

# Water, Wastewater, and Energy Solutions for Off-grid Bedouin, Palestinian, and Jordanian Communities

Clive Lipchin, PhD, director, Center for Transboundary  
Water Management

[clivearava@gmail.com](mailto:clivearava@gmail.com)



	<b>Arizona</b>	<b>Nevada</b>	<b>Israel</b>
Population (million)	6.9	2.9	8
Surface Area (km <sup>2</sup> )	295	286	21
Per capita water consumption (gallon/day)	148	205	100
Percent water use in agriculture	69	77	50
Average monthly water bill (\$) for family of four (100 gallons/person/day)	34.29 (Phoenix)	32.93 (Las Vegas)	1.89/cubic meter
Annual precipitation (inches)	13	9.5	22
Main water source	Colorado river	Colorado river	Sea of Galillee, groundwater, desalination
Reclaimed water (%)	3	N/A	80

# Off Grid Communities

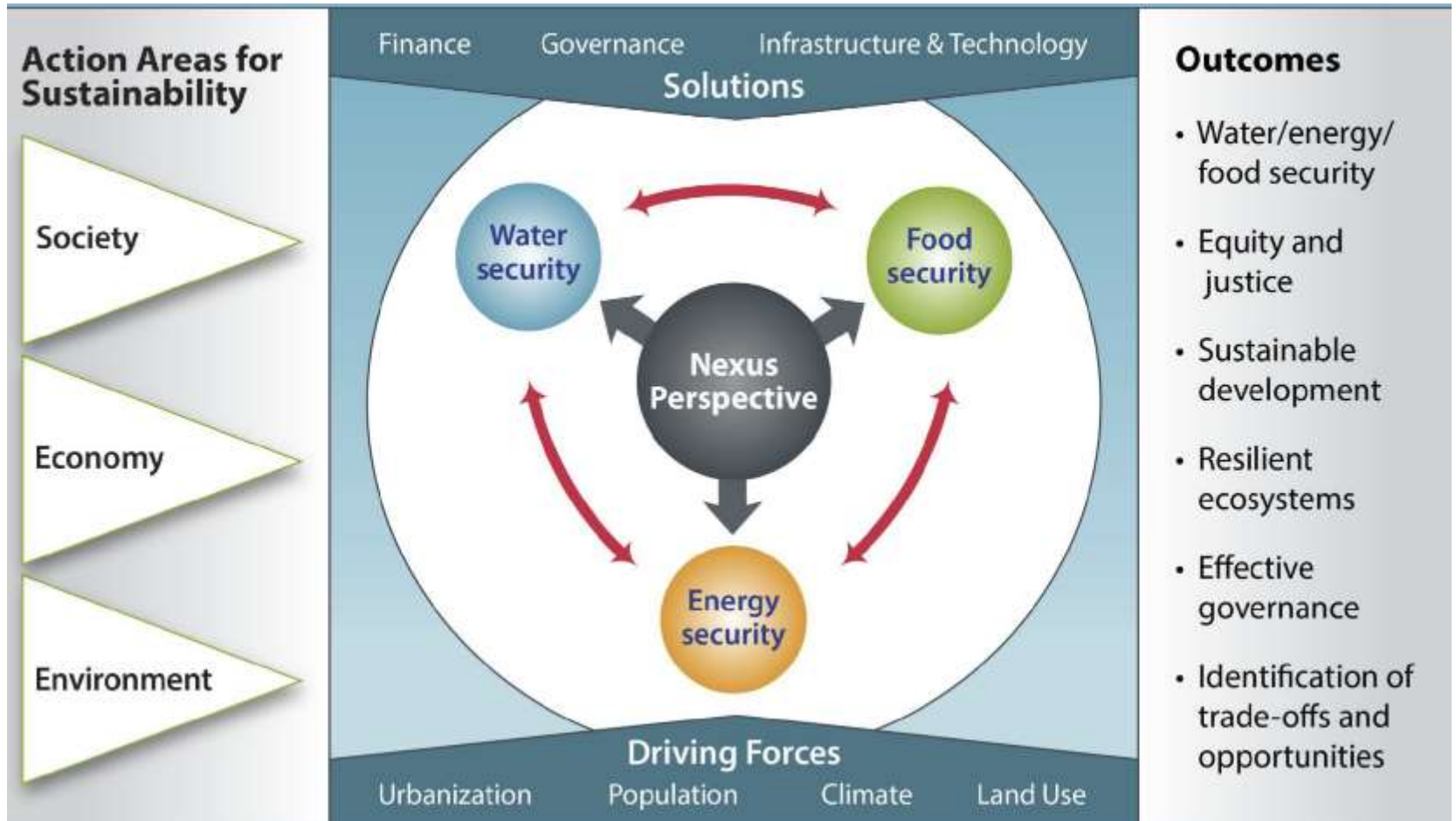
Unfortunately it is a fact that, in the world today, a staggering 1.3 billion people have limited access to water, sanitation and electricity.

Many of these people live in rural and semi-rural communities.

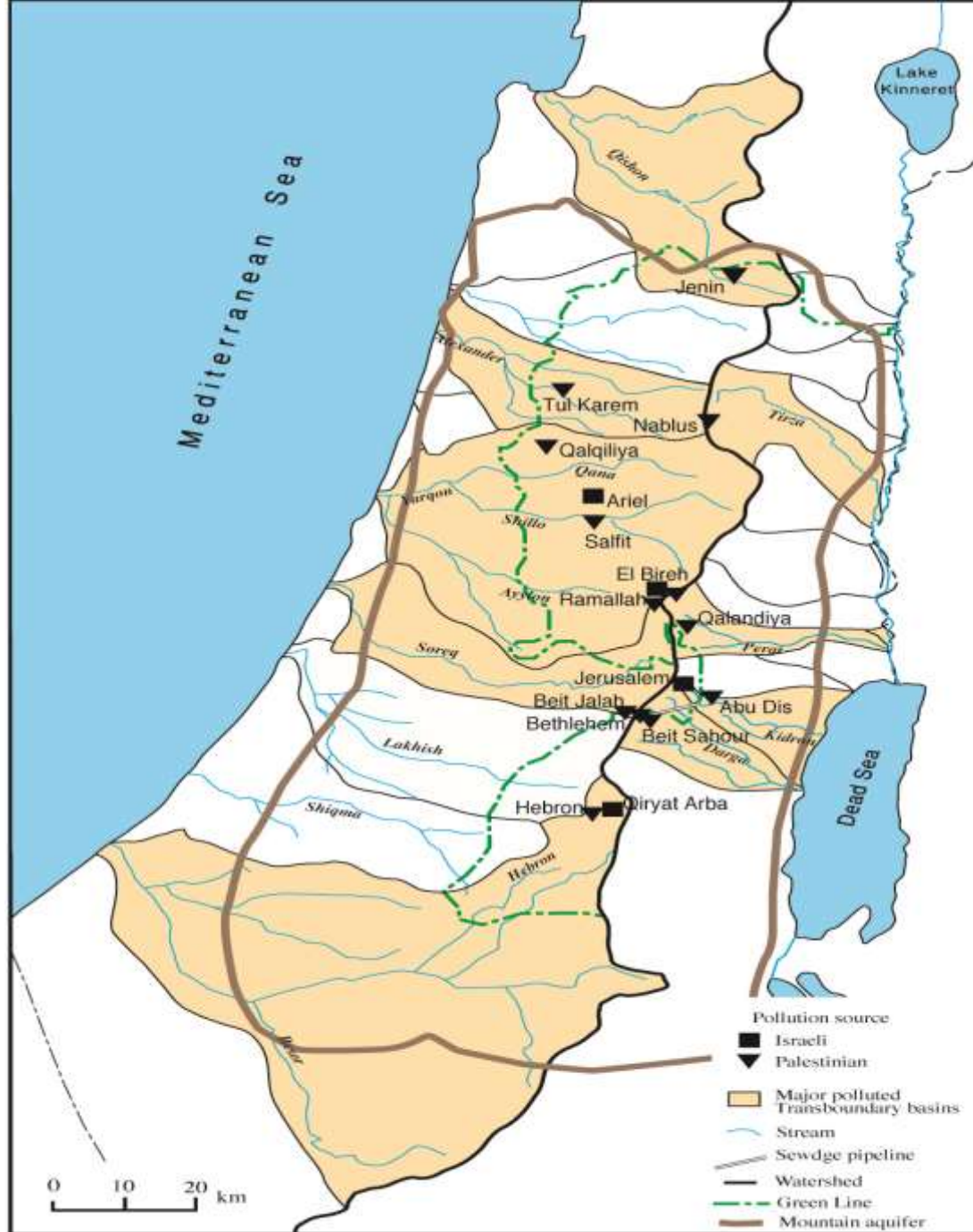
Until such communities have access to efficient water, energy and sanitation services, little progress can be made to develop their economies and improve their lives.

# Off Grid Communities

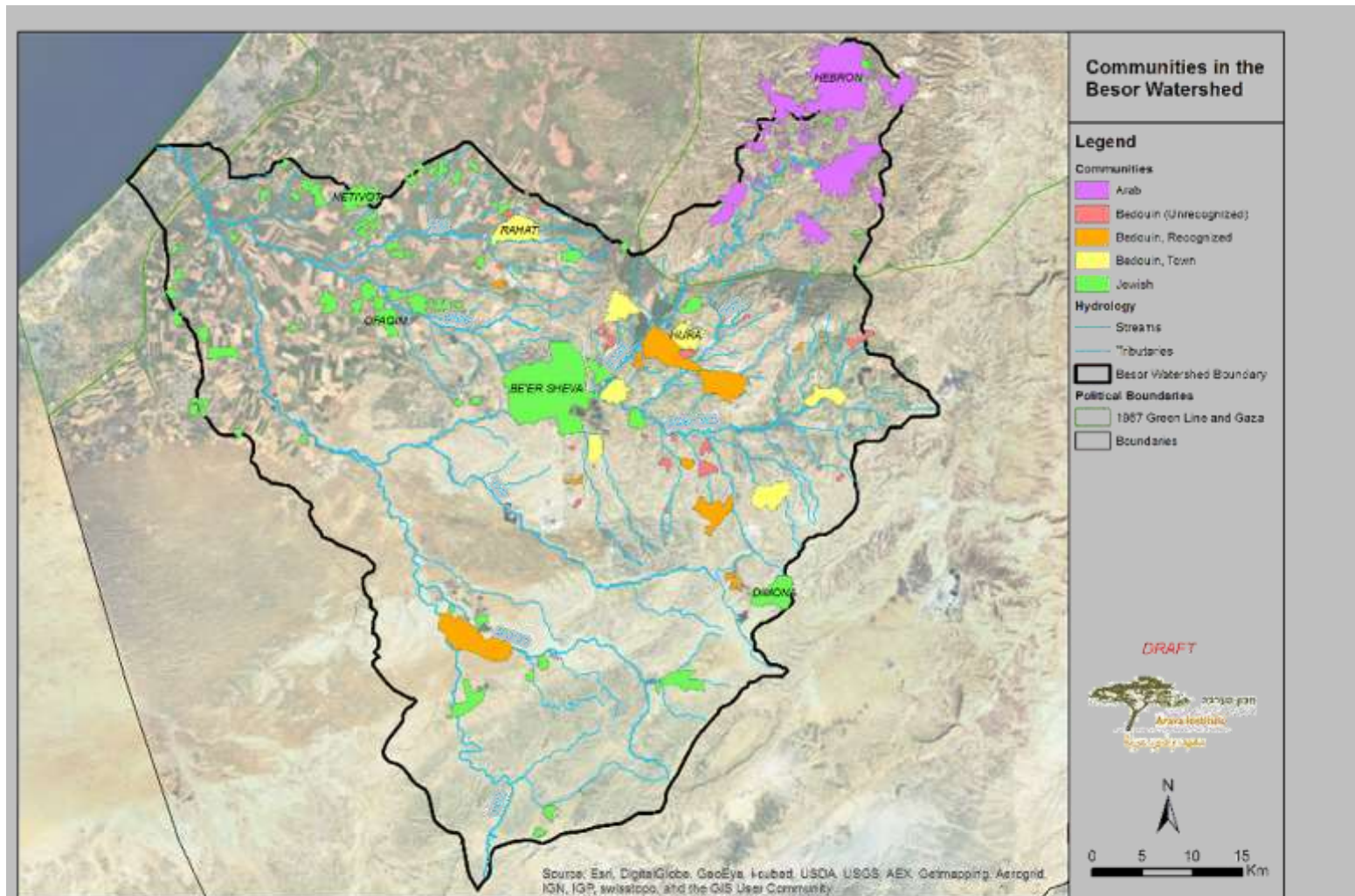
- Around 70% of the Palestinian population in the West Bank
- Approximately 30% of the Jordanian population
- Roughly 50% of the Bedouin population in the Negev, Israel



After R. Waskom, N. Grigg, and M. Akhbari, 2014

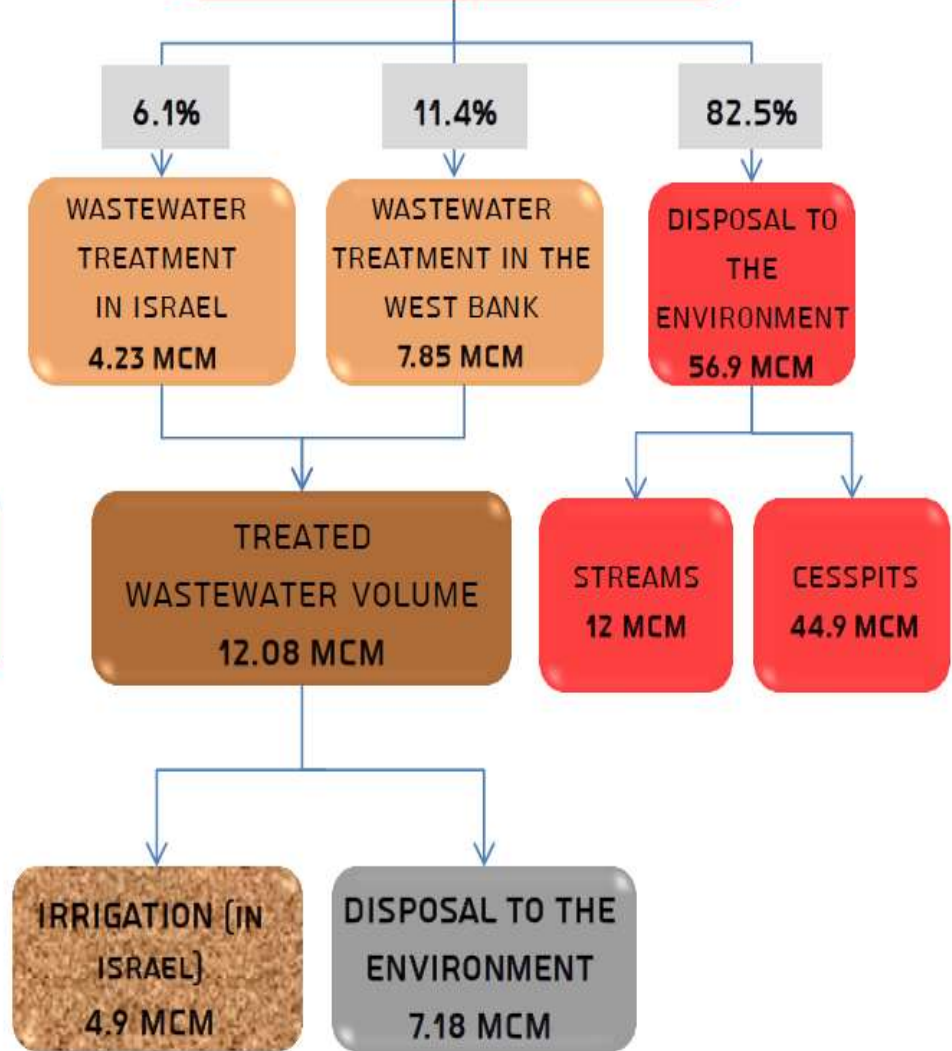
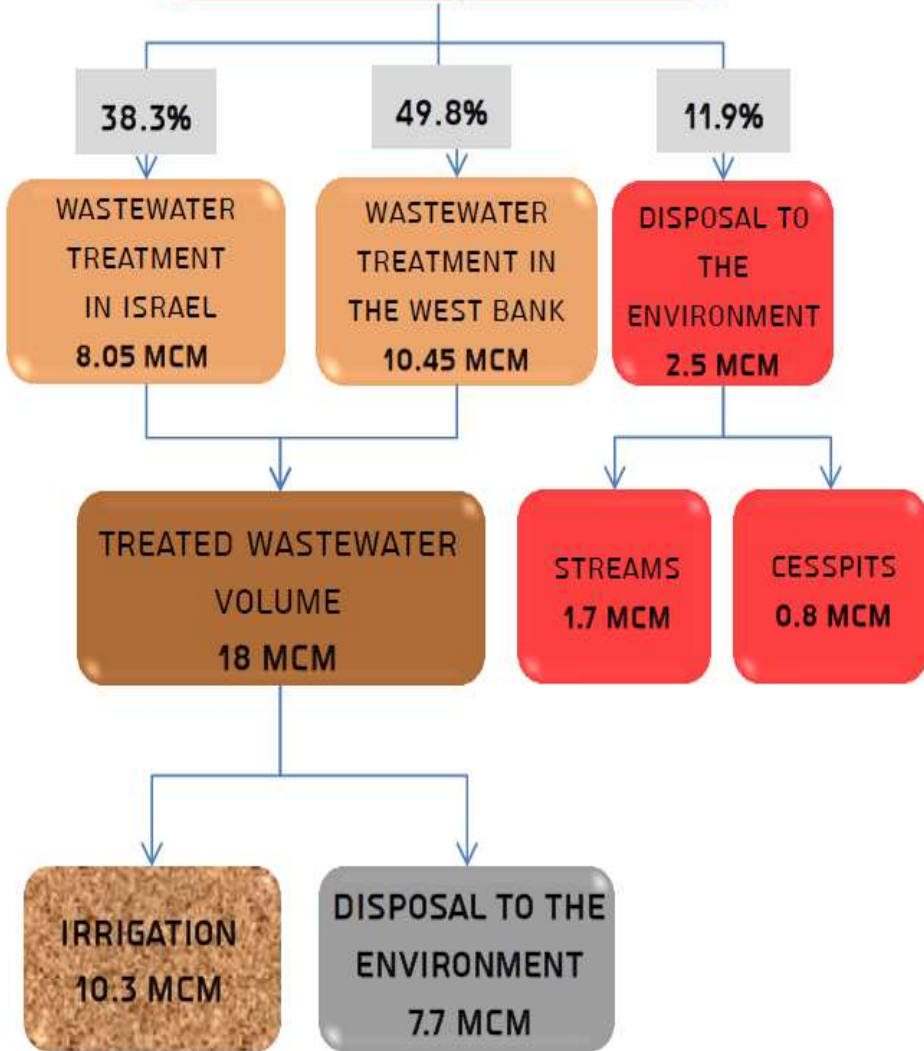


# Off-grid Communities and Cross Border Complications

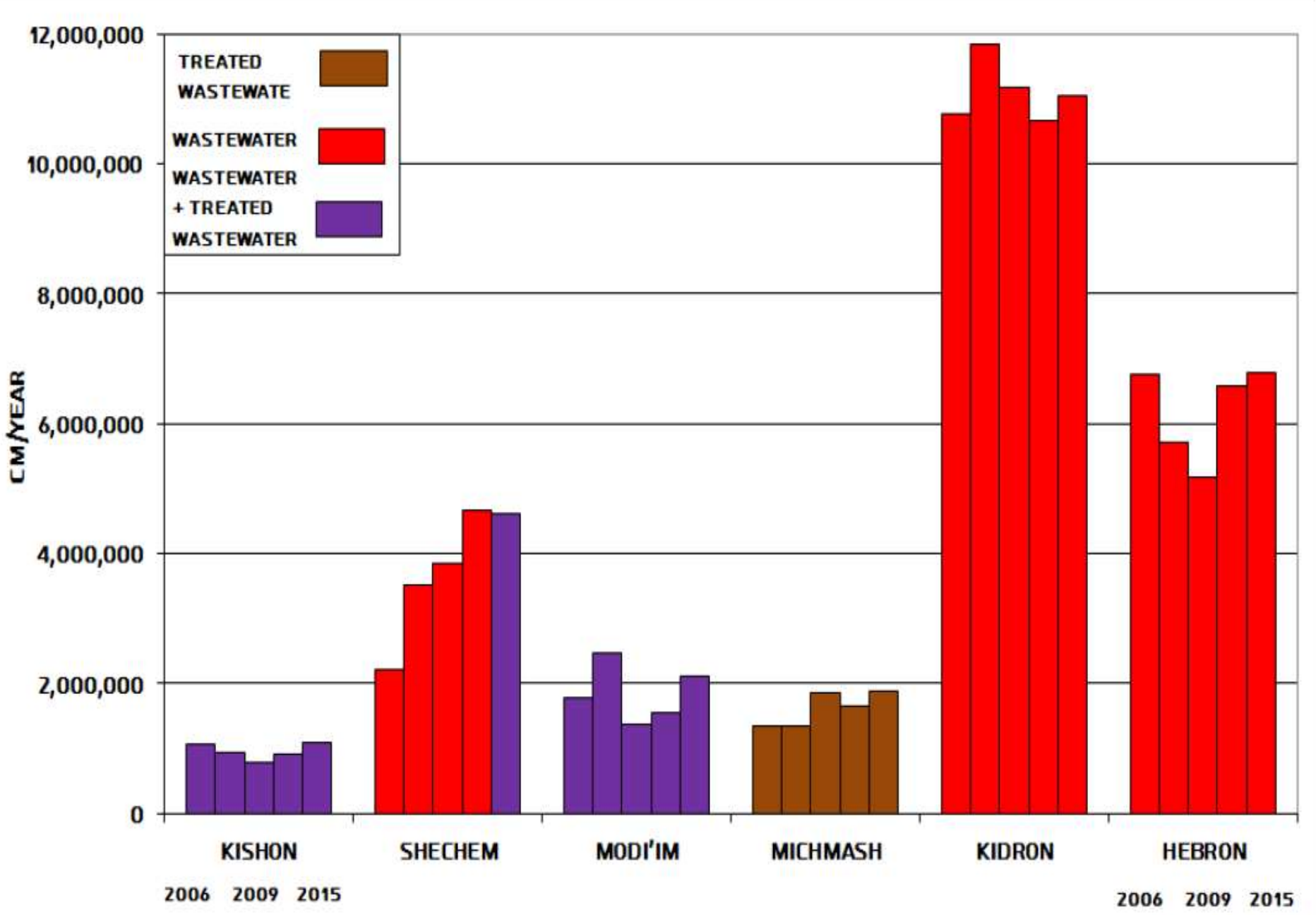


# SEWAGE FROM ISRAELI SETTLEMENTS 21 MCM/YEAR

# SEWAGE FROM PALESTINIAN CITIES / VILLAGES 69 MCM/YEAR

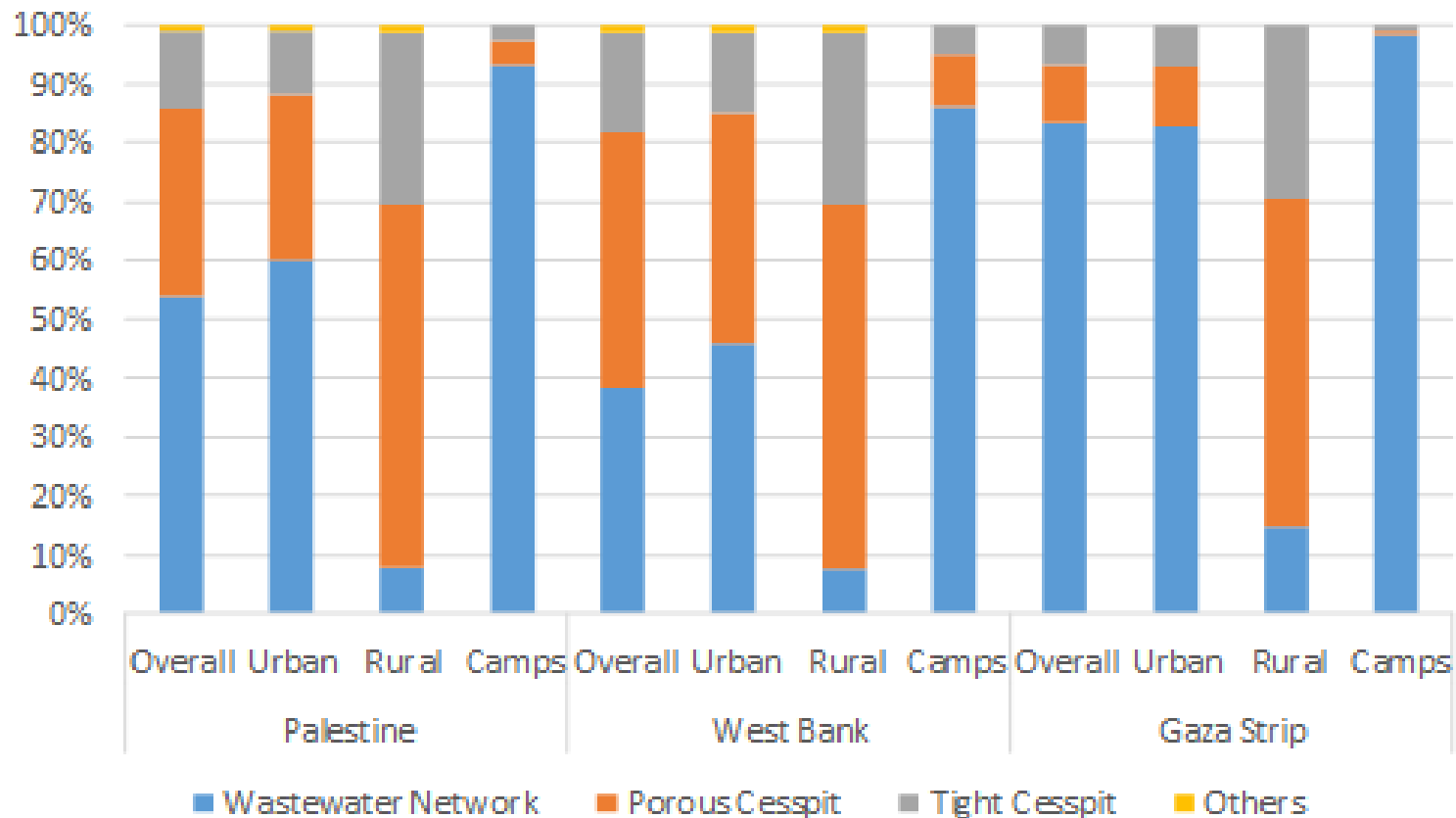






**FIGURE 2: FLOW VOLUMES AT THE MAIN STREAMS IN JUDEA & SAMARIA, 2006-2015**

## Wastewater Disposal Methods in the PA



Source: *The Palestinian Central Bureau of Statistics*. 2015 [cited 2015 November]; Available from: <http://www.pcbs.gov.ps/>.

# The Negev Bedouin



- The largest minority population in the Negev – approx. 200,000 people
- Arab, Muslim but not Palestinian
- Are citizens of the state of Israel

# The Negev Bedouin

- According to Israel's Central Bureau of Statistics of 2014, the Bedouin (Muslim) Population in the Negev numbered 224,200, representing 27.4% of the total population of the Negev. In 2014, the Bedouin citizens of the Negev constituted 13.2% of the total Arab population of Arab citizens in Israel around 1,700,000 Arab residents.
- Of the total Bedouin population of the Negev, 154,369 live in towns, 20,473 of them are in recognized villages within two regional councils. The remaining approximately 55,700 reside in 36 unrecognized villages.

# Urban Planning for the Bedouin

- Approx. half the population live in recognized towns and villages
- The other half live in unrecognized villages – some of these are slated for demolition by the government
- In both recognized and unrecognized communities the Bedouin lack access to basic services of water, sanitation and solid waste

# Project Objective

- To provide a solution to untreated wastewater in off grid communities as a means for environmental protection, public health and improved opportunities for water for irrigation
- To engage the government and the private sector in adopting a decentralized approach to wastewater treatment and reuse in the off grid community

# The Current Situation of Untreated Wastewater



- Sewage is discharged untreated into wadis and streams, polluting the groundwater and surrounding environment to Bedouin and other Israeli communities in the Negev

# The Current Situation of Untreated Wastewater



- Untreated sewage is discharged into open cesspits – a major insult to the environment and public



Bedouin sheep grazing near and in a polluted stream of untreated sewage



# Public Health Impacts to Untreated Sewage

- There is a direct connection between exposure to sewage due to lack of infrastructure and peoples' morbidity
- Diarrheal diseases constitute the leading cause of hospitalization in Bedouin infants.

ite of the world.  
he A White House statement

ing to force a solution on  
the other.

## News in Brief

### 2-year-old dies after falling into sewage pit

A two-year-old child died yesterday after he apparently fell into a sewage pit in the Bedouin village of Bir Hadaj in the Negev. Paramedics arrived and tried to resuscitate the boy but he was declared dead in Soroka Medical Center in Be'er Sheva. Police have opened an investigation into the circumstances of his death. Beterem, an Israeli NGO dedicated to child safety, says that eight Bedouin children have died in accidents since the beginning of 2017. From 2008 through 2016, 217 Bedouin children were reported to have died of injuries. (Yotam Berger)

re  
s-  
or  
re  
r-  
u-  
es  
to

I  
r  
t  
s  
c  
c  
d  
is  
Il  
su  
th

TEPPER

miss

of this

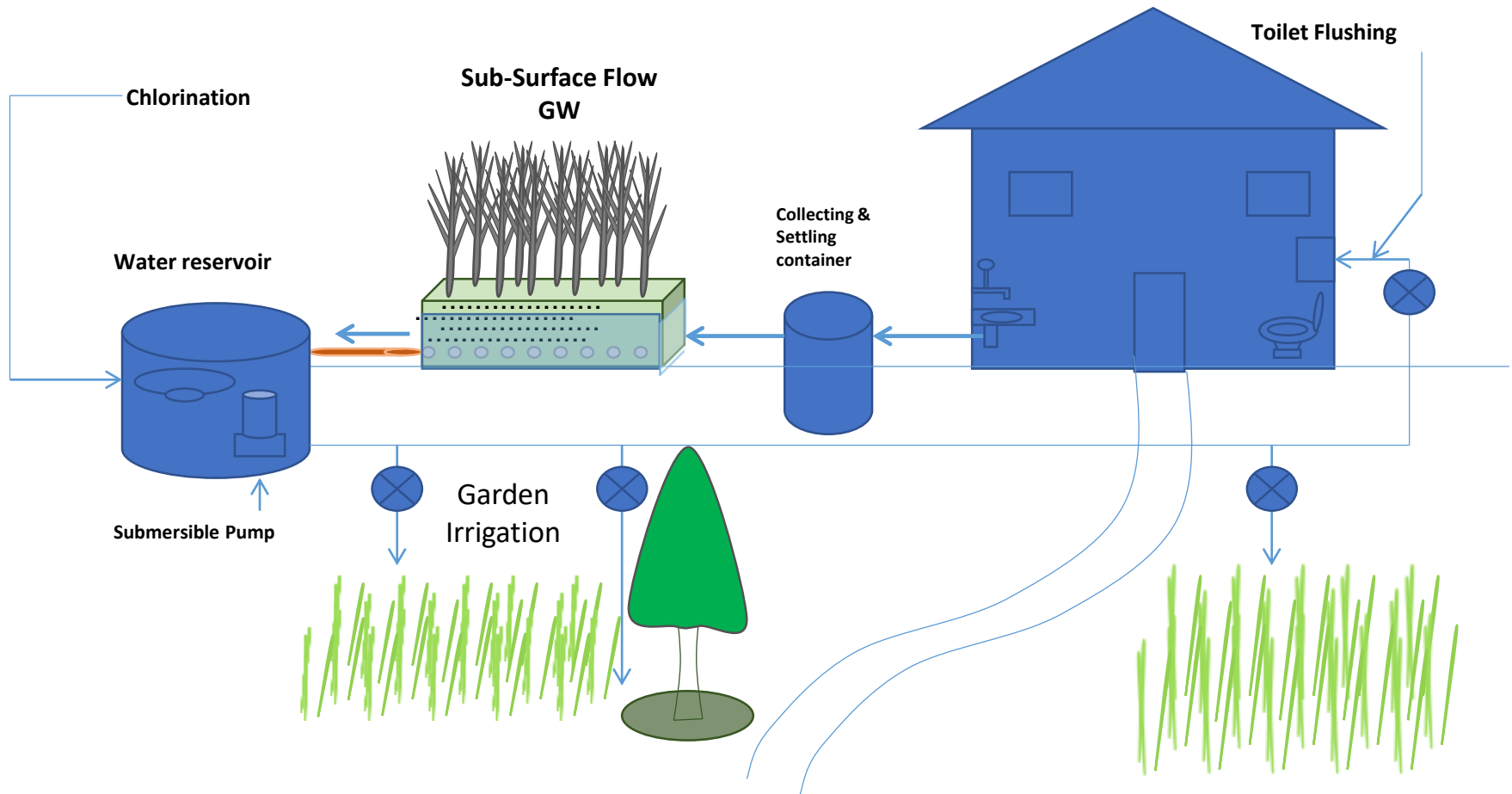
# According to Dr. Mansur Al Gargui, physician treating the Bedouin population

*“Diarrhea is much related to domestic hygiene. It does not matter how much you will keep the house clean, as long as you are exposed to sewage, it's affecting intestinal diseases, especially in children. Dysentery is very common and without a doubt related to sewage. Children's morbidity is high due to water borne diseases such as Brucella and Giardia lamblia. Dysentery and Giardia are common in children, due to exposure to sewage. There is a direct connection between sewage exposure and morbidity from these diseases.”*

# The Solution

- Treating the black water (toilet water) by a sealed septic tank instead of an open cesspit
  - Advantages are groundwater protection and reduction of water borne diseases
- Treating and recycling the grey water (kitchen and bathroom water) for irrigation and livestock watering
  - Advantages are additional sources of water for crop production
  - Economic benefits by improved crop yields

# The Solution: On-site wastewater treatment and reuse



The Arava Institute has successfully installed many low-tech and low-cost constructed wetland systems in Palestinian communities. This will be the first project to focus on the Bedouin community in the Negev.



# Constructed wetlands can drastically improve crop yields

July 22, 2015



April 5, 2015



May 21, 2015



Improvements in crop yields from a Constructed Wetland System installed in the West Bank









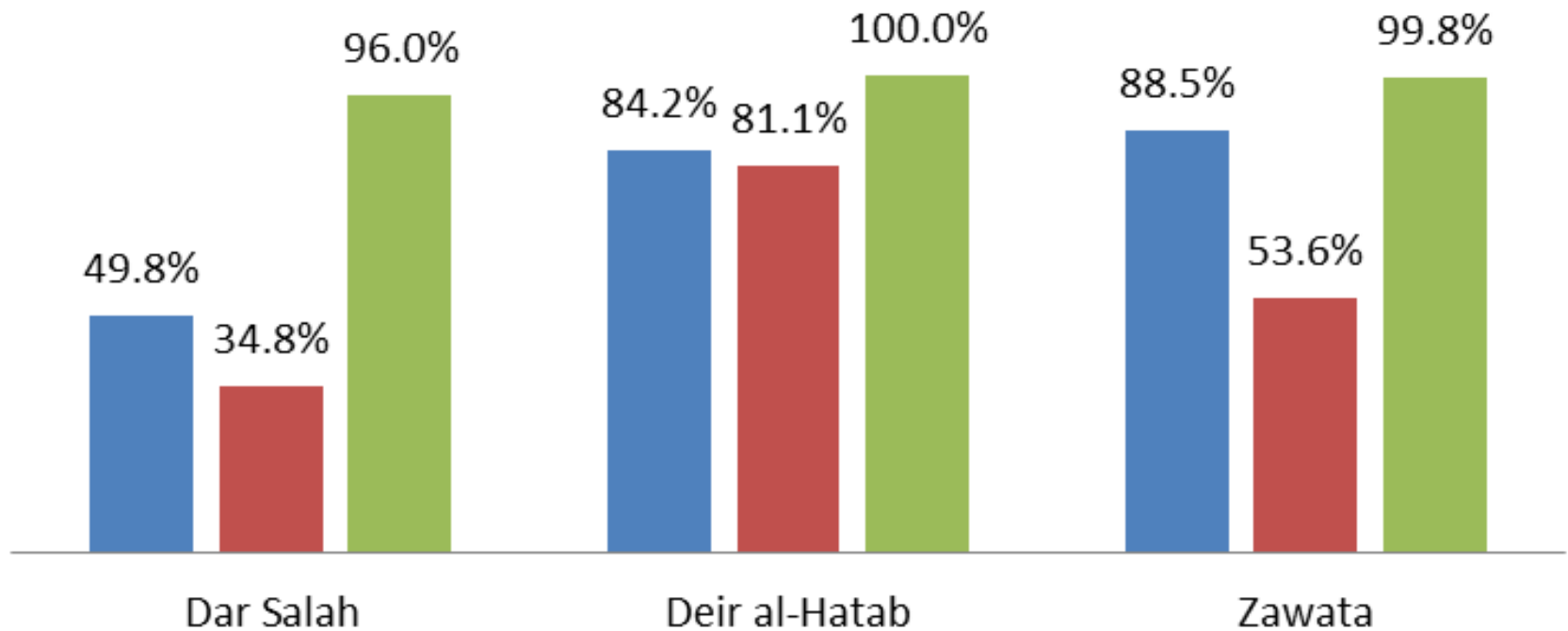
# Decentralized WWT – Sustainability and Scalability

- Community buy-in
- Local government support
- Local institutions
  - FEW utilities
- Capacity
  - O & M
  - Extension services
- Local business initiatives
- “Beyond Aid”

# Water Quality Results

## Removal Efficiency








■ BOD ■ COD ■ TSS



Type to filter sites ...

-  GSM  
-67.000 db | 21-02-2015, 07:33:24
-  GPS  
5.600 hdrop | 18-02-2015, 15:33:28
-  Level  
243.384 cm | 21-02-2015, 11:19:26

**Hebron**

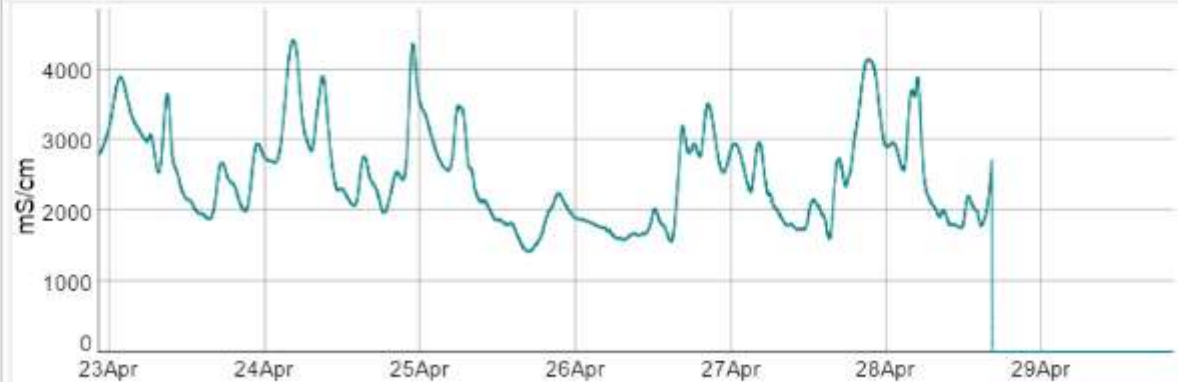
-  Dissolved Oxygen  
0.000 mg/L | 2 hours ago
-  Conductivity  
4.218 mS/cm | 2 hours ago
-  TSS  
N/A
-  GSM  
-67.000 db | 6 hours ago
-  GPS  
1.400 hdrop | yesterday
-  Temperature  
22.546 c | 2 hours ago
-  Level  
0.000 cm | 5 hours ago
-  GSM Level  
-65.000 db | 17 hours ago

refresh in 1 sec.



Charts

Time Frame: 6 hours, 12 hours, 1 day, 3 day, 1 week, 1 month, 3 month, 6 month, 1 year. Range: ▾



Legend: — Hebron / Conductivity

cm / mg/L mS/cm

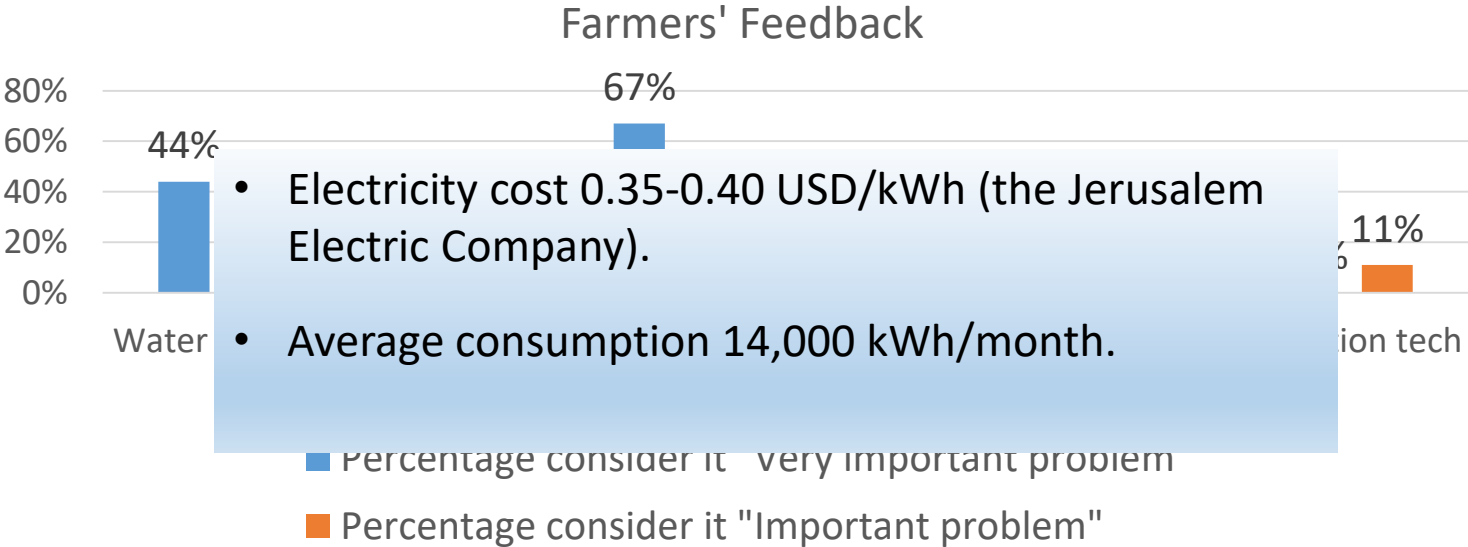
# Solar PV Energy to Offset Electricity Cost of Groundwater Pumping

## Auja Village

- Dates farmers with a total of land of 420 dunums.
- 100m deep groundwater well.
- Current pumping capacity 50 m<sup>3</sup>/hour in 9 months
- Auja water spring is used for 3 months



# Community Needs Assessment







Solar panels from Build Israel Palestine. Uriel Sinai for The New York Times

Broader Impact of this project is to provide a wastewater solution to other off-grid communities including refugee camps

**Zaatari Refugee Camp in Jordan is home to around 250,000 people and is completely off grid**



# Indian Health Service: The Federal Health Program for American Indians and Alaska Natives

Adequate sanitation facilities are lacking in approximately 145,000 American Indian and Alaska Native homes (or 36 percent). Of these homes approximately 26,000 (or 6.5 percent) lack access to a safe water supply and/or waste disposal facilities, compared to less than 1 percent of homes for the U.S. general population.

