



Methods for Irrigation and Agriculture

## The Water-Energy-Food NEXUS & On-Farm Irrigation Systems Auditing



# WATER for FOOD

Irrigated agriculture in Jordan is a critical source of food and income for farmers.



Almost ready-to-harvest Barhi Dates and potatoes harvest at a farm in the governorate of Aqaba, south Jordan. Both are very common food items in Jordan.

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In Jordan, irrigation consumes nearly 60% of the country's available water resources



A plastic-mulch lined irrigation water collecting pond at a farm in the southern Jordan Valley, Ghor Al Safi.

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# ENERGY for WATER

Jordan imports nearly 95% of its energy needs in the form of crude oil and natural gas. Irrigation comes with a high



energy footprint. A self-feeding cycle of pumping groundwater reduces the water-level of the aquifer each year, which increases groundwater salinity, depth and the energy required to pump it.

A pumping unit at a citrus farm in the northern Jordan Valley.  
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More farmers are required to irrigate with marginal water (treated wastewater and brackish groundwater) which is more saline than some crops can tolerate. This is forcing



some farmers to install desalination systems on the farm which elevates the energy footprint of their operations.

In Jordan, reverse osmosis is the chosen on-farm saline water desalination technology where needed. This technology has a high energy footprint.

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# FARMERS

Farmers in Jordan are facing a great challenge of water scarcity combined with high energy costs. In particular, small holder farmers are more vulnerable to these conditions



Farmers picking Okra at a farm in the northern Jordan Valley.  
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## IRRIGATION SYSTEMS

Proper irrigation systems design, operation and maintenance has the potential of reducing water and energy consumption thereby reducing operational costs. For this purpose, MIRRA has been working since 2007 with farmers to improve on-farm water and energy management.



Main and submain lines of a drip irrigation system at an Onion farm in the southern Jordan Valley.  
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# IRRIGATION AUDITS

MIRRA conducts thorough irrigation system audits that collect farm-level data to verify irrigation systems are working as designed. These audits provide the basis for training farmers on irrigation systems and leads to actionable steps towards improving irrigation systems' design, operation and water-use efficiency.



MIRRA's irrigation senior expert, Samer Talози, conducts an on-farm irrigation management assessment at a vegetable farm in the northern Jordan Valley with the farmer owner, Mr. Zaki Rababaa.

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MIRRA's irrigation engineer, Khalil Bani Mustafa, conducts an on-farm irrigation management assessment at a small farm in the Azraq region north east of Jordan.  
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## WHAT IS AN IRRIGATION AUDIT?

An irrigation system audit examines the irrigation system in its current state to evaluate system performance, create an effective irrigation schedule, and make design and/or operational adjustments to improve irrigation efficiency, conserve water and energy use.



At this banana farm in the southern Jordan Valley, an irrigation audit revealed a high-water salinity that is negatively impacting the growth and development of trees.

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## WHAT ARE THE BENEFITS OF AN IRRIGATION AUDIT?

Efficient irrigation, depends on knowing the amount of water an irrigation system applies during each cycle. Completing an audit of an irrigation system provides the information needed to deliver the proper amount of water.

Part of a pressurized irrigation system in a farm in the Azraq region, north east of Jordan.

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# WHAT SERVICES DOES MIRRA OFFER?

- Auditing irrigation systems
- Developing optimal irrigation systems design and irrigation schedules
- Advising on irrigation systems re-design, operation and maintenance to achieve reliable and cost effective system operation
- Recommending innovative irrigation technologies, products and practices.
- Providing hands-on training and tailor-made capacity building programs for farmers, youth and other stakeholder at MIRRA's Climate-Smart Farm in the Jordan Valley.



A poorly maintained disk filter at a vegetables farm in the central Jordan Valley (upper picture) and a properly-maintained disk filter (lower picture) at a citrus farm in the northern Jordan Valley.


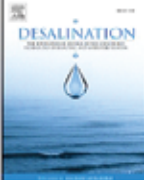
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# CELEBRATING A NEW PUBLICATION


Check out the results of our latest joint field work with the department of Mechanical Engineering at the Massachusetts Institute of Technology, USA.

Desalination 561 (2023) 116628

Contents lists available at ScienceDirect

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journal homepage: [www.elsevier.com/locate/desal](http://www.elsevier.com/locate/desal)



## Feasibility and design of solar-powered electro dialysis reversal desalination systems for agricultural applications in the Middle East and North Africa

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**HIGHLIGHTS**

- Current methods to desalinate irrigation water in the Middle East and North Africa (MENA) are expensive and energy intensive.
- Photovoltaic-powered electro dialysis reversal (PV-EDR) was chosen as an improved desalination method to be deployed in MENA.
- A time-variant scheme for EDR is proposed wherein flow rate and stack voltage are varied based on available solar irradiance.
- The levelized cost of water (\$/m<sup>3</sup>) of TV-PV-EDR was found to be 24% less than current RO systems despite a higher CAPEX.

<https://www.sciencedirect.com/science/article/abs/pii/S0011916423002606>

Front page cover photo: A hands-on training program at MIRRA's Climate Smart Farm in the Jordan Valley.  
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