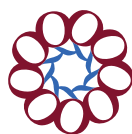




## Technical Water Sector Capacity Building Programme

Supporting the development of the water  
sector in Palestine and Jordan

Funded by:



QATAR FUND  
FOR DEVELOPMENT  
صندوق قطر للتنمية



## MEDRC Water Research

MEDRC is a nonprofit international organization headquartered in Muscat, Oman and mandated to find solutions to fresh water scarcity in the Middle East.



## Qatar Fund for Development

Qatar Fund for Development (QFFD) is a public development institution committed, on behalf of the State of Qatar, to improving the livelihood of communities around the world. It does so by providing loans, grants and technical assistance to developing countries in the Arab and Muslim world and beyond, so as to contribute to their economic and social development.



## Technical Water Sector Capacity Building Program in Palestine & Jordan

The program is designed to support the development of the water sector in Palestine & Jordan. MEDRC works in close collaboration with the Palestinian Water Authority (PWA) and the Jordan Valley Authority (JVA) to build capacity by identifying key areas of need and to provide Palestinian and Jordanian agencies with a multilateral framework for cooperation and knowledge transfer.



*H.E. Ali Bin Fahad Al-Hajri, Ambassador of the State of Qatar to the Sultanate of Oman, Sayyid Badr bin Hamad bin Hamood Albusaidi, Chairman of MEDRC, and Ciarán Ó Cuinn, Center Director, MEDRC Water Research, at the signing of the agreement between the Qatar Fund for Development and MEDRC Water Research.*



With the generous Qatar funded project and the extraordinary effort exerted by MEDRC management under the current challenging situation, Palestine had the chance to build the capacity and improve the performance of a number of the staff working in the water sector; while the project has enabled MEDRC to continue its effort towards an improved regional cooperation in desalination and water treatment."

**Eng. Rebhy Al Sheikh,**

Deputy head of the Palestinian Water Authority (PWA)



Jordanian professionals have benefited hugely since MEDRC has been established. Together, the in-country training programs and the CPET water courses offer a great combination of practical and theoretical work. We thank MEDRC and QFFD for their commitment and support in aiding the continued development of the Jordanian water sector."

**Dr. Khalil Al Absi,**

Director of Development, Jordan Valley Authority (JVA)

**A message from Ciarán Ó Cuinn,  
Center Director, MEDRC Water Research**

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MEDRC and the State of Qatar have worked together for many years in the search for solutions to fresh water scarcity in our region. Nowhere is that work more important than in Palestine and Jordan where water is such an urgent and pressing issue.

We are deeply honored to have partnered with the Qatar Fund for Development on this program. The QFFD and the State of Qatar are now widely recognized as global leaders in supporting human development, innovation, and capacity building in the water and food security sector. As a Member State of MEDRC, Qatar has brought this focus center-stage in the organization.

In delivering the program, our joint approach has been to work closely with the Palestinian Water Authority and the Jordan Valley Authority at every stage to ensure the output and outcomes from the program were useful and impactful on the ground.

We are proud of the project outcomes and thank the Qatar Fund for Development and our colleagues in Palestine and Jordan for making them a reality.



A stylized handwritten signature in black ink, consisting of a large initial 'C' followed by a long horizontal stroke.





Eng. Riadh Dridi, Head of Training, MEDRC Water Research, during an in-country training session at Deir Al Balah desalination plant, Gaza.

## **The mission in Palestine and Jordan**

The challenge of providing sustainable, secure and affordable fresh water is nowhere more urgent than in the Middle East region where the lowest rainfall levels on earth are matched by a dramatic growth in population and economic development.

In Palestine and Jordan meeting that challenge requires significant investment in infrastructure and technical capacity. MEDRC has worked in Palestine and Jordan for many years supporting water research, capacity building, and technical assistance. Hundreds of research projects, thousands of trainees and a twenty year record of technical support has been greatly enhanced through our partnership with the Qatar Fund for Development. This program has built on that record and was designed and delivered in close collaboration with our colleagues in Palestine and Jordan.

## **Desalination**

The world's oceans account for 96% of all water on the planet. Desalination is the process of removing salt and other minerals from sea water or brackish water, to make it fit for human consumption, agricultural or industrial use. The most commonly employed desalination method is that of Reverse Osmosis, in which salt water is forced through a membrane that allows water molecules to pass but blocks salt and other minerals. While the advantages of desalination are clear, it is an expensive, energy intensive technology, and desalination plants are costly to both build and maintain.

MEDRC's work focuses on applying the most up to date technical approaches to cut operational costs, energy requirements, and the environmental impact of desalination and other water processes.

## **Training**

We operate the only purpose-built reverse osmosis training plant in the Middle East at our training center in Muscat, Oman. Designed by MEDRC for research and training purposes, the plant contains all the systems and processes of large scale industrial plants.

Desalination, waste water treatment, and other technical water processes require highly skilled staff at all levels. Technicians must be able to run process control systems and tend to electrical and mechanical equipment, as well as computerized instrumentation. Trainees who attend a MEDRC course will graduate with knowledge and skills that can be put into practice at any reverse osmosis desalination plant, no matter the scale or size.



## Continued Professional Educational Training (CPET)

MEDRC Water Research's CPET training programme is conducted at our training facility in Muscat, Oman.

Classroom instruction and hands-on training is delivered by our internationally renowned desalination professionals, using state-of-the-art processing equipment. Trainee proficiency is tested by formal examinations with certificates awarded to those successfully completing their courses. All training sessions are held in English with reading materials available in both English and Arabic for course participants.

## In-Country Training

MEDRC developed a bespoke training program to respond to specific areas of need, as identified in partnership with the PWA and JVA. This was primarily practical, and focused at a local level in the Jordan Valley (Jordan, West Bank) and Gaza.

The training program was agreed with the PWA and the JVA as per their priorities and delivered classroom-based learning as well as hands-on training and field visits.



*From left:  
MEDRC Water Research Headquarters, Muscat, Oman /  
A bore well in the Jordan Valley*



## An overview of training conducted to date:

### 1. In Country

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<b>1.1 Training</b>	<b>Tender Process</b>
<b>In cooperation with When &amp; Where</b>	Palestinian Water Authority (PWA) and the Jordan Valley Authority (JVA) 6-10th September 2016, Limassol, Cyprus
	A four-day intensive training session held in Cyprus. Participants were guided through the tender process from the pre-qualification stage and the tender structure through to the financial side of managing a project. The course included a field trip to the Episkopi Desalination Plant in Limassol. At the plant, participants met with Mr Neocleous, CWO (Acting Chief Water Officer) of Cyprus Water Development Department and toured through the facilities accompanied by the plant manager, Dr Erineos Koutsakos.
<b>From Participants</b>	PWA, Gaza Municipality and Coastal Municipal Water Utility (CMWU), Gaza 12
<b>1.2 Training</b>	<b>Non-Revenue Water Management</b>
<b>In cooperation with When &amp; Where</b>	JVA, PWA 18-21 January 2016, Amman, Jordan
	Conducted by the Arab Countries Water Utilities Association (ACWUA) and Engicon O&M Company, held in Amman, Jordan. This advanced level training course was designed to build on existing knowledge, share best practice and understand advances made in key areas such as general information systems, network management, performance analysis and planning.
<b>From Participants</b>	West Bank Water Department, Coastal Municipal Water Utility (CMWA) and the Gaza Municipality 7, plus 5 invited members of PWA staff

### 1.3 Training

#### In cooperation with When & Where

#### Operation and Maintenance, Small/Agricultural/Domestic Use Units

PWA and JVA

April – May 2016, Palestine and Jordan

The PWA and JVA recognized a need to focus on skill building at a foundational level. The program was intended primarily for local operators of small scale desalination units, while also enabling additional training for the PWA, the JVA and their municipality staff.

#### From Participants

Jordan Valley (Jordan)

Local Operators

*Page 8: Gaza City | Page 9: Clock wise from left: Flow meters at Wadi Salqa - well no.2 desalination plant / Reverse Osmosis units at the Deir Al Balah desalination plant / Bore well head, Jordan Valley / Jordan Valley.*





## Supporting Irrigation

A field visit to the Jordan Valley (East) was conducted by MEDRC to support the Water User Association (WUA) and the Jordan Valley Authority (JVA) in their efforts to increase water availability for domestic and agricultural use through desalination.

There are approximately 316 farms in the Jordan Valley (East) area who struggle with a high salinity of ground water (5-6000 Mg L<sup>-1</sup>) and water scarcity. Through the support of the JVA many farmers can now develop their own desalination facilities. MEDRC is supporting the WUA on the desalination component of a broader capacity building program, led by the WUA. An initial training session was conducted in September, 2016. This was the first time a training program, developed in cooperation with the WUA and the JVA, focused on desalination.



### Arabic Plant Manual

During the 'Operation and Maintenance for Small-Scale Units' training in October in the Jordan Valley (Jordan), it was discovered that most of the farmers owning a small-scale RO unit to irrigate their fields were unable to monitor and maintain the plant properly. Explanations found in manuals or online are predominantly in English, meaning many farmers are unable to understand them. MEDRC therefore created and produced a basic plant manual, written in Arabic. The manual is easily understandable and gives advice on common problems with small-scale plants. The manual will be uploaded to MEDRC, PWA and JVA websites, and distributed to the farmers via the PWA and the JVA.

In cooperation with the JVA in May 2017, the manual was used as a learning tool to train farmers on three specially selected small-scale plants at farms in the Jordan Valley (Jordan). Additional training activities incorporating the use of the manual also took place in the West Bank and Gaza.

“As a Palestinian PhD student in the field of solar thermal desalination, the Sea Water Reverse Osmosis (SWRO) Design System training, enabled me to gain the knowledge of the other half of desalination technologies – Reverse Osmosis.”

**Issam Ghanem,**

Development Engineer, Palestine



#### 1.4 Training

##### Troubleshooting and Non-Routine Maintenance Program

**In cooperation with**  
**When & Where**

PWA  
February 2016, Gaza, Palestine

Designed to support the Coastal Municipal Water Utility (CMWU) as an onsite technical training program for plant managers and operators, in response to the PWA's need to provide training programs in country. The nature of a plant manager's job requires them to be on hand, and on site at all times. This means they are unable to leave their positions for significant periods of time to attend training elsewhere. To circumvent this issue, the course was held on site at their respective plants.

**From**  
**Participants**

Plant Managers & Operators  
Existing Desalination Plants in Gaza

#### 1.5 Training

##### Operation and Maintenance of Submerged Pumping Stations and Welding of Transmission Pipelines

**In cooperation with**  
**When & Where**

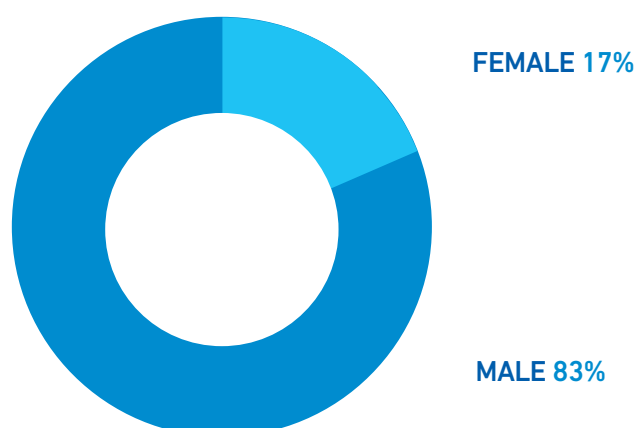
PWA & The Ministry of Water & Irrigation, Jordan  
April 5-16 2016, Miyahuna Water Company, Amman, Jordan

Conducted on-site at the Miyahuna facilities, this training helped the West Bank Water Department to address the optimization of its water systems for pumping stations and transmission pipelines.

**From**  
**Participants**

The West Bank Water Department  
20

#### Ratio of Male to Female Trainee Participation



### Gaza Test Bench

The Gaza Test Bench is a small scale NF-RO (nanofiltration and reverse osmosis) desalination testing plant, which provides the opportunity for hands-on training and development of water sector professionals using cutting-edge water treatment technologies. The facility provides the necessary teaching infrastructure for learning advanced desalination techniques in-country, providing for the design, construction, and funding of the facility. The Gaza Test Bench is an important initiative to address the technical capacity gaps and pressing water problems in Gaza. Designed by MEDRC and built by an international construction company, the test bench will be used by MEDRC fellows in their Master's research projects.

“ The training programs organized by MEDRC in the field of desalination and water management assist to develop capacity and capabilities in the Palestinian water and wastewater sector. ”

**Sawsan El Masry,**  
PWA, Training Department

“ MEDRC Water in-country training has created a distinctive footprint on the water sector in Palestine ”

**Ahmed Baraka,**  
PWA, Scholarship Coordinator

## Continued Professional Education and Training (CPET)

Under this activity, nominated candidates from the PWA and the Ministry of Water and Irrigation, Jordan, participated in MEDRC's CPET program. CPET provides high quality specialized training for engineers and professional technicians operating in desalination plants or plants processing waste water for reuse. It takes place at the MEDRC Water Research training centre in Muscat, Oman, where trainees receive hands on instruction using our state-of-the-art, purpose-built, reverse osmosis pilot plant.

## 2. CPET

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### 2.1 Training

#### When & Where

#### Sea Water Reverse Osmosis (SWRO) System Design

14-17 September 2015, MEDRC, Muscat, Oman

The training program covered the theoretical and practical aspects of engineering and design of sea water reverse osmosis (SWRO) membrane systems. The course provided a brief overview of reverse osmosis system fundamentals and focused on the practical aspects of selection and design of all key RO system components. The training also discussed alternative RO membrane systems configurations, key performance parameters of SWRO and BWRO (Brackish Water Reverse Osmosis) elements, and instrumentation and control components of SWRO plants. One session of the training was dedicated to the interactive demonstration of standard software design of SWRO systems. The training was suitable for desalination plant designers and operators and included examples of RO systems incorporated into large desalination plants in the Middle East.

#### From

Nominated Candidates from the PWA (4 Candidates) and the Ministry of Water and Irrigation, Jordan (5 Candidates)

#### Participants

9

**2.2 Training****When & Where****SWRO Operation, Monitoring and Trouble Shooting, Level 1**

15-18 February 2016, MEDRC, Muscat, Oman

This four-day training course was designed for plant operators and supervisors with a technical background. Conducted as a practical entry level training, it provided participants with knowledge in key areas of the operation and monitoring of desalination plants and membrane technology.

**From  
Participants**

PWA  
4

**2.3 Training****When & Where****Cost Estimating of SWRO Desalination Plants**

11-14 May 2015, MEDRC, Muscat, Oman

Delivered by Mr. Nikolay Voutchkov from Water Globe Consulting, this CPET course provided a practical understanding of key technical and economic factors which determine the site-specific capital, operation, and maintenance costs for a given desalination project. The course included a one-day interactive session on excel spreadsheet cost modelling and estimation, which was then applied to a specific SWRO desalination project case study.

**From  
Participants**

PWA, Ministry of Water and Irrigation, Jordan  
6

**2.4 Training****When & Where****SWRO System Operation and Features of Optimum Design**

19-22 September 2016, MEDRC, Muscat, Oman

Through the analysis of plant design parameters, this course provided participants with a practical understanding of operations and potential problem predictions in reverse osmosis processes. The course culminated in an exam on the final day, which all participants completed successfully.

**From  
Participants**

The West Bank and Jordan  
9





“Through the training course I understand my work in better detail and have gained confidence. MEDRC trainer Eng. Riadh Dridi made it easier for me to understand certain processes in the plant and their analysis.”

**Mousa Swelim Abu Jameh,**

Executive Director of the Council of East Water Management, Palestine

“My experience in SWRO was significantly upgraded in terms of technical information and practical solutions, through my participating in two related training courses which have been held in MEDRC during the year 2016.”

**Eng. Samhan Samhan,**

Project Manager, Palestinian Hydrology Group for Water and Development, Palestine

“I attended two training courses at MEDRC. The training on desalination was very helpful for me and the Ministry of Agriculture because recently we have a desalination unit used for irrigation and my knowledge and experience of operation and maintenance of this unit was highly increased after participating in the training. I hope to continue and finalize the level 3 which is focusing on SWRO pretreatment.”

**Imad Ghanma,**

Director of Land Classification, Ministry of Agriculture, Palestine



## 2.5 Training

### When & Where

## SWRO System Design

24-27 October 2016, MEDRC, Muscat, Oman

Aimed at plant designers and operators, this course covered both the theoretical and practical aspects of the engineering and design of SWRO Membrane Systems. It provided an overview of reverse osmosis system fundamentals and focused on the practical aspects of selection and design of all key RO system components. The course also covered alternative RO membrane systems configurations, key performance parameters of state-of-the-art SWRO and BWRO elements along with instrumentation and control components of SWRO plants.

### From Participants

Jordan and Palestine  
4

## 2.6 Training

### When & Where

## CPET RO Level 2: Seawater Reverse Osmosis Pretreatment

5-8 February 2017, MEDRC, Muscat, Oman

Four Jordanian participants attended the course which provided them with a practical understanding of key pretreatment processes widely used in reverse osmosis (RO) desalination plants and focused on selection, operation, maintenance, monitoring, troubleshooting and optimization of conventional and membrane pretreatment technologies. The participants were engineers and technicians from the Water Authority of Jordan (WAJ) and the Palestinian Water Authority (PWA).

### From Participants

Jordan  
4

CPET training  
at MEDRC Water  
Research, Muscat,  
Sultanate of Oman









“ The SWRO Operation & Features of Optimum Design training course was the reason I started specializing in seawater desalination. ”

**Khalid Elmezaini,**

Project Manager at Universal Group  
for Engineering and Consulting

## Profession of participants trained

Profession of Participants	Number	Percentage
Plant Operator	18	15%
Administrator	5	4%
Technician	19	16%
Mechanical Engineer	22	18%
Chemical Engineer	2	2%
Developer/Planner	12	10%
Farmer / End User	43	35%
<b>Total</b>	<b>121</b>	<b>100%</b>

### Expert Technical Advisory Panel

MEDRC, in cooperation with the PWA, have brought together a panel of leading industry experts to form an Expert Technical Advisory Panel. The panel exists to provide advice, technical expertise and guidance to the Technical Water Sector Capacity Building Program in Gaza.

Gaza suffers from several environmental issues that impact the quality and quantity of water for its inhabitants. An excessive use of chemical fertilizers in agriculture, illegal and random disposal of solid waste, and partially, or even completely untreated wastewater at many natural reservations, all combine to have a devastating impact on water, soil, fauna and flora. In parallel, there is a pressing need to invest in the development of the technical capacity of the water sector and its staff, if improvement to the current situation are to be achieved.

Working in collaboration with Almadina Consultants – Environmental Management and Urban Planning, a number of consultancy projects were undertaken to assist the work of the PWA in Gaza.

## Consultancy Projects in Palestine

### 1 **Technical Evaluation of Well Head Brackish Water Reverse Osmosis Desalination Plants in Gaza**

Due to the chronic water situation in Gaza, several small and medium scale emergency well head reverse osmosis brackish water desalination units have been constructed and operated by the Coastal Municipalities Water Utility (CMWU).

The facilities operate under harsh conditions with spare parts in short supply and regular interruptions to the electric power supply adversely affecting the plants performance. MEDRC visited, inspected and evaluated each of the 16 plants and provided the PWA with a Bill of Quantities for the needed parts and maintenance work, including a detailed estimate of costs involved.

In the framework of the Water Supply and Sewage Services Improvement Project (WSSSIP) funded by the World Bank, and subject to the recommendations and findings of this project's final report, the PWA shall implement refurbishment, upgrading and repair works for these plants.

### 2 **Technical Evaluation of Management Capacity of Desalination Plants Operation and Maintenance**

There are three sea water desalination plants in Gaza. Two of them are in the stage of expansion with the third currently under construction. Under the project, the required modifications and training needs necessary for these plants to achieve optimum performance were identified. An alternative organizational structure was proposed, consisting of a centralized style of management responsible for all divisions within the plants. In line with international practices, a full review of existing staff's professional experience and qualifications was conducted and all future human resource requirements and training needs were identified.

### 3 **Information Technology Support**

Providing IT support to the PWA with their ArcGis Web mapping software - ArcGIS viewer for Silverlight - a review was conducted of the existing system components including the hardware and software systems, the geo-database and the computer network capabilities.

Throughout the course of the project, assistance was provided to resolve ongoing technical issues, give recommendations on hardware and software compatibility, and to design, develop, and program a tool to enhance browsing capabilities. The project concluded with the PWA receiving a final set of recommendations designed to ensure the future optimum performance of systems.

### 4 **Assessment of Wadi Gaza Environmental Mitigation**

This project assessed the current status of Wadi Gaza with a view to proposing a set of mitigating environmental actions that would ensure the future sustainability of the Wadi.

Wadi Gaza is internationally recognized as being an important coastal wetland, characterized by a high degree of biological diversity, including globally threatened, endemic, and rare species. The ecosystem and biodiversity of Wadi Gaza is being destroyed by land conversion, fragmentation and increasing air and water pollution. The report focused on the ambient life of Wadi Gaza, its solid waste dumpsites, the aquifer, existing infrastructure, and its impact on the flora and fauna.

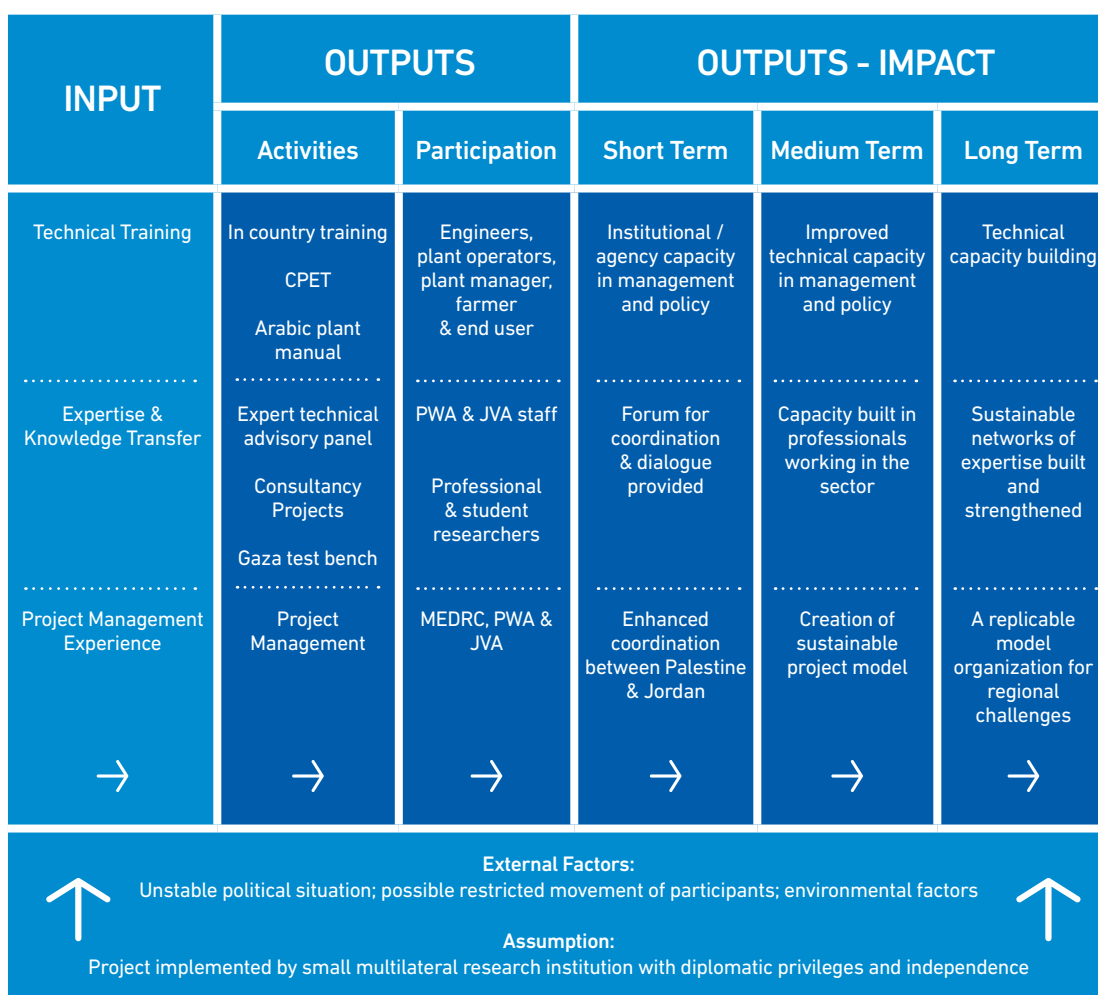
Working in collaboration with the PWA, priority was given to two areas most in need of a solution - the solid waste lying on the bed of the wadi, and issues pertaining to the infrastructure of the wadi.

## Project Sustainability

The overall objective of the Technical Water Capacity Building Program is to support the development of the water sector in both Palestine and Jordan. This is an ongoing project that will soon embark on Phase Two. With the continued support of the Qatar Fund for Development, Phase Two will consist of 2 aspects. The first will include an ongoing focus on applied research and training. The second will be to construct in-country reverse osmosis training plants using the MEDRC training plant model and approach.

Our vision for the future is to provide the PWA and JVA with all the resources necessary to run these plants independently within a 3-year time frame following their construction. The technical knowledge and capacity gained at these plants will then be dispersed to more localized plants and farmers, leading to the transfer of knowledge within sectors and across the region.

## The Pathway to Building Capacity









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