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WORKSHOP ON THE ROLE OF INDUSTRY IN THE DEVELOPMENT AND RATIONAL USE OF WATER RESOURCES IN THE ARAB REGION

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A. Rationale for the workshop

The vast rise in water demand for agriculture, industry and municipal uses in the Arab region exerts severe pressures on the finite water resources. The deficit in 2030 will be double the available renewable supplies. In addition, major water bodies of the region are shared between countries within and outside the region, which creates complex riparian problems.

Facing this critical situation, the Arab region has no alternative but to improve demand management through promotion of water-saving technologies, proper reallocation among user, and proper policy reforms to rationalize use and improve water utilization efficiency.

In view of the above considerations, industry may assume a leading role in conserving water in manufacturing as well as developing new technologies to improve water use efficiency for agricultural and domestic uses.

UNIDO, in cooperation with the Royal Scientific Society of Jordan (RSS) took the initiative to convene a technical workshop on the role of industry in the development and rational use of water resources in the Arab countries.

The objectives of the workshop were reassessing the status of the region's water resources in relation to growing demands; reviewing current approaches and views world-wide on the use, development and management of water resources under conditions of scarcity; defining the role of industry in the development and conservation of water resources in the Arab region; identifying the prospects and constraints for managing water demand in industry, agriculture and urban uses; and recommending activities and formulating proposals that might constitute the main elements of an intervention programme at the national and regional level.

The workshop was attended by 33 experts from Egypt, Iraq, Jordan, Libyan Arab Jamahiriya, and representatives of ACSAD, ESCWA, CEHA/WHO and INWARDAM. A Turkish expert attended the workshop as an observer.

B. Opening session

In his opening address, M. Abtahi, UNIDO Senior Area Programme Officer, thanked RSS for hosting the workshop and elaborated on recent changes in the industrial sector in the Arab region, which entailed enhancing the institutional and legal framework for a sound market economy; restructuring and privatizing industrial enterprises; achieving gains in productivity, production technology and quality control; and promoting environmentally sound industry throughout the region. Within this context, it is expected that industry may play a major role in improving demand management as a cost-effective means for meeting future water needs in the region by incorporating affordable and adaptable technologies. This would eventually lead to sustainable demands and curb damage to the already overtaxed water resources.

In his inaugural remarks, the Vice-President of RSS highlighted the importance of conserving water resources in the Arab region and the important role the international and regional organizations should play in promoting cooperation and exchange of information and experience among countries of the region. Such cooperation might emphasize industry interventions to develop practical and affordable water-saving technologies that could lessen the need for inordinately expensive and ecologically-disruptive water supply projects. He wished every success for the participants in their deliberations and formulation of appropriate recommendations to meet future water challenges in the Arab region.

I. Miqdadi, UNIDO Industrial Development Officer, referred in his address to industry's impact on the entire water cycle, as a consumer with increasing water demand, as a major contributor to water pollution and as a supplier of technology for water purification, wastewater treatment and water distribution equipment. He suggested that the workshop should not only suggest means to improve transfer of information but should also propose actions to strengthen cooperation among regional and international organizations for proper mobilization of resources to conserve water resources of the Arab region. In this regard, Mr. Miqdadi identified the basic elements of an action programme for enhancing industry's role in the development and rational use of water resources in the region.

C. Presentation of technical papers

Session I was chaired by O. Salem, Director of the Water Authority in the Libyan Arab Jamahiriya. An overview of the background document " The role of industry in the development and conservation of water resources in the Arab region: challenges and prospects" was given by A. Hamza, UNIDO consultant. He pointed at first to the recent World Bank study on water scarcity in the Middle East and North Africa, which concluded that drastic change in the way water resources are managed in the region is needed to avert severe water shortage and economic decline in the coming 30 years.

The presentation then addressed in depth the existing water supply and demand situation in the region and identified opportunities for improving supplies by harvesting rain, by desalination and by water reuse. Actions to improve demand management in domestic, industrial and agricultural uses were delineated. A special emphasis was placed on the contribution of industry to water infrastructure and the impact of cleaner technology on minimizing water use and reducing pollution.

A strategy for water conservation in the region was presented. It focused on creating a market for water-saving equipment and strengthening national institutions and inter-agency cooperation in the water sector. Finally, specific activities to improve demand management and to enhance industry's role in this connection were proposed.

M. Al-Hafedh, UNIDO Country Director for Lebanon, the Syrian Arab Republic and Jordan, chaired session II. In this session, J. Khouri, ACSAD Director of water management studies, presented a comprehensive review of the available renewable water resources in the Arab region which are presently estimated at 340 billion m^3 annually. He stated that the region might have already tapped all its renewable water resources and that the potential for developing additional resources from non-renewable sources was expensive and unaffordable.

The presentation also addressed the issue of groundwater vulnerability in the Arab region and concluded that depletion of aquifers had reached a critical stage, particularly in the Arabian Peninsula and North Africa. This had led to - (i) deterioration of groundwater quality due to seawater intrusion, (ii) land subsidence due to rapid groundwater extraction, (iii) soil salinization and (iv) contamination of shallow groundwaters.

H. Bakir, CEHA/WHO advisor on rural health and environment, stated in his presentation that many countries of the region were facing serious problems in meeting basic water requirements for sustaining their social and economic development. Water conservation should be pursued to maximize returns from water utilization, to sustain water resources and safeguard water quality and to reduce consumption of water. First priority should be given to securing reasonable supplies of acceptable quality to meet domestic needs.

The paper presented an outline for a strategy on water conservation in the Arab region. The Strategy encompasses assessment of water resources and development, water management and allocation, pollution control and use of wastewater and conservation of water in industry, agriculture and municipal uses. The paper also detailed phased approaches for the execution of the strategy, which involves assessment, planning and implementation activities.

M. Abdulrazaq, ESCWA Programme Officer, presented a perspective on water supply and demand in the ESCWA region. The region is situated in arid to semi-arid zones with scarce water supplies. He stressed the fact that rapid population growth coupled with vast industrialization and urbanization was expected to reduce annual per capita renewable water from about 3,400 m^3 in 1960 to less than 600 m^3 in 2025.

The paper described the southern ESCWA region as extremely arid, with groundwater from shallow and deep aquifers as the main water source for agriculture and desalination as the major source for domestic and industrial supplies. The northern region gets most of its supplies from surface water resources with less reliance on groundwater for irrigation, domestic and industrial supplies. The paper proposed a multi-faceted programme for water conservation, including public education, metering, proper pricing policy, reuse/recycling, leak detection and repair, improving plumbing codes and fixtures, and restrictions on non-essential uses such as landscaping with potable water.

A. Al-Hassan, Director of the (RSS) Environmental Research Center, presented a critical review of the status of industrial water management in selected Jordanian industries. The paper discussed present water use practices and waste-water disposal methods in major industrial sectors and outlined mitigation measures for abatement of industrial pollution in the country.

M. Bino, Executive Director of INWARDAM, presented an assessment of the opportunities for water reuse in industry. He stipulated that sewage effluent could be used as a suitable alternative water resource for industry. Many industrial processes such as cooling, washing and processing of non-edible products could rely on treated sewage effluent as a replacement of fresh water supplies. Incentives were likely to encourage industry to access treated effluent, which in many occasions might be less saline than local groundwater, could be provided sometimes at no cost.

The paper proposed that multiple reuse should be promoted in the region, with the first use cycle of a clean groundwater supply to be devoted to domestic uses. The second cycle of reuse would be for industrial uses and the last cycle of reuse for irrigation and less sensitive uses such as landscaping. He concluded his presentation by referring to the experience of other countries in multiple water reuse, which could benefit the Arab region. Such innovative approaches presented real opportunities for improving water productivity and enhancing demand management of the scarce water resources in the region.

O. Salem, Director of the Tripoli Water Authority in the Libyan Arab Jamahiriya, presented an overview on management of the diminishing water resources of that country. He first pointed to the fact that the country was witnessing a severe deficit in its water resources budget. While desalination of sea-water and use of treated sewage were expected to play an important role in the future as non-conventional water resources, the Libyan Arab Jamahiriya would secure most of its rising water needs from groundwater, which could cause a sharp decline in groundwater levels and dry up shallow aquifers; sea water intrusion into coastal aquifers; and further aggravation of the desertification problem.

A strategy had been formulated to improve water supply and demand management by securing additional water from non-conventional sources, optimizing groundwater reserves from major basins in the south and rationalizing water consumption. To achieve the strategy objectives, Libya would soon complete its Great Man-made River Project, which would convey 2.2 billion m^3 of fresh water from the south to the coastal areas in the north. Desalination capacity in Tripoli would be increased by 0.5 million m^3 per day,

while concerted efforts were directed to construction of large-scale sewage treatment plants and modernization of the irrigation system to reduce water losses.

D. Plenary session

Session III, chaired by J. Khouri, was devoted to discussing means to enhance the role of industry in managing water supply and demand in the Arab region. Mr. Khouri proposed a thematic approach to the subject consisting of four phases, namely, assessment, development, management, and operation and maintenance. Actions would involve hardware (telemetry, computers, monitoring instruments etc.) and software (data systems, GIS, models, design criteria, institutional tools, economic instruments, human resources development, grass-roots participation etc.)

With regard to identifying opportunities for industry to improve the supply management of water resources, most discussions centered around the need for new affordable and cost-effective approaches to the harvesting of rain, desalination and water recycling and reuse.

Some participants pointed to the importance of promoting harvesting technologies that relied on local resources, material and labour. Proposed interventions included the development of simple manually operated pumping devices for drawing water from rainwater storage systems, minimizing evaporation losses, developing effective micro-catchments and employing new technologies for dew and mist harvesting in the region.

The need to develop appropriate desalination technology based on membrane processes for the treatment of brackish water was highlighted. Developing new reverse osmosis technology with increased energy recovery and decreased membrane replacement costs should receive greater attention in the region. Energy requirements might be also reduced if distillation-based desalination was combined with generating of electricity in such a way that partially expanded steam could be used to drive the distillation process. Pointing to the fact that the region was the largest producer of fresh water by desalination, the participants suggested that more research must be devoted to developing cost-effective desalination technologies, with maximum reliance on indigenous resources and technical capabilities.

Several participants pointed to the expanded schemes of water reuse in the region. More treated effluent was being used for irrigation, and studies were under way for extending its use in non-sensitive manufacturing processes. Scarcity of water encouraged water recycling in industry, which could be further motivated by the rising costs of municipal supplies and enforcement of pollution control regulations.

The Sinai irrigation scheme in Egypt was presented as a viable example for reuse of irrigation drainage water in the region. Since most Arab countries were implementing land reclamation projects in the desert areas, use of irrigation return flows in various mixes with fresh water constituted in the view of the participants - a reliable source for water supply for land reclamation projects, particularly in water-scarce countries.

In the second part of session III, the discussions centered on the role of industry in improving demand management of water. Several participants referred to the need to adopt cleaner technologies in the manufacturing industry as an effective means of pollution prevention and conservation of water resources. Adopting cleaner technology was believed to be most cost-effective in new industrial plants or during retailing of old ones. Good housekeeping was emphasized as an important no-cost intervention for the significant reduction of water consumption and waste generation. However, the discussions revealed that cleaner technology had not reached the desired level in most Arab countries due to lack of research and development, inadequacy of information on new technology applications and their cost-effectiveness,

and lack of legislative and economic incentives.

The participants also discussed the need to rationalize municipal water uses by improving plumbing and metering of household water supplies and minimizing leakage in the distribution systems, which ranged from 40 to 50 percent of the treated water for municipal uses. Industry might intervene by developing durable equipment and simple processes for conserving water supplies. The manufacture of package systems for treatment of water and wastewater in the region should be encouraged. New low-water sanitation systems such as recycling chemically treated flushing water must be developed by industry. New household water-saving fixtures should be produced locally to replace conventional models that were less durable and caused substantial water losses.

As agriculture consumes more than 80 percent of the region's water supplies, the participants emphasized the necessity of using irrigation water in the most judicious manner. Manufacturers of micro-irrigation and ultra-low-volume spraying systems for agro-chemicals should develop new inexpensive equipment and pipes that were less subject to corrosion and easily operated with minimum maintenance.

Some participants suggested that design modifications of spraying equipment were essential to improve the application of chemicals and hence reduce off-target losses and minimize pollution. In this connection, light weight, high-strength, electronically controlled equipment could be developed to reduce occupational hazards to the exposed farmers and to avoid excessive pollution associated with conventional pesticides application technologies. Integrated pest management (IPM), which emphasizes the reduced use of chemicals, should be encouraged. Expanding IPM practice would eventually reduce the release of harmful chemicals to water streams and minimize hazards to the rural environment.

O. El-Kholy, Professor Emeritus, Cairo University, chaired session IV, which addressed institutional and infrastructure considerations, including the need for strengthening legislative systems, developing human resources for water resources management and encouraging private sector participation in management and operation of water systems. Dr. El-Kholy pointed in his introductory address to the need to change the prevailing attitude to the water problem at all levels, by enhancing the awareness of public officials and planners, encouraging the participation of local communities in decision-making and supporting NGO initiatives to conserve water. He also suggested that the management of water resources should be pursued in an integral manner by assigning a central authority the tasks of policy formulation and long-term planning of water resources and by decentralizing the management of water delivery and distribution to local or regional entities.

Several options were suggested by the participants for improving the existing institutional mechanisms to rationalize water use and to conserve the quality of water resources. These comprised reducing water demand by cutting subsidies for domestic uses, imposing higher prices on water-intensive industries to encourage conservation and introducing a cost-recovery scheme in agriculture to adjust cropping patterns to available water supplies in each country. Any water cost-recovery scheme must give due consideration to the socio-economic implications of the water pricing system, which varied from country to country.

Mr. Abtahi drew the participants' attention to the World Bank report "From scarcity to security: averting water crises in the Middle East and North Africa". The report estimates that $45-$60 billion would be needed in the region over the next 10 years to invest in water development and management projects. Only 25 per cent of the estimated costs would be provided by donors. The bulk must come from the private sector.

He stressed that international organizations and the United Nations specialized agencies had very limited financial resources and would not be in a position to provide direct financing for expensive water development projects. However, they could provide assistance for improving demand management,

strengthening existing programmes for hydrological data collection and information exchange, establishing regional water quality monitoring networks and upgrading institutional mechanisms, in addition to providing technical advice on watershed planning for shared water resources.

During the discussions, some participants stressed the fact that legislative and management mechanisms in most Arab countries were inadequate. This was attributed to the dynamic evolution of polluting activities in the Arab region, industry in particular; the loopholes and vagueness in regulations, which allowed gross violations; the possible transfer of pollution from strictly regulated media to other unregulated media; and the imposition of ludicrous charges and ineffective penalties on violators.

Financial sanctions should be supported by an effective enforcement system. The participants emphasized the role of water taxes, fees and other financial sanctions as dis-incentives for wasting water.

One other major institutional handicap in the Arab region was the fragmentation of decisions on management of water resources in terms of both geographic boundaries and allocation among various uses.

To overcome this problem, a greater control of water resources is needed to restrict irrational use in the longer term. Proposed actions to ensure effectiveness of management tools include coordination of activities of public agencies involved; enhancement of the decision-making role of private concerns, NGOs and local communities; and enactment of an effective and enforceable water permit system to enable efficiency in allocation and resolution of use conflicts. In this connection, permits issued for discharge to water bodies should be subjected to periodic review to ensure continued compliance with the conditions granted in the initial permits. Fairness and firmness in enforcing regulations should be imposed on all concerns to ensure equity and respect for the law.

Some participants claimed that decisions concerning the management of water resources were made with an imperfect knowledge of the behaviour and characteristics of the water supply systems in the region. Therefore, developing adequate information systems at the national and regional level was essential for identifying supply and demand projections and trends in water quality due to increased reuse of drainage water and accumulation of pollutants in water bodies and for seeking alternative water resources with quality to suit the particular uses.

There was a general agreement among the participants that skilled manpower was short in various areas, including management and administration of water utilities, operation of industrial and municipal water treatment systems and monitoring of pollution and water quality. In response to this problem, it was suggested that personnel rules, salary structures and promotion potentials were critical aspects of staffing. In this connection, it was noted that water institutions tied to the civil system structure were not in a position to recruit the needed professional cadre; private water concerns exercised more freedom in hiring and were usually in a better position to offer attractive salaries and other employment incentives.

In summing up, the participants called for integrated programme of possible interventions to enhance the role of industry in the development and rational use of water resources in the Arab region. The programme should draw on partnership between international donors, the United Nations organizations, regional institutions, national governments, the private sector, and NGOs. It might constitute an agenda for addressing future water scarcity in the region and means of securing water supplies on sustained basis.

E. Closing session

The last session was chaired by A. Hamza. It was devoted to soliciting the views of the participants on means of water conservation in the region and to identify the specific interventions and potential technical cooperation activities to enhance the role of industry in augmentating water supply, strengthening existing infrastructure and improving water demand management. Discussions in this session led to two outputs. The first comprised broad recommendations for strengthening industry's role in the management of water supply and demand in the Arab region. The second was an outline for an action-oriented plan for industry interventions for the development and rational use of water resources at the national and regional level.

OUTPUT 1: RECOMMENDATIONS FOR ENHANCING THE ROLE OF INDUSTRY FOR MANAGEMENT OF WATER SUPPLIES AND DEMANDS IN THE ARAB REGION

- Providing technical advice on industry least-cost solutions for proper management of conventional and non-conventional water resources and effective management of demands for industrial, agricultural, municipal and other beneficial water uses.

- Establishing a United Nations inter-agency mechanism, which should involve country representatives and international financial institutions in developing and implementing national and regional activities to enhance water productivity and to strengthen capabilities for management of water resources in the Arab countries.

- Advocating cooperation in implementing inter-country programmes on water conservation, including human resources development, waste minimization, pollution monitoring and information exchange and research on innovative technologies to reduce water consumption in various uses and to minimize discharge of pollutants and hazardous contaminants in water streams.

- Promoting appropriate business opportunities and markets at the national and regional levels for material recovery, manufacture of pollution prevention and water-saving equipment and local environmental consultancy services.

- Improving existing pollution monitoring schemes, with particular emphasis on surveillance of micropollutants discharged into water streams.

- Strengthening information exchange on applicable cleaner production technologies, waste recovery and reprocessing, institutional mechanisms for water conservation, and legislative and economic instruments, with particular emphasis on identifying successful practices in the Arab countries.

- Promoting community participation by involving NGOs and citizens groups in defining priorities, evaluating alternatives and helping in implementing appropriate water conservation measures.

- Involving the private sector in the management and operation of water services while ensuring that the basic demands of low-income consumers are provided at an affordable cost.

- Planning new water-intensive agricultural and industrial activities throughout the region, with the understanding that opportunities for further development of water resources are limited. Therefore, developmental activities that require significant consumption of water and/or cause significant deterioration of water resources should be banned in order to avoid corrective interventions that may be costly and difficult to implement.

- Improving the demand management of water resources should receive the highest priority. The future development of industry and agriculture should result in water uses that are both sustainable and geared to a multiple-use strategy. Single and exclusive use of water resources should be discouraged in favour of multiple uses to achieve compatibility of water supplies and demands at the local and national levels.

OUTPUT 2: PROPOSED INDUSTRY INTERVENTIONS FOR WATER CONSERVATION IN THE ARAB REGION

1. Interventions at the national level

Proper and immediate interventions are indispensable for conserving water to meet future demands in the Arab region. National actions in this regard should account for the unique socioeconomic and political conditions in the individual countries. The proposed interventions should be cost-effective, practical and socially acceptable.

The interventions should be implemented within the framework of a national action programme on water resources management and should have built-in flexibility to accommodate changes in national development targets and potential alterations in socio-economic conditions in the long term.

While recognizing the need to manage water resources in a coherent manner to achieve a maximum benefit for all stakeholders, industry may assume a leading role in conserving water in all manufacturing activities and in developing appropriate technologies to improve water efficiency in agricultural and municipal uses. Conservation measures should significantly reduce the demands for water, safeguard its quality and maximize returns from water utilization.

Broad interventions at the national level in concert with the above principles require new modalities of cooperation and coordination with the concerned international and regional organizations, the United Nations specialized agencies and international financing institutions.

An integrated programme that emphasizes the role of industry in developing and conserving water resources at the national level might comprise the following interventions:

- Providing technical support for the conservation and protection of water resources by setting up demonstration projects and promoting of cost-effective water-saving technologies including recycling of water in industry and use of irrigation and municipal wastewater.

- Providing assistance to the public and private industries on new cleaner production technologies and developing appropriate guidance for water consumption in various industrial sectors.

- Providing assistance for the implementation of self-monitoring programmes in industry in support of law enforcement.

- Establishing guidelines to influence industrial development by identifying likely problems and proper mitigation measures for pollution control. Environmental impact assessment should be promoted as an essential tool for sound environmental management in industry.

- Developing human resources to prepare national specialized cadres for water conservation, waste minimization, environmental monitoring and associated water management services.

- Identifying opportunities and commissioning field studies for manufacturing and marketing pollution prevention equipment, water-saving devices and environmental monitoring devices.

- Establishing, wherever feasible, local manufacturing industries for package water treatment plants and compact waste-water treatment facilities that would suit the requirement of small communities and local industries in the region.

- Developing an appropriate scheme for proper management of hazardous wastes arising from industrial and institutional sources, including establishing systems and facilities for proper collection, treatment and disposal of these wastes.

- Instituting proper legislation and regulations backed by proper penalties and incentives and strengthening the enforcement mechanism to ensure adequate compliance with laws on water protection.

- Instituting regulations that are based on scientific knowledge and that embody the principles of practicality, acceptability and affordability.

- Developing local plans for disaster-preparedness in industry-intensive areas and ensuring the provision of facilities and trained personnel for containment of spills that could release toxic chemicals into surface and/or groundwaters.

- Promoting community participation in water conservation by mobilizing the industrial workforce and fostering a sense of belonging among the local community.

- encouraging the use of non-conventional water resources such as the harvesting of rain and storm water wherever available and expanding the use of micro-catchments.

- Encouraging the use of water-saving devices in households and water metering for municipal consumers and developing local industries for durable plumbing and metering facilities.

- Providing large industrial, commercial and institutional establishments with adequate metering facilities. The tariff structure for all non-residential users should reflect recovery of capital investment costs as well as the cost of operating and maintaining the water works.

- Using new irrigation technologies (micro-irrigation), ultra low-volume (ULV) applicators of agro-chemicals and leveling and moisture control to optimize economic return and increase the productivity of water use in agriculture.

2. Interventions at the regional level

International agencies actively engaged in the field of water in the region include UNEP, FAO, IFAD, WFP, UNESCO, UNDP, WMO, IAEA, WHO, UNICEF, ILO, ESCWA and ECA. Their programmes and projects cover areas related to water conservation, distribution, management, pollution control, water quality, storage, water supply, treatment and utilization. While many of the above entities are interested in water conservation, none of them have industry as their main focus.

The following interventions might be implemented within the framework of the mandate and the operational programmes of the specialized United Nations agencies, the Arab League agencies, the concerned regional organizations such as CEDARE, ACSAD and ICARDA, and the international and regional development funds.

UNIDO, within the context of its mandate, might provide technical assistance and play a catalytic role in mobilizing regional and national resources to enable industry to assume a proper place in the development and rational use of water resources in the Arab region.

The following proposed interventions might be undertaken by a specific agency or as cooperative inter-agency endeavors.

Appropriate water saving technology:

- Providing assistance in adopting cleaner production in industry and in conducting environmental audits for polluting activities, aimed at reducing water consumption and waste generation and at improving productivity. This can be achieved by establishing more cleaner production centers in the region.

- Providing assistance in utilizing non-conventional techniques such as rain and mist harvesting and desalination of brackish water for industrial and municipal uses.

- Providing assistance in establishing environmental management systems and eco-labeling according to the new ISO 14000, to ensure that local products meet environmental requirements and are competitive in the international markets.

- Strengthening existing systems of process safety and emergency preparedness for the accidental release of hazardous materials into waterways.

- Integrating information on appropriate water-saving technologies, material substitution, water and waste recycling, water quality standards and acceptable levels of consumption in the manufacturing industry, into the existing data-bases on industry and the environment in the region and perhaps, establishing a regional center for information exchange on legislation, technology, management and other issues pertinent to water conservation in the Arab countries.

- Promoting intercountry cooperation in developing human resources, monitoring shared water resources, responding to transboundary emergency situation and creating business opportunities at the regional and sub-regional levels for material recovery, manufacturing of water-saving equipment and consultancy services.

- Providing assistance in developing regional guidelines for the introduction of new environmentally safe materials and products and of water-saving technologies and equipment in the countries of the Arab region.

Pollution prevention:

- Enhancing regional capabilities for the manufacture of package wastewater treatment facilities for industry and municipal use that are appropriate to local conditions and upgrading skills for the operation and maintenance of existing treatment plants.

- Providing technical assistance for the design and operation of centralized schemes of wastewater treatment and hazardous waste reprocessing or containment for major industrial estates in the region.

- Providing assistance in establishing unified guidelines for monitoring of emissions and discharges, including methods of sampling, analysis and QC/QA, to ensure the compatibility of pollution monitoring and environmental quality data from the various countries of the region.

- Providing assistance for the replacement of hazardous materials and products with more environmentally friendly ones and advice on hazardous materials and processing practices subject to banning in the region.

- Building regional capacity in risk assessment and ecotoxicology as tools for pollution prevention and for the approval of new products in the Arab market.

Strengthening institutional capabilities:

- Providing assistance in devising practicable, enforceable, scientifically - based and flexible legislative instruments to conserve water resources and prevent and control industrial pollution.

- Providing advice on cost-recovery schemes for water services that are equitable, socially, politically acceptable and economically feasible to encourage investment in water development projects.

- Providing assistance for integrating environmental impact assessment into industrial development projects, with particular emphasis on measures to mitigate adverse impacts on water resources.

- Providing technical support for water saving programmes and demonstration projects that could be replicated throughout the region at least cost and maximum return on investment.

- Arranging study tours for industrial managers, decision makers and water planners to demonstrate successful water-saving practices in industry, irrigation and municipal uses within the region or outside it.

- Assisting in the development of an enforcement mechanism, public awareness programmes and practical guidance on cost-benefit and cost-effectiveness analysis of water-saving projects and programmes applicable to the socio-economic conditions of the Arab region.

Research and development:

- Providing assistance for studies at the national and subregional levels to assess the impact of environmental stresses in industry-intensive locations, with emphasis on the impact on water resources.

- Supporting surveys on human perception and the socio-economic implications of industrial polarization in human settlements and their potential impacts on the quality of water resources.

- Promoting collaboration among leading research institutions and centers of excellence in the region for undertaking long-term studies on the exposure of populations and sensitive subgroups to potentially toxic substances and for assessing the effect of water pollution on human health and environmental amenities.

- Providing technical assistance for field research and demonstrations on low-cost technologies, new water-saving equipment for municipal, agricultural and industrial uses and cost-effective recovery and recycling of used products and industrial wastes.

- Providing technical support for developing indigenous research capabilities in the less-developed countries of the Arab region to help them cope with their pollution problems and design appropriate water conservation measures.

Streamlining and coordinating international cooperation in the Arab region:

- Establishing an inter-agency mechanism for international donors, United Nations Organizations and the concerned regional institutions to enable multi-lateral coordination and cooperation in addressing water conservation problems in the Arab region.

- Giving priority to technical and financial assistance for action programmes and projects that deal effectively and amicably with transboundary pollution that affects shared water resources.

- Sharing the financial and technical assistance burdens when the costs of solving multi-faceted water problems exceed the capacity of the international institutions and/or the financial resources of the benefiting countries.

- Emphasizing the development of channels for transferring experience on water-saving technologies and management practices through existing national institutions, which could serve as regional centers. Such selected centers may also execute regional training programmes, develop regional guidelines, gather water quality data and disseminate relevant information on water-saving technologies and practices.