomings. There is a serious shortage of trained human resources in the MoEnv and in the six regional environmental directorates for EIA administration and management. There are no established criteria, guidelines, and rules for reviewing EIA and making decisions on approval or disapproval of the EIA reports. There are neither standard terms of reference (ToR) for preparing EIA reports in specific nor comprehensive sector guidelines, and the content and quality of the EIA reports generally indicate that the requirements in the EIA Regulations No. 37 often are not met and that the quality of these reports is variable. There is no follow-up on the implementation of the EMP as required by the EIA regulation, because of lack of staff, resources, and manuals for inspections, and there are no fines for not conducting an EIA. Furthermore, the track record for monitoring and enforcement is evolving. Because of fragmentation at the national and regional levels, no single institution can take enforcement actions effectively.

Despite its recent establishment, the MoEnv continues to make considerable progress toward institutionalizing the EIA system in Jordan. USAID and the EC are providing technical assistance to the MoEnv on environmental management, which includes strengthening the EIA system. One of the major shortcomings is the limitation of consultation to only the scoping stage, and the disclosure of the EIA reports is limited to the project proponents and is specifically authorized by the MoEnv. In ASEZA, public consultation is required even after scoping and the EIA reports are supposed to be made public, although ASEZA management does not disclose the reports for fear that national consulting firms will resort to plagiarizing existing reports rather than conducting the needed research and analysis. Public consultation and disclosure are permitted in Jordanian legislation, namely Town and Country Planning Law No. 79/1966 and its amendment, which allows consultation and disclosure of local and regional master plans. Projects cofinanced by the international financial institutions and donors require full consultation and dissemination of the EIA reports to public locations in country. The MoEnv has expressed its full support to amend the EIA regulations
to require public consultations throughout the EIA process and widely disclose the EIA reports.

**The improvement of the EIA process should be realistically implemented over the short and medium terms, taking into consideration MoEnv’s limited human and financial resources.** The first recommendation is to consolidate and strengthen the present EIA system using existing laws and regulations followed by changes and reforms of these regulations once the consolidation phase is successfully implemented and verified.

Annex 5 in World Bank (2010) includes a proposed action plan to address the identified gaps to achieve equivalence and acceptability for using the national EIA system in World Bank operations. USAID has agreed through its Sustainable Mechanism of Business Expansion and Quality Program (SABEQ) to support the preparation of EIA guidelines and generic ToRs for key sectors; to develop format, criteria, and guidelines for reviewing EIA reports; and to improve compliance monitoring through training and preparing inspection manuals. The MoEnv will take the necessary measures to amend the EIA regulations to allow public consultation and public disclosure, permit environmental audits, and modify the list of projects for which an EIA is required to include construction and operation of landfills, WWTPs, and desalination plants. The MoEnv has asked the World Bank to continue to provide overall guidance and quality control to strengthen the EIA system to achieve full compatibility with the World Bank EIA policy.

### 7.5.5 Role of the judiciary

**Jordan has an independent and impartial judiciary system on par with some EU countries,** as evidenced by the Judicial/Legal Effectiveness Index \(^3\) (JLEI) in which Jordan’s score of 67 percent is the highest among Arab countries measured, as well as on par and in some cases higher than the average for non-OECD and European countries.

**Legislation stipulates the role of courts in the settlement of environmental cases.** Environment Protection Law No. 52/2006 specifies the cases for which violators may be referred to court for legal action. Aqaba’s Environmental Regulation No. 21/2001 specifies the Aqaba court of first instances as the court responsible for environmental issues, in addition to its authorities, and is responsible for adjudicating envi-
## TABLE 7.4 SUMMARY OF MAIN STRENGTHS AND WEAKNESSES

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legal and institutional setup</strong></td>
<td></td>
</tr>
<tr>
<td>− Existing environmental legal framework that continues to evolve and improve.</td>
<td>− Gaps in formal laws accompanied by multiplicity of sometimes-conflicting legislation.</td>
</tr>
<tr>
<td>− Establishment of MoEnv with clear role to set policies and coordinate action to protect the environment.</td>
<td>− Emphasis on command and control instruments with little legal framework for applying economic incentives.</td>
</tr>
<tr>
<td><strong>Picking up signals</strong></td>
<td></td>
</tr>
<tr>
<td>− Increase in seeking public feedback on key documents, and the GoJ drive toward e-government.</td>
<td>− Lack of a system of homogeneous, results-focused indicators of environmental quality.</td>
</tr>
<tr>
<td>− Public interest in environmental matters and positive attitude toward the environmental movement.</td>
<td>− Weakness in environmental monitoring systems.</td>
</tr>
<tr>
<td>− Varied environmental NGO and CBO base.</td>
<td>− Lack of metadata base of monitoring information that is accessible to the public.</td>
</tr>
<tr>
<td><strong>Balancing interests</strong></td>
<td></td>
</tr>
<tr>
<td>− Good base of standards for environmental quality and established participatory mechanism led by JISM for issuance and updating standards.</td>
<td>− Lack of mechanism to determine priorities among the environmental sectors.</td>
</tr>
<tr>
<td>− Several nonenvironmental ministries have environmental sections within their organizational structure.</td>
<td>− Lack of sustainable and systematic mechanism for mainstreaming environment into sectoral and developmental plans and strategies; lack of target of improved environmental performance in sector policies and strategies.</td>
</tr>
<tr>
<td>− Strong planning tradition and current emphasis on linking government action plans to ministries budgets.</td>
<td>− Weak coordination mechanism between institutions responsible for environmental management.</td>
</tr>
<tr>
<td><strong>Executing decisions</strong></td>
<td></td>
</tr>
<tr>
<td>− Favorable environment as measured by governance indicators on quality of public administration and public sector accountability and an independent and impartial judiciary system.</td>
<td>− Centralized governance system compounded with top-down organizational culture</td>
</tr>
<tr>
<td>− MoEnv’s willingness and capacity to improve its performance.</td>
<td>− Limited human and financial resources in MoEnv.</td>
</tr>
<tr>
<td></td>
<td>− EIA process, though well established, suffers from administrative, technical, and management shortcomings.</td>
</tr>
</tbody>
</table>

*Source: Authors.*

*Note: CBO = community-based organization; EIA = environmental impact assessment; GoJ = Government of Jordan; JISM = Jordan Institution for Standards and Metrology; MoEnv = Ministry of Environment; NGO = nongovernmental organization.*
environmental offences. Nevertheless, recourse to judiciary for upholding environmental rights by citizens and NGOs is limited.

**Jordan’s access to justice in environmental matters could be improved following good practice defined in the context of the Aarhus Convention.** Access to justice is the third pillar of the Aarhus Convention, and it provides a mechanism for the public to enforce environmental law directly. The convention recommends a number of actions that countries should achieve to ensure access to justice in environmental matters, including the following: ensuring availability of independent and impartial review bodies; developing clear rules concerning rights of individuals and NGOs to judiciary access for environmental violations; and establishing mechanisms to provide public with information on access-to-justice procedures.

### 7.6 CONCLUSION

This chapter analyzed the way in which Jordan’s institutions pick up signals, balance interest, and execute decisions on environmental management, highlighting progress and remaining challenges. It identified the main strengths and weaknesses of the system, which are summarized in table 7.4.

### NOTES

1. The analysis is based on the definition of environmental products resulting from combining the OECD and Asia-Pacific Economic Cooperation (APEC) list. See http://www.unctad.org/trade_env/test1/meetings/egs/crp.pdf
2. Such comparison provides a rough picture as it does not take into consideration the numbers of professional versus administrative staff, as well as the environmental management framework within the countries (that is, the responsibilities of other institutions with environmental mandates).
3. JLEI: Percentage firms in the country giving satisfactory ratings to questions on judicial independence, judicial bribery, quality of legal framework, property protection, and parliament and police effectiveness.
This chapter proposes selected priority recommendations to enhance the overall effectiveness of Jordan environmental management. Recommendations are classified (see table 8.1) in accordance to their time horizon (short term, that is, actionable within 18 months; and medium to long term, actionable within one to three years); environmental theme (air quality, water quality, cross-cutting); and the agency that is likely to lead the implementation of the proposed action (MoEnv or other agencies).

The recommendations—which take into account comments and suggestions made by the participants to the CEA wrap-up workshop—are evenly split between single theme and cross-cutting; and between

<table>
<thead>
<tr>
<th>Theme</th>
<th>Short Term</th>
<th>Medium and Long Term</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MoEnv</td>
<td>Other Institutions</td>
<td>MoEnv</td>
</tr>
<tr>
<td>1. Air quality</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2. Water quality</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3. Cross-cutting</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

*Source: Authors.*
lead implementation responsibility (with the MoEnv as leader in about half the cases).

The rest of this chapter discusses the specific recommendations proposed for the short (section 8.1) and the medium to long term (section 8.2). The key features of each of the recommendations (including roles and responsibilities, as well as qualitative assessments of coordination costs and expected impacts) are summarized in tables at the end of each section.

8.1 SHORT TERM

8.1.1 Air quality

Enhance air quality monitoring, including improved coordination arrangements

The MoEnv, in partnership with the GAM, and building on the technical assistance provided by the French development agency, should lead national efforts to accelerate the enhancement of the air monitoring system, including ambient air quality, as well as emission from stationary (possibly giving priority to the likely highest emitting sectors, such as those identified in the chapter on industrial pollution) and mobile sectors. The geographic coverage should include the major population and industrial centers in the country.

Promote integration of the environment in development processes

Accelerate the phase-out of high-sulfur diesel: the Ministry of Energy already made this decision, so it is important to mobilize the resources required for its enactment (for example, refinery upgrades). This can decisively contribute to the reduction of SO₂ emission and, to a lesser extent, PM. Options to improve the quality of fuel used by the industrial sector should be considered.

Define an action plan for implementing other key policies to reduce emission per unit of traffic (that is, emissions per vehicle-kilometers, ton-kilometers), namely, enhancing maintenance of vehicles, improving the environmental performance of vehicular fleet through strengthened regulation of imports, and promoting the replacement of older vehicles.

Establish Jordan-specific emission factors (based on driving-circle measurement or other internationally accepted methodologies) to im-
prove information on the volume and distribution across the vehicular fleet of polluting emissions from road transport. The technical capacity and equipment of relevant authorities (MoEnv, Driver and Vehicle Licensing Directorate, etc.) need to be adequately strengthened.

8.1.2 Water quality

» Enhance the monitoring of groundwater resources by synchronizing the quality and quantity parameters to better evaluate the impacts of accelerated aquifer use on the quality and availability of groundwater. This requires establishing a dedicated network of observation wells.

» Revise and strengthen the standard for wastewater discharged from industries (JS 202/2007), in particular with respect to TDS, heavy metals, and other toxic organic materials. Revise the regulation related to discharging industrial effluents in the domestic sewer network.

8.1.3 Cross-cutting

Focus the action of the MoEnv, given the limited financial and human resources, and enhance the effectiveness of its action

» Focus the scarce resources of the MoEnv on core functions of strategy development and follow-up, policy making, environmental advocacy within the cabinet, and improved coordination across sectors; limit to the minimum MoEnv direct engagement in project implementation activities.

» Adopt a strategic approach to inspections, defining in a transparent manner priority locations and sectors (as opposed to the current approach, which is primarily complaint driven).

» Improve the decentralization of the MoEnv activities and enhance the role of the regional directorates.

» Support compliance with environmental regulation through provisions of advisory services and technical assistance to industries (for example, on cleaner technologies, processes, energy efficiency, and EMS implementation).
<table>
<thead>
<tr>
<th>Theme</th>
<th>Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating Agencies</th>
<th>Coordination Costs</th>
<th>Expected Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Air quality</td>
<td>Enhance air quality monitoring, including improved coordination arrangements</td>
<td>Accelerate the implementation of the air quality monitoring system, in cooperation with GAM and building on technical assistance by the AFD, including ambient air quality, as well as emission from stationary and mobile sources (possibly giving priority to the likely highest emitting sectors, such as those identified in the chapter on industrial pollution). The geographic coverage should include the major population and industrial centers.</td>
<td>MoEnv</td>
<td>MoEnv, MoH, GAM, and relevant municipalities</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Promote integration of environment in development processes</td>
<td></td>
<td>Ministry of Energy</td>
<td>MoPIC, MoEnv, Ministry of Finance</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accelerate the phase-out of high sulfur diesel: the decision has already been made by the Ministry of Energy, so it is important to mobilize the resources required for its enactment. This can decisively contribute to the reduction of SO\textsubscript{2} emission, and to a lesser extent, of PM. Options to improve the quality of fuel used by the industrial sector should also be considered.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Define an action plan for implementing other key policies to reduce emission per unit of traffic, namely enhancing maintenance of vehicles, improving the environmental performance of vehicular fleet through strengthened regulation of imports, and promoting the replacement of older vehicles.</td>
<td>MoEnv</td>
<td>Ministry of Transport, Drivers and Vehicles Licensing Directorate</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

Continued on next page
### TABLE 8.2 DETAILED SHORT-TERM RECOMMENDATIONS

<table>
<thead>
<tr>
<th>Theme</th>
<th>Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating Agencies</th>
<th>Coordination Costs</th>
<th>Expected Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Air quality (cont.)</td>
<td>Promote integration of environment in development processes (cont.)</td>
<td>Establish Jordan-specific emission factors (based on driving-circle measurement or other internationally accepted methodologies) so as to improve information on the volume and distribution across the vehicular fleet of polluting emissions from road transport. The technical capacity and equipment of relevant authorities (e.g., MoEnv, Drivers and Vehicles Licensing Directorate, etc.) will need to be adequately strengthened.</td>
<td>Drivers and Vehicle Licensing Directorate</td>
<td>MoEnv, Ministry of Transport</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>2. Water quality</td>
<td>Enhance environmental monitoring and tools to support decisions</td>
<td>Enhance the monitoring of groundwater resources by synchronizing the quality and quantity parameters, so as to better evaluate the impacts of accelerated aquifer use on the quality, and availability, of groundwater. This requires establishing a dedicated network of observation wells.</td>
<td>MoWI</td>
<td>WAJ, MoEnv, JVA</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Promote integration of environment in development processes</td>
<td>Revise and strengthen the standard for wastewater discharged from industries [JS 202/2007], in particular with respect to TDS, heavy metals and other toxic organic materials. Also revise the regulation related to discharging industrial effluents in the domestic sewer network.</td>
<td>WAJ</td>
<td>MoEnv, Ministry of Industry, Chambers of Commerce</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

*Continued on next page*
TABLE 8.2 DETAILED SHORT-TERM RECOMMENDATIONS (continued)

<table>
<thead>
<tr>
<th>Theme Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating Agencies</th>
<th>Coordination Costs</th>
<th>Expected Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Cross-cutting</td>
<td>Focus the action of the Ministry of Environment given the limited financial and human resources, and enhance the effectiveness of its action</td>
<td>MoEnv</td>
<td>MoEnv</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Adopt a strategic approach to inspections, defining in a transparent manner priority locations/sectors (as opposed to the current one which is primarily complaint-driven).</td>
<td>MoEnv</td>
<td>MoEnv, MoH</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Improve the decentralization of the MoEnv activities and enhance the role of the regional directorates.</td>
<td>MoEnv</td>
<td>MoEnv</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Support compliance with environmental regulation through provisions of advisory services and technical assistance to industries (e.g., on cleaner technologies, processes, energy efficiency, and EMS implementation).</td>
<td>MoEnv</td>
<td>MoEnv, RSS, JCI</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

Continued on next page
### TABLE 8.2 DETAILED SHORT-TERM RECOMMENDATIONS (continued)

<table>
<thead>
<tr>
<th>Theme Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating Agencies</th>
<th>Coordination Costs</th>
<th>Expected Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Cross-cutting (cont.) Improve public participation and develop guidelines to improve the EIA process</td>
<td>Improve the application of the EIA system in Jordan, initially through strengthening the existing system, through application of the Jordanian Public Law related to public consultation and disclosure; and through development of standard Terms of Reference (ToRs), guidelines for sector EA guidelines and EA reviews, and decision making criteria for the Central Licensing Committee and the EIA Review Committee.</td>
<td>MoEnv</td>
<td>MoEnv, ASEZA</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Encourage the fuller integration of air and water quality improvement objectives into sector policies</td>
<td>Based on the results of improved air and water quality monitoring, establish a list (or improve existing ones) of priority pollution hot spots, particularly in Zarqa.</td>
<td>MoEnv</td>
<td>Ministry of Industry, Chambers of Commerce</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

*Source: Authors.*

*Note: AFD = Agence Francaise de Developpement; ASEZA = Aqaba Special Economic Zone Authority; EIA = environmental impact assessment; GAM = Greater Amman Municipality; JCI = Jordan Chamber of Industry; JVA = Jordan Valley Authority; MoEnv = Ministry of Environment; MoH = Ministry of Health; MoPIC = Ministry of Planning and International Cooperation; MoWI = Ministry of Water and Irrigation; RSS = Royal Scientific Society; WAJ = Water Authority of Jordan.*
Improve public participation and develop guidelines to improve the EIA process

» Improve the application of the EIA system in Jordan, initially through strengthening the existing system, through application of the Jordanian Public Law related to public consultation and disclosure, and through development of standard ToRs, guidelines for sector EIA and EIA reviews, and decision-making criteria for the Central Licensing Committee and the EIA Review Committee.

Encourage the fuller integration of air and water quality improvement objectives into sector policies

» Based on the results of improved air and water quality monitoring, establish a list (or improve existing ones) of priority pollution hot spots, particularly in Zarqa.

8.2 MEDIUM TO LONG TERM

8.2.1 Air quality
Enhance environmental monitoring and develop tools to better analyze the environmental implications of development policies

» Establish, as part of the strategic planning of large urban areas (starting with the implementation of Amman’s Master Plan), traffic models to optimize the design of transportation system and the related air pollution and congestion reduction benefits.

» Define—in priority pollution hot spots and where not already available—air pollution abatement plans, including targets for selected environmental improvement objectives, and clear assignments of roles and responsibilities for the different stakeholders involved; and, subject to criteria of financial sustainability and cost recovery, provide incentive mechanisms to encourage industries to comply with environmental regulation.

8.2.2 Water quality
Enhance environmental monitoring and develop tools to better analyze the environmental implications of development policies

» Under the initiative of the MoWI, streamline the national water quality monitoring system, avoid duplication of efforts, and enhance
data management (a simplified preliminary suggested monitoring schedule is presented in chapter 4 and further discussed in annex 2 in World Bank 2010).

» Conduct a study to evaluate the potential for reducing the social damage of water quality degradation through water-saving policies, to be combined with hygiene programs and enhanced wastewater treatment. The mix of policy tools would be defined following criteria of cost-effectiveness and using analytical tools, such as water quality simulation, multi-criteria and economic optimization models, GIS, and water PEER.

**Promote integration of the environment in development processes**

» Adopt a unified national water law, based on the principles of Integrated Water Resources Management (IWRM), linking water quality and water quantity sustainability objectives.

» Promote pollution control through a combination of (1) positive incentives (including soft loans and technical assistance) to encourage the use of cleaner production processes; and (2) gradual phasing-in of negative incentives (pollution levy for industrial emissions exceeding a given standard) to induce firms to meet effluent and ambient standards (for example, via end-of-pipe treatment). Initially the levy could be linked to level of activity/employment, and later—once adequate monitoring capacity is in place—to emission levels.

**8.2.3 Cross-cutting**

**Enhance environmental monitoring and tools to support decisions**

» Undertake a rapid assessment (based on environmental audits or other tools) of the average and marginal abatement cost by pollutant type and industrial sector as a basis to better inform pollution abatement policies and programs.

**Improve public access to information and participation in environmental matters**

» Improve public access to information and participation in environmental matters. To that end, the MoEnv, in collaboration with relevant agencies, should revise Environment Law No. 52/2006, after a suitable implementation time.

» Institutionalize the practice of disseminating information, holding consultations, and instituting the right of access to information
without justification. This might require amendments to the law regulating access to information (47/2007).

Further consolidate and strengthen the EIA process to approximate it further to international best (such as the EU and World Bank OP 4.00)

» Amend the EIA regulations to allow public consultation and disclosure (starting with distribution of scoping statements to relevant stakeholders); environmental audits; and outsourcing to qualified third parties the inspection of large polluting installations, as well as monitoring and follow-up of EMPs (as illustrated in chapter 7).

Enhance mainstreaming of the environment in the development processes and establish a mechanism for determining environmental theme priorities and monitoring their progress of achievement

» Accelerate, through development of the necessary regulation, the adoption of SEA to promote the integration of environmental concerns across sectors.

» Promote the inclusion of specific targets of environmental improvements in selected sector strategies (starting with the implementation with the newly adopted transport strategy), as well as the definition of responsibilities for their achievement, performance indicators, and the allocation of the required human and financial resources.

» Establish a system of accounting of public and private expenditure for environmental protection in adherence to international statistical standards, and explore ways in which the results could be discussed at the cabinet level to evaluate the adequate volume and composition of public expenditure for environmental protection.
<table>
<thead>
<tr>
<th>Theme</th>
<th>Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating agencies</th>
<th>Coordination Costs</th>
<th>Expected Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Air quality</td>
<td>Enhance environmental monitoring and develop tools to better analyze the environmental implications of development policies</td>
<td>Establish, as part of the strategic planning of large urban areas (starting with the implementation of Amman’s Master Plan) traffic models to optimize the design of transportation system and the related air pollution and congestion reduction benefits. Define – in priority pollution hotspots and where not already available: air pollution abatement plans, containing: (a) targets for selected environmental improvement objectives, (b) a clear assignment of roles and responsibilities for the different stakeholders involved; and –subject to criteria of financial sustainability and cost recovery, (c) incentive mechanisms (including soft loans) to encourage industries to comply with environmental regulation.</td>
<td>GAM</td>
<td>Ministry of Transport, Public Transport Regulatory Commission</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>2. Water quality</td>
<td>Enhance environmental monitoring and develop tools to better analyze the environmental implications of development policies</td>
<td>Streamline the national water quality monitoring system, to avoid duplication of efforts and enhance data management (a simplified preliminary suggested monitoring schedule is presented in chapter 4.</td>
<td>MoWI</td>
<td>WAJ, MoEnv, JVA, MoWI, MoH</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

*Continued on next page*
<table>
<thead>
<tr>
<th>Theme</th>
<th>Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating agencies</th>
<th>Coordination Costs</th>
<th>Expected Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Water quality (cont.)</td>
<td>Water quality (cont.)</td>
<td>Conduct a study to evaluate the potential for reducing the social damage of water quality degradation through water saving policies, to be combined with hygiene programs and enhanced wastewater treatment. The mix of policy tools would be defined following criteria of cost-effectiveness and using analytical such as water quality simulation, multi-criteria/economic optimization models, Geographic Information Systems (GIS), and water Public Expenditure Reviews.</td>
<td>MoWI</td>
<td>MoEnv, WAJ, JVA</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Promote integration of environment in development processes

<table>
<thead>
<tr>
<th>Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating agencies</th>
<th>Coordination Costs</th>
<th>Expected Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Water quality (cont.)</td>
<td>Water quality (cont.)</td>
<td>Adopt a unified national water law, based on the principles of Integrated Water Resources Management (IWRM) and linking water-quality and water-quantity sustainability objectives</td>
<td>MoWI</td>
<td>MoEnv, WAJ, JVA</td>
<td>High</td>
</tr>
</tbody>
</table>

Promote pollution control through a combination of (1) Positive incentives (including soft loans and technical assistance) to encourage the use of cleaner production processes; and (2) gradual phasing-in of negative incentives (pollution levy for industrial emissions exceeding a given standard) to induce firms to meet effluent/ambient standards (e.g., via end-of-pipe treatment). Initially the levy could be linked to level of activity/employment, and later—once adequate monitoring capacity is in place—to emission levels. | WAJ         | MoEnv, Ministry of Industry, Chambers of Commerce | High          | High            |

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<table>
<thead>
<tr>
<th>Theme</th>
<th>Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating agencies</th>
<th>Coordination Costs</th>
<th>Expected Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Cross-cutting</td>
<td>Enhance environmental monitoring and tools to support decisions</td>
<td>Undertake a rapid assessment (based on environmental audits or other tools) of the average and marginal abatement cost by pollutant type and industrial sector, as a basis to better inform pollution abatement policies and programs.</td>
<td>MoEnv</td>
<td>Ministry of Industry, Chambers of Commerce, DOS</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Improve public participation and access to information</td>
<td>Revise the Environment Law No. 52/2006, after a suitable implementation time</td>
<td>MoEnv</td>
<td>Government and nongovernment stakeholders</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Institutionalize the practice of disseminating information, holding consultations, and instituting the right of access to information without justification. This might require amendments to the law regulating access to information (47/2007).</td>
<td>Information Council (when established)</td>
<td>MoEnv</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Strengthen EIA process</td>
<td>Amend the EIA regulations to allow public consultation and disclosure (starting with distribution of scoping statements to relevant stakeholders); environmental audits; and outsourcing to qualified third parties the inspection of large polluting installations as well as monitoring and follow up of the environment management plans</td>
<td>MoEnv</td>
<td>—</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
### TABLE 8.3 DETAILED MEDIUM- TO LONG-TERM RECOMMENDATIONS (continued)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Area</th>
<th>Recommendation</th>
<th>Lead Agency</th>
<th>Participating agencies</th>
<th>Coordination Costs</th>
<th>Expected Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Cross-cutting (cont.)</td>
<td>Enhance Mainstreaming environment in the development processes and establish a mechanism for determining environmental theme priorities and monitoring their progress and achievement</td>
<td>Accelerate, through development of the necessary regulation, the adoption of Strategic Environmental Assessment (SEA) as a tool to promote the integration of environmental concerns across sectors.</td>
<td>MoEnv</td>
<td>Interministerial committee</td>
<td>Medium</td>
<td>High</td>
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<td></td>
<td>Promote the inclusion of specific targets of environmental improvements in selected sector strategies (starting with the implementation with the newly adopted transport strategy), as well as the definition of responsibilities for their achievement, performance indicators, and the allocation of the required human and financial resources.</td>
<td>MoEnv</td>
<td>MoEnv, MoWI, MoH, MoT, MIT, MoMA</td>
<td>High</td>
<td>Medium</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td>Establish a system of accounting of public and private expenditure for environmental protection in adherence to international statistical standards, and explore ways in which the results could be discussed at the cabinet level to evaluate the adequate volume and composition of public expenditure for environmental protection.</td>
<td>DOS</td>
<td>DOS, MoEnv, MoH, MoWI, ASEZA, MoF, MoPIC, MoA, MoMA, GAM, WAJ, JVA</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Source: Authors.

Note: ASEZA = Aqaba Special Economic Zone Authority; DOS = Department of Statistics; EIA = environmental impact assessment; GAM = Greater Amman Municipality; JCI = Jordan Chamber of Industry; JVA = Jordan Valley Authority; MoEnv = Ministry of Environment; MoF = Ministry of Finance; MoH = Ministry of Health; MoMA = Ministry of Municipal Affairs; MoPIC = Ministry of Planning and International Cooperation; MoWI = Ministry of Water and Irrigation; RSS = Royal Scientific Society; WAJ = Water Authority of Jordan.


Drivers and Vehicles Licensing Directorate. 2007. Vehicle statistics according to registration year and vehicle category.


تعديل تشريعات تقييم الأثر البيئي للسماح بالتشاور مع كافة شرائح المجتمع ونشر البيانات والمعلومات (التركيز على نشر وتوزيع تقارير الجلسات وورش العمل التشريعية وتيسير عملية الوصول لـ جميع الجهات المعنية); وتتشافل عمليات التدقيق البيئي؛ وتكليف جهات مؤهلة كطرف ثالث تقوم بمعاينة الإنشاءات الكبيرة الملوثة وكذلك مراقبة ومتتابعة خطط الإدارة البيئية.

10. المساعدة الفنية وبناء القدرات

وضع نظام محاسبة لإنفاق العام والخاص على نشاطات حماية البيئة يكون متوافقاً مع المعايير الإحصائية الدولية، واقتراح آلية يمكن من خلالها مناقشة النتائج على مستوى الحكومة لتقييم حجم الإنفاق العام المناسب على أنشطة حماية البيئة في الأردن.
الضرورية بمستوى النشاط/عدد العاملين في المنشأة، على أن يتم لاحقًا، عند تطوير القدرة الرقابية، ربطها بمستويات الإبعادات.

٦. إجراء دراسة تقييم إمكانية الحد من الأضرار الاجتماعية الناشئة عن تدهور نوعية المياه من خلال تشجيع سياسات توفير المياه، وتفعيلها بالتزامن مع برامج صحية وتحسين معالجة المياه العادية. وتحديد مزيج السياسات من خلال إتباع معايير جدوى الكلفة واستخدام طرق تحليلية مثل محاكاة نوعية المياه (Water Quality Simulation)، والنماذج متعددة المعايير للوصول للأدلة الأمثل، وأنظمة المعلومات الجغرافية، ومراجعتين الإتفاق العام على المياه.

القضايا المتداخلة/المتناقضة

٢. السياسات العامة والاستراتيجيات والتشريعات

- إجراء تقييم سريع (يستند إلى عمليات التكيف البيئي أو أدوات أخرى) لكل من متوسط كلفة الحد من التلوث والكلفة الإضافية لتخفيف التلوث لكل نوع من الملوثات والقطاع صناعي، تستخدم كأساس لرسم سياسات وبرامج الحد من التلوث.

- تشجيع إدراج أهداف محددة لحماية البيئة وتحسينها في استراتيجيات قطاعات مختارة (بدءًا بإستراتيجية قطاع النقل التي اعتمدت مؤخرًا)، وكذلك تحديد المسؤول عن تنفيذها، ومؤشرات الأداء، وتخصيص الموارد البشرية والمالية المطلوبة لذلك.

التنسيق وإدراج الاعتبارات البيئية

- تطوير التشريعات اللازمة لتسريع تنفيذ مفهوم التقييم البيئي الاستراتيجي (SEAs) كأداة لدمج الاعتبارات البيئية في مختلف القطاعات.

التنوعية والمشاركة العامة ونشر المعلومات

- تحسين مستوى الحصول على المعلومات والمشاركة في القضايا البيئية، وهنا قد تحتاج وزارة البيئة بالتعاون مع الجهات المعنية إلى مراجعة قانون البيئة الحالي رقم ٢٠٠٠/٥/٢ بعد فترة مناسبة من تطبيقه.

- مؤسسة عملية نشر وتوزيع المعلومات، وعملية التشاور، ومنح الحق بالوصول إلى المعلومات دون الحاجة إلى تقديم تبرير، وهذا بدورة قد يتطلب بعض التعديلات على القانون الذي ينظم عملية الوصول إلى المعلومات (قانون رقم ٤٧/٢٠٠٧).
التوصيات المتوسطة المدى (من سنة إلى 3 سنوات)

نوعية الهواء

1. وضع، كجزء من تطبيق المخططات الشمولية في المناطق الحضرية الكبرى (بدءاً بالخطط الشمولي لأمانة عمّان الكبرى)، نموذج لحركة المرور من أجل تحسين خطط النقل والمواصلات والاستفادة من خفض تلوث الهواء وازدحام المرور المرتبطين بها.

2. وضع خطة تخفيف مستوى تلوث الهواء، بحيث تكون الأولوية للمناطق شديدة التلوث والمناطق التي لا يوجد لها بعد مثل هذه الخطط وتنتمي: (أ) أهدافاً محددة لتحسين الوضع البيئي، (ب) توزيع واضح للأدوار والمسؤوليات لمختلف المشاركين المعينين استناداً إلى معيار القدرة على الاستدامة المالية وإمكانية امتثال الكلفة، (ج) آليات التحفيز (بما في ذلك القروض الميسرة) لتشجيع الصناعات على الالتزام بالقوانين البيئية.

نوعية المياه

3. إقرار قانون وطني موحد للمياه، يستند إلى مبادئ الإدارة المتكاملة لموارد المياه (IWRM) ويربط ما بين أهداف الاستدامة لتنوع المياه وللمياه.

4. تسعر النظام الوطني لمراقبة نوعية المياه بمبادرة وزارة المياه والري من أجل تغديد تكرار الجهود المبذولة وتحسين عملية إدارة البيانات.

5. تعزيز الحد من التلوث من خلال مزيج من: (1) الحوافز الإيجابية (وتتمثل القروض الميسرة والمساعدة في التدريب) لتشجيع استخدام عمليات الإنتاج الأنظف، (2) الإدخال التدريجي للحوافز السلبية (ضرورية تلوث عن الإشعارات الصناعية التي تتجاوز مستوى معين) لاحتفاظ الشركات على الامتثال لمعايير التلوث وأعمال ومحاصيل التلوث المحيط (مثل معالجة المياه العادمة قبل تصريفها خارج المناشأة). يمكن في البداية ربط مستوى
التقنية وغيرها من المواد العضوية الأخرى السامة. كذلك مراجعة الأنظمة المتعلقة
بتصرف المياه العادية الصناعية في شبكات الصرف الصحي العامة.

القضايا المتنازلة/المتشابكة

7. السياسات العامة والاستراتيجيات والتشريعات

اعتمد خطة استراتيجية للتقييم البيئي، وتحديد المناطق والقطاعات ذات الأولوية
لإحصاءها بعمليات التقييم وفق آلية واضحة وشفافة (على عكس الآلية المتبعة حالياً
والتي تعتمد على تنفيذ التقييم البيئي بناء على شكوك مقدمة سابقاً).

بناء على نتائج البرامج المحسنة لمراقبة نوعية الهواء والمياه، وضع قائمة (أو تحسين
القائمة الموجودة) لمناطق اليوس البيئية الساخنة وخاصة في الزراعة.

تشجع الامتثال إلى القوانين والتشريعات البيئية من خلال الكشف الرسمي عن الجهات
الملوحة وكيفية تعاملها مع الوضع البيئي وذلك عن طريق المنظمات غير الحكومية
ووسائل الإعلام.

8. التنسيق وإدراج الاعتبارات البيئية

تركيز الموارد المحددة لوزارة البيئة على الوظائف والمهام الرئيسية المتعلقة برس
السياسات والإستراتيجيات ومتابعتها، وتحسين التنسيق بين مختلف القطاعات فيما يتعلق
بحماية البيئة، والحد إلى أقل ما يمكن من انخراط الوزارة المباشر في أنشطة تنفيذ
المشاريع.

تعزيز اللامركزية في أعمال وزارة البيئة وتقديم دور مديريات البيئة في المحافظات.

9. التوعية، المشاركة العامة ونشر المعلومات

تحسين تطبيق نظام تقييم الأثر البيئي في الأردن من خلال تعزيز النظام الحالي، عبر
تطبيق القانون المتعلق بالتشاور مع المواطنين والجهات التي تمتلكهم والتشريعات
الخاصة بنشر المعلومات، وعبر تطوير قاعدة معايير موحدة للشروط
المرجعية (TORs)، وأدلة إرشادية لكل من دراسات التقييم البيئي للقطاعات المختلفة
والمرجعية البيئية لهذه الدراسات، إضافة إلى وضع معايير لصناعة القرار بالنسبة
للجنة الترخيص المركزية ولجنة مراجعة تقييم الأثر البيئي.
التوصيات قصيرة المدى (لغة 18 شهراً)

نوعية الهواء

1. يجب أن تقوم وزارة البيئة بالاشتراك مع أمانة عمّان الكبرى واعتمادًا على الدعم الفني المقدم من وكالة التنمية الفرنسية الجهود الوطنى لتسريع تحسين نظام مراقبة الهواء، بما في ذلك نوعية الهواء المحيط، وملوثات الهواء المنبعثة من المصادر الثابتة (إعطاء الأولوية بصورة أكبر للقطاعات المحتمل أن تكون أعلى إنتاجًا، مثل تلك المذكورة والمحددة في الفصل المتعلق بالتنويع الصناعي). كما يجب أن تتضمن التغطية الجغرافية مراكز التجمعات السكانية والمراكز الصناعية الرئيسية في الأردن مثل عمّان، والزرقاء، واربد.

2. تسريع الإلغاء التدريجي للديزل عالي الكبريت: لقد تم اتخاذ القرار من قبل وزارة الطاقة، لذا من المهم توفير الموارد المطلوبة لتنفيذ (مثل تحديث الوحدات الخاصة بذلك في مصفاة البترول)، لأن ذلك سيساهم بشكل كبير في تخفيف انبعاثات الكبريت، ودرجة أقل المواد الجزيئية. إضافة إلى الاهتمام برداسة خيارات تحسين نوعية الوقود المستخدم في القطاع الصناعي.

3. تحديد خطة عمل لتطبيق سياسة أساسية أخرى لخفض انبعاثات لكل وحدة نقل (أي الإشعاعات للمركبة/كيلومتر، طن/كيلومتر)، وتحديداً تحسين صيانة المركبات وتحسين الأداء البيئي للمركبات عبر تعديل وتحسين تعليمات الاستيراد، وتشجيع استبدال المركبات القديمة.

4. وضع معايير لانبعاثات خاصة بالأردن (بالاستناد إلى قياس حركة السير أو غيرها من الهياكل المتصلة عالمياً) وذلك لتحسين المعلومات عن حجم وتوزيع انبعاثات الملوثات الناتجة عن حركة النقل البري. وسيطلب ذلك تعزيز القدرات الفنية وتشجيع التجهيزات اللازمة للجهات المعنية (مثل وزارة البيئة، وإدارة الترخيص ...الخ).

نوعية المياه

5. تعزيز مراقبة موارد المياه الجوفية من خلال استخدام كل من معايير النوعية ومعايير الكمية والتزام، وذلك لإجراء تقييم أفضل لتأثيرات الاستخدام المتزايد للمياه الجوفية على نوعية ووفرة هذه المياه، وهو أمر يتطلب إنشاء شبكة متخصصة لمراقبة الآبار.

6. مراجعة وتعزيز المواصفات والمقياسات الخاصة بالمياه العادمة الصناعية (مواصفة رقم JS 2007/2007)، ويقة خاصة فيما يتعلق بمجموع الأملاح المذابة (TDS)، والمعادن
بالنسبة لحجم الموارد المخصصة لحماية البيئة، فإن تلك الموارد المتاحة لوزارة البيئة أهمية خاصة تتمثل في دور الوزارة الاستراتيجي في صياغة السياسات البيئية، والتسيير، والمرافقة وتطبيق القانون. وقد وجد التحليل البيئي القطري أنه على الرغم من التحسينات التي حققت منذ تأسيسها في 2003 فإن الوزارة ما زالت تعاني من حاجة ماسة للموارد البشرية (كما تأكد من المقارنتين الدولية) ونقص في التجهيزات. بالإضافة إلى ذلك، يبدو أن غياب آلية مناسبة للتنسيق داخل وزارة البيئة يشكل عائقاً لفعالية عمليتها.

هذا وما زال إدارتها البيئية في الأردن مركزية في الغالب، باستثناء الحالة الخاصة لمنطقة العقبة الاقتصادية الخاصة، حيث تم تكليف هيئة محلية هي سلطة منطقة العقبة الاقتصادية الخاصة بمهمة حماية الموارد البيئية ضمن حدود هذه المنطقة إلى جانب معظم الوظائف الحكومية الروتينية. ولكن هناك حاجة ملحة لزيادة الموارد وبناء قدرات مديريات البيئة في المحافظات وتوزيع الصلاحيات الممنوحة لها وتحديث وتوضيح مهامها ومسؤولياتها بمقابل تلك المديرات الموجودة في مركز الوزارة. إضافة إلى تحسين قدرات الجهات المحلية الأخرى ذات العلاقة في مجال إدارة البيئة وذلك لتحقيق إدارة بيئة أقوى على المستوى المحلي وفي بقى مناطق المملكة.

أخيراً، يعد تقييم الأثر البيئي شكلاً مهماً من أشكال تنفيذ القرار. وقد توصلت المقارنة بين نظام تقييم الأثر البيئي في الأردن وأفضل التجارب والأنظمة العالمية (مثل البنك الدولي والاتحاد الأوروبي) إلى أن العديد من خصائص هذا النظام متوافقة مع متطلبات البنك الدولي والاتحاد الأوروبي، على الرغم من وجود بعض الفجوات المختلفة، واضحة أن التطبيق الفعال لإجراءات تقييم الأثر البيئي متأثر بنقص الموارد البشرية كذلك.

ب. التوصيات

تتضمن التحليل البيئي القطري للملكة (ألفاظ الفصل الثامن لمزيد من التفاصيل) عدد من التوصيات من شأنها المساهمة في تحسين نوعية الهواء والبيئة وغير ذلك من القضايا والموارد المتداخلة والمشابكة، وحدثت هذه التوصيات الجهة المسؤولة عن التنفيذ والمؤسسات الشريكة، وتقديم نوعي للتأثيرات المرتبطة والتكاليف المتوقعة للإجراءات والتنسيق. وتم تقسيم هذه التوصيات - حسب العمدة الزمنية المقترحة للتنفيذ - إلى مجموعتين: توصيات ينتميها على المدى القصير (نحو 18 شهر) وأخرى على المدى المتوسط (من سنة إلى 3 سنوات). وقد راعت التوصيات الرئيسية وأخذت بالحسبان التفاعلات والافتراضات التي قدمها المشاركين في ورشة العمل الختامية للتحليل البيئي للملكة: 24
تم تقييم قيمة المؤسسات الأردنية على المصالح بين المواقف المختلفة أولًا من خلال تقييم مدى إقبالها للمعايير البيئية، والتي يُظهر أن الأردن يتناول بصورة جيدة مقارنةً مع دول منظمة التعاون والتنمية الاقتصادية (OECD) وتحديداً فيما يخص العديد من ملوثات الهواء الرئيسية، الأمر الذي يشير إلى أن حماية البيئة تعطى أولوية في حالتنا هناك تعارض مع بعض الأهداف التنموية. وفي نفس الوقت، يبدو أنه لا يوجد أي آلية لتقنين المنظمات المعايير بين الفئات الاقتصادية وغير موحدة البيئة؛ حيث ما يزال تطبيق المعايير أمرًا معتدلاً وما زال الهيدرو البيئي للتوافق والتكاليف بين المواصفات والمعايير وبين الآليات المبنية على السوق لتوزيع المصالح والاهتمامات محتملاً.

إن إدراج الاعتبارات البيئية في الاستراتيجيات القطاعية اعتبارًا عن يكون بصورة كبيرة من خلال إعلان المبادئ العامة دون تحديد أهداف واضحة ولا تخصيص للموارد اللازمة؛ وهذا الأمر يستدعى تطوير الإجراءات المناسبة وجودية الهيكلية المناسبة لإدراج الاعتبارات البيئية ضمن هذه الاستراتيجيات، واستخدام الآليات المناسبة لذلك، مثل تطبيق مفهوم التقييم البيئي الاستراتيجي.

تتطلب القرارات: نظرًا لأن توفر الموارد الملائمة يعد من أحد القواعد الأساسية لتنفيذ القرارات الخاصة بإدارة شؤون البيئة، فقد قام التحليل البيئي التقني (المرحلة الأولى في الأردن) بمراعاة الثقافة العام (الحكومي) على القضايا البيئية (PEER). وقد أظهر التقرير المركزي أنه بلغ معدل الثقافة العام على البيئة خلال الفترة من 2002 – 2006 حوالي 0.8% من إجمالي الناتج المحلي الأردني وشكل نسبة 2.3% من إجمالي الثقافة الحكومي. وهذا يعكس وقفة جيدة بعدد من دول الاتحاد الأوروبي، ولكنه رغم ذلك لا يشير بأي حال إلى نوعية أو فاعلية هذا الإتفاق، إضافة إلى ذلك فإن حجم التدمر البيئي والذي تم تقديره في هذا التقرير بلغ 2.3% من إجمالي الناتج المحلي في سنة 2006، يشير إلى ضرورة بذل جهد إضافي لحماية البيئة.

تشير مراجعة الثقافة العام على القضايا البيئية (PEER) إلى انحياز كبير للثقافة الحكومي لصالح معدلة الموارد العامة (والتي تشير بما لا يقل عن 40% من المجموع الكلي). وتشير هذه النتائج خاصة الأولى إلى تفاصيل من تحليل وحساب كلية التدمر البيئي، والتي تشير إلى أن

ثلوث/نوعية الهواء له أهمية أكبر من تلوث/نوعية المياه.
التقييم المؤسسسي

قامت التحليل البيئي القطرى بعمل تقييم مؤسسسي لنظرية إدارة شؤون البيئة في الأردن بناءً على الإطار المطروح في التقرير الدولي حول التنمية المستدامة سنة 2003. حيث يحدد هذا الإطار ثلاثة وظائف رئيسية ينبغي على المؤسسات تنفيذها للارتقاء بالإدارة البيئية المستدامة ورفاهية الإنسان على المدى الطويل وتمثل في: أ) جمع المؤشرات بشأن حالة البيئة، ب) موانعة المصالح، ج) تنفيذ القرارات، كما قام التحليل البيئي القطرى أيضًا بقياس أداء نظام الإدارة البيئية في الأردن وفقًا لمعايير الممارسات الدولية الجيدة، مثل اتفاقية كيوتو بشأن إمكانية الحصول على المعلومات، والمشاركة العامة (الشعبيّة) وتحقيق الحداثة البيئية، والآليّة المعتمدة لدى الإتحاد الأوروبي والUNCTAD بشأن عملية تقييم الأثر البيئي.

لقد كان التشريع لفترة طويلة في الأردن يخول مسؤوليات القضايا وال能找到 البيئية إلى عدد من المؤسسات المختلفة حتى جاء قانون حماية البيئة في عام 2000 (آخر تعديل عليه كان في 2006) والذي تم من خلاله إنشاء وزارة البيئة ومنحها قويّة شاملاً لاصلاح السياسات البيئية وتنسيق أجهزة العمل البيئي في الأردن.

وسيطةً لذلك، فما زال العمل قامًا بنظام معقد يركز على إصدار وظائف التنبؤ ومرتبطة إلى مؤسسات مختلفة وهذا النظام يضعف من الفعالية الكاملة لإدارة الشؤون البيئية في الأردن نظرًا لانطلاق الأدوار والمسؤوليات وتشابكها (بصفة خاصة فيما يتعلق بالماحة، والأنظمة وتطبيق القانون).

ويستعيد جميع المؤشرات من المجتمع على مراقبة حالة البيئة (الشعبية)، ونشر النتائج، وجمع الملاحظات والتعليقات وردود الأفعال والارادة من المجتمع، حيث تعاني مراقبة نوعية الهواء والمياه في الأردن من العديد من المعوقات منها: الادخار في المسؤوليات والصالحية، محدودية نشر البيانات والتحليل (وتحديداً فيما يتعلق بمراقبة نوعية الهواء)، إضافة إلى معيقات تتعلق بالعدد القليل للمناطق التي يتم تغطيتها برامج المراقبة ومديتها الزمنية.

يبدى المواقف في الأردن اهتمامًا بالقضايا البيئية (وفقًا للانتقادات فإن هذا الاهتمام فقوف مطلق في بلدان ذات أوضاع متشابهة في منطقة الشرق الأوسط وشمال أفريقيا وفي غيرها من المناطق) وهناك العديد من المنظمات غير الحكومية المنخرطة في إدارة شؤون البيئة، كما تساهم وسائل الإعلام في نشر الوعي حول القضايا البيئية. ومع ذلك، فإن إمكانية الحصول على المعلومات الخاصة بحالة البيئة وجودتها محدودة - لعدم وجود قاعدة بيانات بيئية شاملة، ومقددة.
الإسهامات القطاعات الصناعية التي تتداخل التصنيفات، مع إمكانية أن يصبح قطاع الصناعات البلاستيكية والمناطقية من الملوثات الرئيسية في العام 2017.

نظرًا لاختلافات كبيرة في تكاليف وحدة الحد من التلوث والمساهمة النسبية في الإزهارات الكلية بين القطاعات المختلفة، من المتوقع أن تتفاوت بشكل كبير كلفة سياسات وبرامج الحد من التلوث استنادًا إلى نوع القطاعات المستهدفة. فعلى سبيل المثال، من المقدر أن تتفاوت بمعدل يصل 3.5 مرات كلفة تحقيق خفض شامل يستهدف كافة الملوثات (50% أو أكثر).

اعتمادًا على طبيعة الإجراءات التي سيتم اتخاذها للقطاعات المختلفة.

تم تقسيم بعض المنحنى البياني لكلفة الحد من التلوث لتوضيح أهمية الجهود التي تستهدف تحقيق مثل هذه الأهداف. في حالة تلوث الهواء، يمكن خفض 80% من مجمل الإعدادات بالتركيز على قطاع الصناعات الغذائية، والكيميائية، والطبية البلاستيكية، وذلك بكفاءة قدرها 2000 دولار أمريكي/طن أو أقل. وإذا تراوح وحدة الكلفه لتحديد نسبة 20% المتبقية بين 2000 و2000 دولار أمريكي. أما بالنسبة لمحلولين المياه (شكل 5) فيجب إعطاء الأولوية للقطاعات الجلود والمواد الغذائية، مواد البيانو والمفروشات، والتي لديها أدنى وحدة كلفة لتحقيق التلوث وتسامح بنسبة 80% من مجمل الإعدادات، كما أن مستوى التخفيض الذي يمكن التوصل إليه لأي وحدة كلفة معينة يختلف بين منطقة صناعية وأخرى.

الشكل 5: مخططات بيانية لكلفة خفض المواد السامة في المياه

المصدر: فريق التقرير

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لن تقدير تركيبة التلوث الصناعي. وعلى الرغم من أنه ينبغي أن يتم التعامل مع النتائج بحذر بسبب محدودية المنهجية وطريقة تصنيف وتوزيع البيانات إلا أنها وجدت متماثلية مع النتائج المجربي المتاح. كما ينبغي استخدام النتائج الرئيسية التالية كمؤشرات أولية عند صياغة السياسات ذات العلاقة مع إعادة النظر بها استنادًا إلى بيانات التلوث الصناعية الخاصة بالأردن. فور توفرها:

1. تساهم مؤسسات صناعية في الأحياء الصناعية في عمّان والزرقاء بالجزء الأكبر من التلوث؛ أما التلوث في مدينتي أربد والزرقاء فهو يساهم نسبيًا بشكل أقل في التلوث الكلي، إلا أنه مرتبط بمظاهر متقدمة من التدهور البيئي المحلي التي لا تقترح أهمية عن التدهور البيئي في عمّان.

2. بينما يصدر معظم التلوث على مستوى الأردن من الشركتيات/المؤسسات الصناعية الكبرى (50% إلى 80% حسب نوع الملوثات)، تعتبر المؤسسات الصناعية الصغيرة في إربد وخاصة في الزرقاء أيضًا مصدر آخر مهم للتلوث، إذ تساهم بنسبة تصل إلى 50% من توزيع بعض الإنبساطات (مثل الأكسجين المتطلب حيويةً في الزرقاء).

3. تشكل القطاعات الكيماوية والطبية والهندسية/الكهربائية أكبر المساهمين في معظم الإنبساطات الملوثة في عمّان و bèزق الأردن عند تحليل التكلفة. ويرجع هذا، بشكل عام، إلى أن قطاع صناعات الغذائية، طبقًاً لتصنيف الضرر، على رأس ملوثات المياه والهواء. في حين يحتل قطاع الصناعات الهندسية والكهربائية بنصيب الأسد في التلوث المتصدر بالمغذيات النترية، أما قطاع الصناعات البلديّة والألياف في هو المساهم الأول في انبساط المواد السامة الملوثة خصوصاً للمياه، ويبقى قطاع التعبئة والتجفيف والورق "الأنفظ" عمليًاً بالنسبة للكمية الملوثة.

4. تتوزع إمكانيات القطاعات الصناعية الفرعية في التلوث حسب المنطقة. وترتيب متوسط القطاعات الملوثة في عمّان والزرقاء مماثل للترتيب على مستوى الأردن، غير أنه يختلف بشكل كبيرًا في إربد حيث قطاع الجلود هو الصناعة الأكثر تلوثًاً للهواء، وهو نسبًاً مساهم رئيسي لتوثيق المياه (BOD). الأمر الذي يؤكد الحاجة لأن تركز الجهود على مواقع هذا التلوث تحديداً وتأخذ بعين الاعتبار الظروف السائدة في هذه المواقع.

5. تعتبر عمليات التعمير مهمة كمصدر ثلثيّ للمياه، و لكن من الصعب تحديد تأثيراتها الصحية لتواجدها في مناطق بعيدة عن التجمعات السكانية.

6. تشير توقعات الضغوط البيئية لسنوات 2012 و 2017 أن القطاعات الأكثر تلوثًاً تبقى نفسها (الصناعات الكيميائية، الطبية، الهندسية/قطاع الكهرباء والبناء). بيد أنه قد تنغير
كما يشير التحليل أيضًا إلى وجود بدلات وخيارات للحصول على خفض أكبر للتدفقات وبطرق فعالة من ناحية الكفاءة، مثل الحواجز الضريبية (مثل ضربة الورود ورسوم الطاقة)، وعلى المدى الطويل من خلال خفض الطلب (الفرد أو لكل واحدة من إجمالي الناتج المحلي) استعمال المركبات الأكثر ثقيلية (المركبات الخفيفة والثقيلة) عبر تغيير وسائط النقل وتحسين البنية التحتية والخدمات لهذا القطاع. خذ، غير أن هذه الخيارات والبدائل لم يتم تحليها بشكل معمق بسبب نقص البيانات عن حركة الشحن والطلب على نقل الركاب (طن-كيلومتر وركاب-كيلومتر)، مما يشكل عائقًا كبيراً أمام رسم وتحقيق سياسات النقل، دون ذكر إدارة نوعية الهواء.

أما فيما يتعلق بالملوثات الأخرى، والتي لا يمكن تقدير قيمة ضررها مالياً، (مثل أكسيد الكربون)، يتيح التحليل البيئي القطري للمملكة وضع تقييم مهني لخفض الإفلاحات الممكن تحقيقه من خلال زيادة نسب استخدام وسائل النقل العام. ويدر التحليل البيئي القطري (باستخدام بيانات العام 2006) أنه يمكن خفض إفلاحات أكسيد الكربون والهيدروكربون (بالتالي تصل إلى 10%) استنادًا إلى هدف رفع حصة النقل العام من إجمالي حركة النقل، والذي تصل على أ trần الكربون ليصل إلى نسبة 75% في سنة 2020. لكن، لأن الحصة الراهنة للنقل العام للركاب تصل إلى حوالي 40%، تمثل الزيادة المقترحة إلى 75% خطوة كبيرة نحو التغيير وتنطوي على الأرخص درجة عالية من الدعم والالتزام المؤسساتي والمالي والسياسي.

التدفقات الصناعي

في ضوء الأهمية الاقتصادية لقطاع الصناعة في الأردن والذي يساهم بأكثر من 22% من قيمة الناتج المحلي الإجمالي، ويتغير نموه السنوي السريع الذي بلغ 12% في السنوات الأخيرة وغياب الإطار المناسب لتنظيم هذا القطاع، تعتبر الصناعة مصدر ضغط رئيسي على الموارد البيئية في الأردن. ومن المحتمل أن يزيد حجم هذا الضغط مستقبلاً، لا سيما إذا ما أدى التطبيق الكامل لاتفاقيات التجارة إلى زيادة الطلب الخارجي على المنتجات الصناعية الأردنية.

إن ضعف بيانات المراقبة الخاصة بالإفلاحات الملتوية أو صعوبة الحصول عليها يجعل من تقييم وتحديد الأولويات لبرامج الحد من التدفقات باعتقاداً على نوع القطاعات الصناعية المختلفة والموارد وألوان المواد وحجم المؤسسات الصناعية عموماً صعباً وغير دقيقة. وللحد من هذه القضايا وإعداد صناع القرار بمذكرة قياسية وخيارات واسعة لاتخاذ القرارات المناسبة، يقترح هذا الفصل تطبيق معاملات الإفلاحات المعتمدة دولياً والتي تم الحصول عليها من نظام البنك الدولي الخاص بتقدير التدفقات الصناعي (World Bank’s Industrial Pollution Projection System).
EXECUTIVE SUMMARY AND RECOMMENDATIONS

ومشتابات الكبريتي والتبررات والتي أمكن تقدر كلفتها نقدية/مالياً وذلك اعتماداً على
معايير الكلفة-المنفعة، وهذه الخيارات هي:

- تحسين نوعية الوقود عبر الإلغاء التدريجي للديزل عالي الكبريتي. وفي حين أن هذا الخيار قد تم اعتماده من قبل الحكومة، إلا أن الجدول الزمني المتفق لإلغاء الديزل ما زال غير واضح، لذلك قد تساهم مخرجات هذا التحليل في مرحلة التطبيق لهذه السياسة.

- تحسين سياسة صيانة المركبات عبر شهادات ورش عمل وكسر للعاملين.

- تحسين النوعية البيئية لأسطول المركبات من خلال وضع شروط ومتطلبات بيئية صارمة للمركبات المسجلة حديثاً.

تظهر نتائج التحليل (شكل 4) أن عملية تبني هذه السياسات بالتدرج لوحدها يمكن أن تخفض حوالي 50% من الكلفة الاجتماعية لنلوث الهواء؛ وأن يتم ذلك على نحو ملائم ومقبول من حيث الكفاءة والفعالية (الكلفة / المنفعة أقل من 1).

الشكل 4:

الخطط البياني لتكلفة الحد من تلوث الهواء الصادر من النقل البري

المصدر: فريق التقرير
تظهر هذه النتائج وجوب تركيز السياسات على المركبات التي تنتج أعلى نسبة من الإنباعات من الهيدروكربون (PM)، الهيدروكربونات (HC)، والكربونات والمخاطر المرئية، وأثرها على صحة الإنسان (ارتفاع مخاطر الوفيات المبكرة والأمراض) والكفاءة المالية المترتبة على ذلك، والسعي من أجل خفض نسبة النقل لوحدة النقل على المدى القصير، والتقليل على المدى الطويل من تلزيم نمو النقل ونمو السكان والدخل الفردي.

ومن ناحية أخرى، سيكون لسياسات رفع نسبة استخدام وسائط النقل العام أو بشكل أشمل رفع نسب الإشغال (عدد الركاب لكل مركبة - كيلومتر)، فوائد بيئية كبيرة في تخفيف الإنباعات الأخرى، مثل أكسيد الكربون، والذي لا توفر تقديرات للكفاءة الإهدار المادية التي خلفها في أية دراسات ومقارنات سابقة، ولذلك كان من الصعب تقييمها من حيث معادلة الكفاءة والمنفعة.

لقد قام التحليل البيئي القطري للمملكة بتبني الامكان لعدد من الخيارات (السياسات المقترحة) التي يمكن إتباعها للحد - على المدى القصير- من إنباعات المادة الجزيئية (PM)، الهيدروكربون، والمركبات والمخاطر المرئية، والكفاءة المالية المترتبة على ذلك، والسعي من أجل خفض نسبة النقل لوحدة النقل على المدى القصير، والتقليل على المدى الطويل من تلزيم نمو النقل ونمو السكان والدخل الفردي.

المصدر: فريق التقرير
تلوث الهواء والنقل البري

يساهم قطاع النقل في الأردن بنسبة كبيرة من انبعاثات الهواء (تقدير بنسبة 80% لأكاسيد النيتروجين، 20% لأكاسيد الكربون، و64% للجسيمات الكتلة العالية). لذلك فإن التحليل البيئي القطري للمملكة، يحاول أن يحدد السياسات الملائمة التي يمكن أن تخفف من التأثيرات البيئية الناتجة عن هذا القطاع من خلال وضع تقديرات ذات دلالة للإبعادات الناجمة عن قطاع النقل حسب نوع المركبة والوقود وموقع حركة السير، للسنة المرجعية (2006) والمصادر الأولية للسيناريوهات المستقبلية.

إن معدل النمو السنوي لعدد المركبات والذي يبلغ بين 7% و10%، والعدد الكبير نسبيًا للمركبات القديمة (والتي تشكل 62% من العدد الكلي للمركبات) التي ينتج عنها انبعاثات أعلى، وانخفاض معدل استبدال المركبات القديمة، واستخدام الوقود ذو النوعية المتنامية وتحديداً الهيدروكربونات والكربونات والثاني أكسيد الكربون والذي من المتوقع أن يتم استبداله في الفترة المقبلة، جميعها عوامل تشير إلى أن قطاع النقل في الأردن مرتجل أن يبقى مصدر التلوث الكبير ما لم تلتقي سياسة تدابير ملائمة لمعالجة الأمر. بل ويمكن للإبعادات الصادرة من النقل أن تزداد إذا ارتفع الطلب على السيارات (مركبة- كيلومتر)، و/أو انخفض معدل الإشغال (وهذه هي غالباً من النتائج الجانبية لنمو الدخول الفردي، كما تظهر تجربة بلدان منظمة التعاون والتنمية الاقتصادية). وذكّر هنا أن الحكومة قد تنبت مؤخراً إستراتيجية قطاع النقل والتي ترتب إلى زيادة حصة السكك الحديدية في الشحن البري، سيساعد تطبيقها على الحد من إبعادات التلوث من هذا القطاع.

وكجزء من التحليل البيئي القطري، قد تم وضع نموذج أولي لإبعادات حركة المرور لتقدير مستويات الإبعادات الحالية والمستقبلية. وأتاح هذا النموذج تقدير الحجم الإجمالي للإبعادات الصادرة عن النقل البري، وكذلك الضرر الاجتماعي المرتبط بها، والذي يقدر بحوالي 130 مليون دينار أردني سنوياً. كما حدد النموذج أن المركبات والثاني أكسيد الكربون (PM10) والثاني أكسيد الكربون (SO2) هي المصدر الرئيسي لإبعادات المادة الجزيئية (PM10) وثاني أكسيد الكربون (SO2) بحيث شكلها ما بين 60% و90% من إجمالي الابعادات. واظهر النموذج كذلك أن سيارات نقل الركاب هي المصدر الرئيسي لإبعادات أول أكسيد الكربون والهيدروكربونات (أكثر من 80%).
السياسات قد تتمكن - في حال دعمها بأنظمة حقوق المياه - تخفيض تركيز ملوثات المياه عند مصدر التلوث، ومراجعة موارد المياه (bulk water arbitrages) وتخفيض التركزات الملوثة على مستويات جغرافية أوسع نطاقاً.

ويقترح تحقيق مبسط للتكاليف والمنافع على المستوى الكلي احتمال التخلص من 80% كحد أعلى من الكلفة الاجتماعية للتدهور البيئي (وفقًا لتقديرات التحليل البيئي القطري) من خلال الجمع الأمثل بين: 1) برامج الصرف الصحي، 2) التخفيف من تركيز التلوث المائي عبر قطارات المياه، 3) معالجة المياه العادمة، وتحت الافتراض المستخدم في التحليل البيئي القتري (وفي ضوء المعلومات المحدودة حول التركيز الحالى ووحدة الكلفة والمعايير الأخرى)، يمكن تحقيق ذلك من خلال برنامج للاستهلاك في استهلاك المياه بهدف تقليل نسبة الفاقد في مياه الري بمعدل 3% في العام، يبحث برامج الصرف الصحي تستهدف نحو 80 ألف أسرة.

الشكل 2:
تحليل مبسط للكلفة/المنافع لكيفية تحسين نوعية المياه على مستوى المملكة

المصدر: فريق التقرير
EXECUTIVE SUMMARY AND RECOMMENDATIONS

وفما يتعلق بالمياه العادية الصناعية، ووفقًا للتقديرات يتم معالجته 28% فقط من إجمالي المياه العادية الصناعية (تقريبًا 50% بدون الأخذ بعين الاعتبار المياه العادية الناتجة عن تدجين البوداس، والتي لها تأثيرات بيئية محدودة)، ويتم تصنيف نحو 40% من المياه العادية الصناعية (صافي المياه العادية الصناعية من التدجين) في شبكة الصرف الصحي حسب التقديرات الموجودة، غير أن نوعية المياه العادية الصناعية تبعد على الفق علت نتيجة المعدلات العالية لعمليات التصرف دون توضيح والمعيار المترمدة نوعًا ما فيما يتعلق بالمعايير التحليلية والسموم العضوية، فضلاً عن النسب كبيرة لعدم الاستمالة للازمة المعمول بها (أكثر من 30% للأمونيا والمؤثرات الصحية). وبالتالي، لدى 50% من المياه العادية التي لا يتم تصنيفها في شبكة الصرف الصحي، نجد أن مراقبة نوعية المياه العادية الصناعية محدودة للغاية ولا تغطي المواد السامة بعينها بدرجة كافية. كما يعد التخلص من المياه العادية من خلال صياغة النضج ممارسة واسعة الإنتشار، وفعلاً غير مراقبة من حيث نوعية المياه العادية، كما أنه من المحتمل أن تشكل مخاطر صحية حيث يتم تغريب المياه العادية في مكاتب مكشوفة (مثل الأكبر)، مما يؤدي إلى تسبب محتل إلى المياه الجوفية. ويبدو أن السياسات الحالية تركز على مسارات التنقيح المركزية كستراتيجية مختارة لتناول المسألة. ومع ذلك، ربما تكون هناك فرص هامة لخفض الكفاءة العامة والخاصة للمعالجة ككل من خلال تشجيع إدخال التعديلات والتحسينات على مستوى وحدات المعالجة (خلال عملية الإنتاج وتدوير التصرف).

ونظراً للأثر المتزمن عن استدراج المياه الجوفية، وتناقص تدفق المياه السطحية، والنمو السكاني، والسياسات الهادفة إلى تشجيع التنمية الصناعية، فمن المتوقع أن تتفاقم أكثر من مشاكل النوعية المطرودة في هذا التقرير على المديين المتوسط والطويل، وتؤدي إلى تأثيرات على صحة الإنسان وعلى إنتاجية وعائدات قطاع الزراعة بما يزيد عن نسبة الـ 0.8% من مجمل الناتج المحلي المقدر في الدراسة البيئية للمملكة لسنة 2006.

تضع الأصول الوطنية عدد من الأهداف وتتعلق برفعة التزود المائي وتحسين معالجة المياه العادية، والتي من المرجح أن تقلل ندرة المياه وتؤدي فايدة على نوعية المياه أيضاً. ولكن هذا التقرير يحاول أن يبرهن أيضًا إمكانية تكمل تلك البرامج ورفعها إلى المستوى الأفضل من خلال اعتبار التدخلات والتحسينات التي من شأنها أن تخفف من حدة المشاكل المتعلقة ب نوعية المياه إلى حد كبير بكفاءة مخصصة نسبياً. من الممكن أن تتضمن هذه المبادرات برامج النظام الصحي لتقليل نسبة تعرض المثلقي للممرض؛ ولكن سياسات توفير المياه هي الأهم (ولا سيما في الزراعة) حيث أن
بسبب تأثيرها على الصحة العامة وعلى الزراعة. وعلى الأخص، فإن تركيز بكتيريا القولون (E-coli) وإفراز المواد المذابة (TDS) عند مصب سيل الزرقاء في قناة الملك عبد الله، وهي نقطة تقع أعلى بعض مشاريع الري الهامة في وادي الأردن، قد تجاوزت في السنوات الأخيرة إلى حد كبير محددات المعايير المعتمدة. وقد يمكن لتحسين نوعية المياه المتنقلة من محطة المعالجة الجديدة في خربة السمرا أن يخفف من حدة المشكلة، لكن بالنظر إلى الانخفاض العام لموارد المياه العذبة السطحية الذي لوحظ في السنوات الأخيرة والناتج بشكل خاص عن جفاف التدفق الشحي تحت سطحي (القاعي) لحفر البرموك، فإن المرجح أن يشهد الأردان المزيد من التدهور العام لمتوسط نوعية المياه السطحية.

أما فيما يتعلق بالمياه الجوفية، فتشير الدلالات إلى استمرار تزايد هبوط منسوب المياه الجوفية، وزيادة الملوحة في معظم طبقات المياه الجوفية، مما يؤدي إلى ارتفاع تكاليف الاستخراج (من حيث الضخ والانتقال السريع لأبار بديلة). فضلاً عن الحاجة إلى استخدام المزيد من مياه الري للتكليل من ملوحة التربة. ولا شك أن ارتفاع تكاليف الإنتاج وانخفاض العوائد يؤدي على دخل المزارعين، نظرًا لأن نحو 40% من كلفة التدوير البيني لعام 2006 متعلقة بتقييم نوعية المياه (دون الأخذ بعين الاعتبار تأثير المياه العاملة الصناعية).

بيد أنه من المتوقع أن تتفوق الكلفة في المستقبل، مع استمرار انخفاض مناسبية المياه الجوفية، ومع زيادة الطلب على مياه الشرب في المناطق الحضرية والتي يرافقها ارتفاع في التكاليف البينية الناتجة عن التزويج بمياه إضافية لخفض نسبة الملوحة. كما يبدو أن تثوّث المياه الجوفية بالبيئات داعيةً للفق وبصورة أساسية في حوض عمان-الزرقاء.

إن نسبة الأشخاص الذين يمكّنهم الحصول على خدمات الصرف الصحي عالية نسبيًا (مع بعض الاستثناءات في المناطق العرقيَّة)، وقد ازدادت تدريجيًا كمية المياه المغذية المنزلية التي يتم جمعها ومعالجتها. لكن تبقى نوعية المياه المعالجة المتنقلة سبباً للفق إذا أن نحو نصف إجمالي المياه المعالجة الخارجية من محطات تتقية لا يتجاوز المعايير الوطنية المعتمدة للملوثات مثل الحمل العضوي (BOD) (لا يمثل نسبة 50%) وعصيات القولون الكلية (E-coli) (4%). غير أن الوضع تحسن مؤخرًا مع إنشاء محطة تتقية جديدة في خربة السمرا، والتي لديها القدرة على زيادة معدلات الامتصال للمواصفات حتى 80%، وربما يتم إحراز المزيد من التقدم في حال تحقيق أهداف الأغذية الوطنية، رغم احتمال ارتفاع الكلفة.
EXECUTIVE SUMMARY AND RECOMMENDATIONS

لكن ونظرًا لمحدودية البيانات، ينبغي اعتبار هذه التقديرات تقريبية إلى حد ما، وهي على الأرجح متحفظة لأنه لا يمكن قياس العديد من أشكال التدهور (لا سيما التأثيرات المحتملة على الصحة من المياه العادمة الصناعية غير المعالجة). ويتضمن التفسير الكلاغ الثاني نسبياً لانزلاق الهواء على أنها إشارة للتدهور في مناطق ذرة إزداد حركة السير والأنشطة الصناعية (مثل وسط عمان، الزرقاء، النحاس، الخ)، وليس كان تعكس نوعية الهواء على مستوى المملكة. ويشار بشكل خاص إلى أن نزول الهواء لا يؤثر على المناطق السياحية الرئيسية مثل البتراء، البحر الميت، جرش، الخ. كما إن حجم المشكلة في الأردن هو أقل أهمية مما هو عليه في بلدان قابضة للمقارنة في المنطقة (مثل مصر) وفي مناطق أخرى من العالم (مثل سعودي).

نوعية المياه

يعتبر الأردن من أشد بلدان العالم التي تعاني شأناً في المياه، لذلك تعتبر مسألة إدارة كمية المياه في الأردن من الأولويات الأساسية، لك ذلك نوعية المياه مهمة أيضاً، تُعد المياه ذات النوعية غير الجيدة من أحد الاعتبارات الاجتماعية الهامة نظراً لتاثيرها على صحة الإنسان وعلى الأنشطة الإنتاجية. وعلى النقيض من ذلك، فإن المياه ذات النوعية أفضل تُعتبر توفير المزيد من الموارد للمساعدة في تخفيف وظاة شح المياه، وهذه هي الأسباب الرئيسية التي تكن وراء تركز هذا التقرير على جانب النوعية في أجندات الأردن المعنوية بالمياه، والذي يتضمن مقترحاً لتبني منهجاً تكاملاً من حيث الموارد المائية التي تم تقييمها (المياه السطحية والجوفية والمياه العادية المعالجة، ومصدر الثروة (القطاعات الحضرية والصناعية والزراعة) ومجموعة التأثيرات التي وضعت في الاعتبار (صحة الإنسان، ودخل المزارعين ومستقبل المياه).

لا تزال مسألة توافر الحوافز لإدارة كميات المياه بصورة أفضل ذات أهمية واضحة، غير أنه لم يتم التعرض لها في هذا التقرير، لاسيما أن الأجندات الوطنية أوضحت أن خصص الدعم لقطاع المياه وإيجاد حوافز لاستخدام المياه في أنظمة ذات قيمة مسافة أعلى هي ضروريات لبناء السياسات العامة من تفاديها في المستقبل.

لا تتيح محدودية توفير البيانات وإمكانية الوصول إليها حاليًّا إجراء تقييم إحصائي كامل لنوعية المياه، إلا أنه هناك عدد من المؤشرات الهامة المتعلقة بالسياسات العامة التي يمكن استخلاصها من البيانات الموجودة، ومنها على وجه الخصوص:

- المياه السطحية، هي ذات نوعية مقبولة بشكل عام، وتبين عند جمع البيانات، أن هناك مشاكل تأرجح الملوحة والثقوب البكتيرية في أماكن محددة، والتي لها أهميتها الإستراتيجية.
الزراعة والسياحة)، إلى جانب كلفة "السلوك الوقائي" (مثل تنقية المياه وشراء المياه المعيبة للتنقيط من نسبة التعرض للأمراض المنقولة بالمياه). وقد تم تقدير كلفة التدهور البيئي في الأردن مع الأخذ بعين الاعتبار كل من التأثيرات المباشرة ولأجل التدهور الذي يحدث في العام المرجعي (2007). وباستخدام مجموعة من المهمات المتداولة والمعتمدة دوليًا، تم تقدير الكلفة الإجمالية للتدشير البيئي في الأردن بين 143-327 مليون دينار أردني، مع متوسط ببلغ 237 مليون دينار أردني، أو 25.35% من الناتج المحلي الإجمالي في عام 2006. وإذا ما أضيف تأثير الانبعاثات على البيئة العالمية، ستبلغ الكلفة الإجمالية التي سيتكبدها كل من الأردن والمجتمع العالمي بوجه عام 393 مليون دينار أردني.

بوضوح الشكل 1 حجم التأثيرات المتوقعة لكل موضوع بيئي، حيث يقدر الذكر أن من أهم العوامل المساهمة في الضرر الإجمالي هو تلوث الهواء، وهو تلوث ينحصر في مناطق محددة ويعد مسؤولاً عن 10.15% من الناتج المحلي الإجمالي، يليه في المرتبة الثانية من حيث الأهمية تأثير الإهداد الغير الكافي للمياه، والصرف الصحي، والنظافة الفردية - إذ يمثل زهاء 8.81% من الناتج المحلي الإجمالي - يتبعهم في الترتيب كلفة التخلص من النفايات الصلبة بطرق غير ملائمة بيئيًا، ثم كلفة تدهور الموارد الأرضية والتدهور في المناطق الساحلية.

الشكل 1: توزيع كلفة التدهور البيئي حسب الموضوع البيئي في سنة 2007

المصدر: فريق التقرير
النفخات الصناعية

شهد الأردن تحسناً في إدارة النفخات الصناعية، حيث تقدر معدلات جمع النفخات الحالية بنسبة 90% و70% في المناطق الحضرية والقروية على التوالي. ومع الاستثناء البارز لمنطقة عمان (التي تنتج نحو نصف إجمالي النفخات الصناعية)، لا يزال التخلص الآمن من الأدوات المطهرة، نظرًا لأن غالبية البلدان الأخرى تتخلص من نفاياتها الصناعية في مكبات مُكشوفة دون تبتيين أو إدارة للصرف أو تجميع للغاز الحيوي. علاوة على ذلك، تعد إدارة النفخات الخطرة والنفخات الطبية غير ملائمة، حيث يتم التخلص من معظم النفخات الخطرة (التي بلغ حجمها الإجمالي 42 ألف طن عام 2001) بنظام موزع في منطقتي مكة مكة المكرمة وسقطرية، وبدون معالجة، حيث يتم معالجة نصف النفايات الطبية في محارق قديمة تقع في مناطق مأهولة بالسكان، أما النصف الآخر فيتم ميزه بالنفايات المنزلية في مكبات مكشوفة.

والملف الرئيسي الذي يحاجي إلى التعامل معه هو تنفيذ نظام إدارة النفخات الصناعية في الأردن اقتصاداً بنموذج مبينة عمل، ضرورة إيجاد إطار تشريعي أكثر شمولًا وضيقية، واستراتيجية وسياسية واضحة تعني بالقطاع، بالإضافة إلى ضرورة تحسين نسبة استعداد الكلفة وذلك للتحقيق من محدودية الموارد التي تزود نظام إدارة النفخات الصناعية في العديد من البلدان.

وتشير تصنيفات مؤشرات الأداء البيئي إلى إجهاز الأردن نجاحاً ملموساً مقارنةً بالبلدان الأخرى، المتوسطة الدخل في منطقة الشرق الأوسط وشمال إفريقيا وغيرها من المناطق. وب بصورة خاصة، سجل الأردن تقدماً محسوباً نحو تحقيق الهدف السابع (كفالة الاستدامة البيئية) من الأهداف الإنسانية للاستدامة ولديماً فيما يتعلق بالذات الناهية (إمكانية الوصول إلى مياه الشرب المأمونة).

كما أنه نال المركز الثالث على مستوى منطقة الشرق الأوسط وشمال إفريقيا فيما يتعلق بمؤشر الاستدامة البيئية (ESI)، وتالت على مستوى المنطقة فيما يتعلق بصافي معدل الإخراج (والتي تقيس قيمة البلدان على الحفاظ على موازنة رأس المال الطبيعي والمادي والبيئي). وقد يكون ذلك مؤشراً على وجود ظروف مؤقتة لتركيز جهود الأردن على التحديات البيئية الرئيسية حالياً ومستقبلاً. شروط تعرف البيانات الكافية عن الأولويات النسبية لاختلاف القطاعات البيئية، وعن المتغيرات الأساسية الواجب ملاحظتها من أجل إجراء التقدم في تلك الأولويات.

كلفة التدمر البيئي

يُكتب المجتمع كلفة التدمر البيئي، من حيث معدل الوفيات والاعتلال جراء تلوث الهواء والمياه، وتتم في الدخل الناجم عن خسائر في الأنشطة المرتبطة بانتشار الموارد الطبيعية (مثل...
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ارتفاع في نسبة الملوحة وهبوط مناسبات المياه الجوفية والذي بدوره زاد من تكاليف الضخ ودعت إيستراتيجية المياه لعام 1997 والخطة الوطنية للمياه لسنة 2005 (وزارة المياه والري) والأجندة الوطنية (2005) إلى رفع نسبة التزود المائي (حيث من المتوقع وفق الخطة الوطنية للمياه أن تصل إلى 1.1 مليار متر مكعب سنوياً عام 2020)، كما دعت إلى تعزيز استعمال المياه العادمة المعالجة (والتوقع أن تصل كميتها إلى 200 مليون متر مكعب سنوياً بحلول عام 2025)، وخاصة في قطاع الزراعة. ومن شأن هذه البدائل والمبادرة أن تخفف نواعا ما من القيود التي تحكم في حجم كمية المياه المزودة وتعمل على تحسين نوعية هذه المياه. غير أنه، وفي الغالب، تكون كلفة تنفيذ مثل هذا المزيج من السياسات مرتفعة، ولكن يبقى هناك منافع إضافية هامة للتحسين وتخفيف التكاليف خاصة في مجال الطلب على المياه، حيث يبلغ متوسط عائدات مياه الري 6.5 دينار أردني للمتر المكعب، أي بفارق كبير عن الهدف الطموح للأجنب الوطنى المحدد بـ5 دينار أردني للمتر المكعب بحلول سنة 2017.

تشوه الموارد الأرضية

يؤثر تدحر الموارد الأرضية سلباً على استقرار النظام البيئي وعلى دخل المزارعين (خاصة الفقراء منهم)، وقد انخفضت إنتاجية المراعي، التي تشكل المصدر الأساسي لمعيشة غالبية قراء المناطق القروية، بنسبة 50% خلال الخمسة عشر سنة الماضية، نتيجة الرعي الجائر وتفقت اللافطين (مع مأوىهم) أثناء حرب الخليج الأولى. وتسعى وزارة الزراعة لمعالجة المشكلة بتخصيص مساحة 44 هكتار من الأرضي لإعادة تأهيلها كمحاصيل رعوية. وقد قامت الحكومة مؤخراً بإدراج إستراتيجية التمويل المتكاملة لمكافحة التصحر ضمن البرنامج التنفيذي للتنمية للسنوات 2009-2011.

التنوع الحيوي

بعد حفظ التنوع الحيوي من أحد المجالات التي شهدت تطوراً ملحوظاً في الأردن، مع تحقيق خلال العقود المنصرمين نمواً سريعاً في مساحات المحميات الطبيعية، ومن المتوقع أن تزيد مساحة المناطق المحمية عن 2% من مجمل مساحة الأردن، وهي نسبة تعادل ضعف نسب المناطق المحمية في منطقة الشرق الأوسط وشمال أفريقيا، فضلاً عن كونه نموذجاً للإدارة الادارية للمناطق المحمية التي تعمل من خلال شراكة مع المنظمات غير الحكومية. بيد أن الأردن سيحتاج إلى معالجة المسائل القانونية والتنافسيات في خطط استخدام الأرضي وقيود التمويل لضمان استمرارية نظام المناطق المحمية على المدى البعيد.
EXECUTIVE SUMMARY AND RECOMMENDATIONS

قيادة الجهود لتحسين معالجة المياه العادمة الصناعية (تم مؤخرًا إنشاء وبشراكة مع القطاع الخاص مصنعاً لمعالجة المياه العادمة الصناعية في إربد، بالإضافة إلى وضع خطة قيد التنفيذ لبناء محطة معالجة ثانية في مدينة الزرقاء)، ومعالجة النفايات الخطرة والطبية (حيث من المتوقع بدء تشغيل المصنع في نهاية 2009 ليعمل 70% من الحجم السنوي للنفايات).

تعزيز نظام التفتيش من خلال قوانين حديثة وشاملة سيئ السمعة قريباً.

لعب دور أساسي في إنشاء الإدارة الملكية لحماية البيئة في عام 2006، مما ساهم في تحسين فعالية العديد من الأنشطة من بينها عملية التفتيش البيئي على المركبات والعمل وبشراكة مع منظمات غير حكومية محلية على تشجيع وتعزيز التشارك والنقاشات حول سلسلة من القضايا البيئية.

على الجانب الآخر يبقى هناك عدد من التحديات الرئيسية، ومن أهمها:

نوعية الهواء

على الرغم من محدودية عملية رصد نوعية الهواء القائمة حالياً، تشير الأدلة المتوفرة إلى تدني نوعية الهواء في البوار الساخنة التي تشهد حركة مركبات عالية وأنشطة صناعية كثيفة. وتتناقص قطاعات النقل وتوليد الطاقة والصناعة في معظم الانتفاعات الملوثة للهواء، وخاصة انبعاثات الجسيمات الكلية العالية (TSP) وثاني أكسيد الكربون (SO2)، وكذلك نتروجين (NOx).

وتستدعي السياسات الحديثة المتعلقة بتلوث الوقود (كالغازات التدريجية لاستهلاك البنزين المحترق على الرصاص والديزل عالي الكربون)، وتوسيع مصادر الطاقة (كإعداد دور أكبر لمحلات توليد الطاقة العاملة على الغاز والطاقة المتجددة) خطوات هامة في انتقاه الطبيعية.

ولكن في الوقت ذاته، فإن الزيادة السنوية بحوالي 7% في عدد المركبات (حيث لا تزال تهيمن تقنيات الاحتراق الافتراضي من المحركات في البوار الساخنة) على نوعية الهواء من قبل الصناعات الهامة كالتدفئة وإنتاج الإسمت، مما مصدر للقلق.

شح المياه

لقد أدت مشكلة شح المياه المتزايدة في الأردن (حيث تقدر حصة التردية السنوية بـ 133 متر مكعب من الموارد المائية متضمناً فيها استخدام المياه العادمة المعالجة) إلى اللجوء إلى استخراج المياه الجوفية المتجمدة بنسبة تفوق 50% فوق معدلات الضخ الأردنية (2005)، مما أدى إلى

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الموجز التنفيذي والتوصيات

يعتبر الأردن من الدول ذات الموارد الطبيعية المحدودة، فهو صغير من حيث المساحة ويدفع بمستوى دخل متوسط واقتصاد مفتتح وتخلفات تجارية نشطة، ومع تقدم عملية اندماج الأردن في الاقتصاد العالمي، فإن تحسين إدارته البيئية لن يؤدي إلى تحقيق رفاهية الأردنيين فحسب، وإنما سيحسن أيضا قدرته التنافسية في أسواق تتم بوعي ببيئي متزايد.

ومنذ التقدم الملحوظ الذي شهده الأردن خلال السنوات القليلة الماضية على صعيد الإدارة البيئية، فإنه حتى الآن لا يوجد تقييم شامل للأجندات البيئية في الأردن، ولا سيما فيما يتعلق بتقييم مؤشرات حول كيفية دمج الاعتبارات البيئية طويلة المدى في عملية التنمية.

يهدف هذا التقرير والذي يجمع ما بين عمق التحليل وشموليته إلى الإسهام في رأس هذا الفجوة وتقدم رؤى لطبيعة وشكل الحوار بين البنك الدولي وحكومة الأردن بشأن عدد من المجالات المختارة ذات صلة خاصة بعملية التنمية الاقتصادية والاجتماعية المستدامة والمستمرة.

وقد قام بإعداد هذا التقرير فريق من البنك الدولي وبتعاون وشراكة كاملتين مع فريق أردني، يمثل قطاعاً واسعاً من المؤسسات الحكومية المعاصرة وتحته إشراك وزارة البيئة.

ولتحقيق أهدافه الجوهرية المتمثلة بتحديد الأولويات الإستراتيجية الرئيسية لسياسة بيئة أفضل عبر الحدود القطاعية، يتناول التحليل البيئي الاقتري ومتسلسل الهيكل البيئي الأساسي وأولوياتها النسبية، والروابط بين التنمية والضغوط البيئية في مجالات أو قطاعات مختارة (كجودة المياه والنقل البري)، وقدرة المؤسسات الأردنية على التوافقي بين أهداف التنمية والنمو.

تم جمع البيانات المستخدمة في التقرير ما بين العامين 2007-2008، إلا أنه قد تم الأخذ بعين الاعتبار التطورات والتعديلات التي طرأت على بعض السياسات والاستراتيجيات ذات العلاقة.

أ. النتائج

القضايا البيئية الرئيسية في الأردن

حققت الحكومة الأردنية خلال العقد الماضي تقدماً ملموساً في قدرتها على الحد من التدهور البيئي من خلال إطار تشريعي أفضل، ومؤسسات ذات قدرة أعلى، وعدد من المشاريع الممولة من الموازنة العامة. فكان من إنجازات وزارة البيئة منذ إنشائها في عام 2003:
EXECUTIVE SUMMARY AND RECOMMENDATIONS

إفريقيا: هادي العربي، المدير القطري في البنك الدولي، لاسلو لوفي، مدير قطاع التنمية المستدامة، وليون غونستانتينو، مدير قطاعي البيئة والزراعة في الشرق الأوسط وشمال أفريقيا. وقد ضم فريق عمل الوكالة الأمريكية للتنمية الدولية USAID الدكتورة أم حجازي (ضابط الاتصال مع البنك الدولي) وطارق طراونة، جمال جابر، ولي هدمو (مستشارون دراسة قطاع الصناعة). وقد تمت ترجمة الموجز التنفيذي إلى اللغة العربية من قبل إيمان شماس. كما أن إنتاج هذا الكتاب ما كان سيتحقق من دون مساهمة نضال العوران الذي قام بتسيير عمليات الترجمة والنشر في الأردن، ومن دون مساعدة فريق البنك الدولي في مكاتب عمّان وبيروت (فائزة عبد الفتاح، مهيبة صحراوي، حنان نوار عبيد، محمد أحمد كريم، سيرام أياسوامي، ورياح بدر).

وضم فريق المراجعة والتفتيق في البنك الدولي كل من عزيز بوزهر (أخصائي بيئي رائد) وعنب كارلوس بيالوسوغيويتيا (خبراء اقتصادي بيئي رائد).

والشكر والتقدير أيضاً لكل من صندوق اتحاد البيئي القطري وصندوق اتحام الاستثمار الدانمركين على الدعم المالي الذي قدموه لإعداد هذا التقرير.
وقد ضمت مجموعة العمل (وفق الترتيب الأدبي بالإنجليزية): المهندس أيمن أبو خيارة (وزارة السياحة والآثار)، المهندس زيدون القاسم (أمانة عمان الكبرى)، المهندس علي الصبح (وزارة المياه والري)، المهندس يوسف عريبي (وزارة الزراعة)، المهندس ميسون بسيسو (وزارة الصحة)، السيد محمد خالد دغش (وزارة الطاقة والثروة المعدنية)، المهندس عبير الحاج حسن (وزارة الصناعة والتجارة)، السيد عوان حراجحة (وزارة التخطيط والتعاون الدولي)، الدكتور جمال محبس (وزارة الصناعة والتجارة)، المهندس صالح ملكاوي (وزارة المياه والري)، المهندسة تامارا ميرزا (وزارة الشؤون البلدية)، السيد أيمن عينات (وزارة المالية)، المهندسة رندة الريدي (وزارة النقل).

كما ساهم بشكل أساسي في إعداد هذا التقرير كل من (وفق الترتيب الأدبي بالإنجليزية): السيدة سوزا أبو زهرة (دائرة الإحصاءات العامة)، المهندس محمد العالم (وزارة البيئة)، السيدة نورما الهرش (وزير الصحة)، الدكتور سليم المغربي (سلطة منطقة العقبة الاقتصادية الخاصة)، المهندس حسين بدريان (وزارة البيئة)، المهندس جبر درداكة (وزير البيئة)، السيد محمد خليف (دائرة الإحصاءات العامة)، الدكتور محمد خاشطة (وزارة البيئة)، السيدة سهى مصطفى (غرفة صناعة الأردن)، الدكتور محمد صيدم (المعهد العالي للعلوم المالية)، السيدة غدير صالح (غرفة صناعة الزراعة)، المهندسة روز سمادي (غرفة صناعة عمان)، والسيد أحمد عليمات (سلطة المياه).

وقد استضاف التقرير من تقارير المشاركون في ورشة العمل الختامية، التي عقدت في العاصمة عمان في 24-25 حزيران 2009، وهم يمثلون وكالات حكومية وأكاديمية والقطاع الخاص فضلاً عن منظمات غير حكومية.

أما فريق البنك الدولي فقد كان برئاسة خبير اقتصادي أول رافائلتوشترفيني، وضم: ناثانيا لطيف (خبير بيئي أول)، ليليا كرويتو (مستشار اقتصادي بيئي)، إلينا الفنبر (خبير اقتصادي بيئي)، أحمد شوق (خبير أول في الموارد المائية)، عامر جبارين (خبير وطني)، ارليك هيف وهزيك دوير (مستشارين في النقل البري)، روبرت إندرسون ونضال الحرير (مستشارين في تقنية القيمة المؤسساتية)، وسيفي كريغر (مساعدة الفريق). كما قدمت مساهمات إضافية من كاتبة كورماري (خبير أول في البيئة)، فلايسيف فوسيتيك (خبير طاقة رائد)، كاري فاتحة أحمد (مستشار)، وقد ساعدت جوهانا هولتن في تحرير وراجعة المسودة النهائية للقرير وفي تنظيم ورشة العمل الختامية. وقد عمل فريق البنك الدولي تحت الإشراف الإداري لشعبند الأخطار، نائب مدير البنك الدولي لشؤون الشرق الأوسط وشمال
شكر وتقدير

تم إعداد هذا التقرير بتعاون وشراكة كاملة ما بين الحكومة الأردنية والبنك الدولي، كما أنضم لهذه الجهود الوكالة الأمريكية للتنمية الدولية التي دعمت إعداد الدراسة التحليلية لقطاع الصناعي.

تم المباشرة في إعداد هذه الدراسة التحليلية بإشراف معالي وزير البيئة الأسبق المهندس خالد الإيراني ومتاحة من معالي الوزير الحالي المهندس حازم ملحس، ويدعم من أمين عام البحرين عطوفة المهندس عمر المعاني، وبفضل العمل المؤسسي المميز للأساتذة العلماء لمختلف الوزارات، وتحديداً: المهندس فارس الجندية من وزارة البيئة، وكل من (وفقاً للترتيب الأبجدي بالإنجليزية): المهندس جمال أبو عبد (أمين عام سابق وزارة الشؤون البلدية)، المهندس فاروق الحيازي (وزارة الطاقة والثروات المعدنية)، المهندس خلدون الخشمان (أمين عام سابق وزارة المياه والري)، المهندس مهنّد القضاة (وزارة التقن)، المهندس فاروق الحيدري (أمين عام سابق وزارة المياه والري)، المهندس مهنّد القضاة (وزارة التقن)، المهندس موسى الجمعان (أمين عام سابق سلطة وادي الأردن)، الدكتور منتصر العقلة (أمين عام سابق وزارة الصناعة والتجارة)، المهندس راضي الطراونة (وزارة الزراعة)، المهندس عزيز كنابيك (وزارة المالية)، الدكتور جانيت ميرزا (وزارة الصحة)، المهندس نصير عويس (سلطة المياه)، المهندس ناصر شريدة (وزارة التخطيط والتعاون الدولي).

ولا بد من توجيه تقدير خاص للهيئة ربي الزعيبي، المدير السابق لقسم السياسات العامة في وزارة البيئة، التي نسقت نشاطات مجموعة العمل المشتركة بين الوزارات وكانت ضاغط إرتباط مع البنك الدولي. ولم يكن إنجاز هذا التقرير ممكنًا دون كفاحها وتفانيها والتزامها. وشكر الجزيل للمهندس أحمد قطرة (الأمين العام المساعد لوزارة البيئة) الذي نشأ المراحل الأخيرة لإعداد التحليل البيئي القطري للمملكة من الجانب الحكومي الأردني والدكتور صالح خراشة الذي مثل وزارة التخطيط والتعاون الدولي - الشريك المؤسسي للبنك الدولي، وللسيدة ليانا خوري التي قدمت الدعم والمساعدة الإدارية لدعم أنشطة مجموعة العمل الأردنية ومهام البنك الدولي.

والشكر الموسع لفريق العمل المشترك الذي شكّلته الحكومة الأردنية من كافة المؤسسات لتسهيل الوصول إلى البيانات وتدقيق الملاحظات والمعلومات الإستراتيجية والتقنية خلال مختلف مراحل إعداد التقرير الذي تميز بتناوله للعديد من القطاعات المختلفة، كما أن المشاركة النشطة من جانب أعضاء هذا الفريق، سواء فيما يتعلق بمسير العملية أو توفير المواد، كانت أساسية لإنجاز هذا التقرير.
أود أن أشكر وأهنئ جميع الذين شاركوا في إعداد هذا التقرير وللجهد الوطني الذي أنتج مرجعاً علمياً للربط بين الاقتصاد والبيئة في الأردن.
شكرا لكم.

وزير البيئة
حازم ملحص
تمهيد

نيةة عن الحكومة الأردنية, فإنها من دواعي ضروري البالغ أن أعرض وثيقة "التحليل البيئي القطرى" للأردن, والتي تم إعدادها بالتعاون مع دائرة قطاع التنمية المستدامة للبنك الدولي في الشرق الأوسط وشمال أفريقيا.

هذه الوثيقة والتي هي أداة ضرورية للسياسة كانت نتيجة لجهود طويلة ومضنية وخلافة للكثير من الأردنيين وخبراء البنك الدولي الذين نجحوا في الحصول في إرساء النظرة الأكثر شمولية للحالة البيئية في الأردن. ونحن بدورنا نشكر البنك الدولي على هذا الدعم.

إن وثيقة "التحليل البيئي القطرى" ستكون أداة حيوية لرسم السياسات المستقبلية الأردنية, عن طريق تكامل أدوات السياسة الاقتصادية في عملية اتخاذنا القرار. وكما أظهرت الأزمة الاقتصادية الأخيرة بمثابينها فإن النموذج الاقتصادي القائم على الاستهلاك فقط لا يمكن له الاستدامة. وعليه فإن الكثير من البلدان قامت بتحديد الحاجة إلى تخفيض احتياجاتها كأساس للتنمية والنمو المستدام. إن المبادرة الاقتصادية الخضراء للأردن من شأنها أن تعزز التكامل الاجتماعي والنمو الاقتصادي والاستدامة البيئية من خلال خطة اقتصادية مركزية وموزونة وثابتة.

إن الأدوات التي تم استخدامها في إخراج هذه الوثيقة لحيز الوجود سيتم تطويرها واستخدامها مرة أخرى لبرنامجنا التنفيذي المستقبلي. ونحن ندرك كفاية التشتيت من المعينين في الدولة وتضخف أفكارًا جديدة في المبادرة الاقتصادية الخضراء للأردن وفي الخطط. وقد جاء تطوير إستراتيجية الاقتصاد الأخضر بدعم من قبل رئاسة الوزراء، وكذلك فإنه تم البدء في مبادرات مثل: التمويل الأخضر، والشراكة بين القطاع العام والخاص في فعالية استخدام الطاقة، والبيئة، وإدارة النفقات وإدخال التكاليف البيئية في عملية رسم السياسة.

الأردن بلد صغير وغني بالمورد البشري. وستكون "الرحلة الخضراء" برنامجًا للعشيرين عاما لتجهيز بنيتنا التحتية لتشريد استهلاك الطاقة والمياه والموارد الطبيعية في مراحل الإنتاج جميعًا.

إن التوصيات التي تم تحديدها في هذه الوثيقة ستسمى في وضع السياسات البيئية في البلاد. ونحن نطلع للعمل مع فريق البنك الدولي مرة أخرى لجعل البنية عاملًا أساسيًا في عمليات التنمية الاجتماعية والاقتصادية.
تم إنتاج هذه المطبوعة في المملكة الأردنية الهاشمية.

جميع الحقوق محفوظة

مجموعة البنك الدولي

1818 H Street NW
Washington DC 20433

هاتف: 202-473-1000

الإنترنت: www.worldbank.org

بريد الكتروني: feedback@worldbank.org

توجز هذه الوثيقة التقرير الصادرين بعنوان: التنمية المستدامة في الأردن: تحليل بني قطري باللغة الإنجليزية. وإذا كان أي نص في هذه الترجمة غير متماثل مع نص الوثيقة الأصلية باللغة الإنجليزية فإنه يعد نص الوثيقة الأصلية باللغة الإنجليزية. هذا التقرير تناول عمل موظفي البنك الدولي في إعداد قطاع التنمية المستدامة في منطقة الشرق الأوسط وشمال أفريقيا، والأحكام الوراثية فيه لا تعكس الضرورة أنrat fís مجلس مديرية التنفيذ أو البلدان التي يمثلونها. ولا يضم البنك الدولي دقة البيانات المدرجة في هذه المطبوعة ولا يتحمل أي مسؤولية كانت عن أي نتائج ترتكب على استخدامها، ولا تعني العدوان والأنوال والسمم والمعلومات الأخرى المبينة على أي خريطة مدرجة في هذا المجلد

أي حكم من جانب البنك الدولي على الوضع القانوني لأي إعلان أو تأييد أو قبول لهذه الحدود.

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التنمية المستدامة في الأردن: تحليل بيئي قطري

الموجز التنفيذي

تحرير: رافائيلو تشيرفني ويلينا النبر

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