

Wastewater Reuse Pilot Projects in Gaza Strip



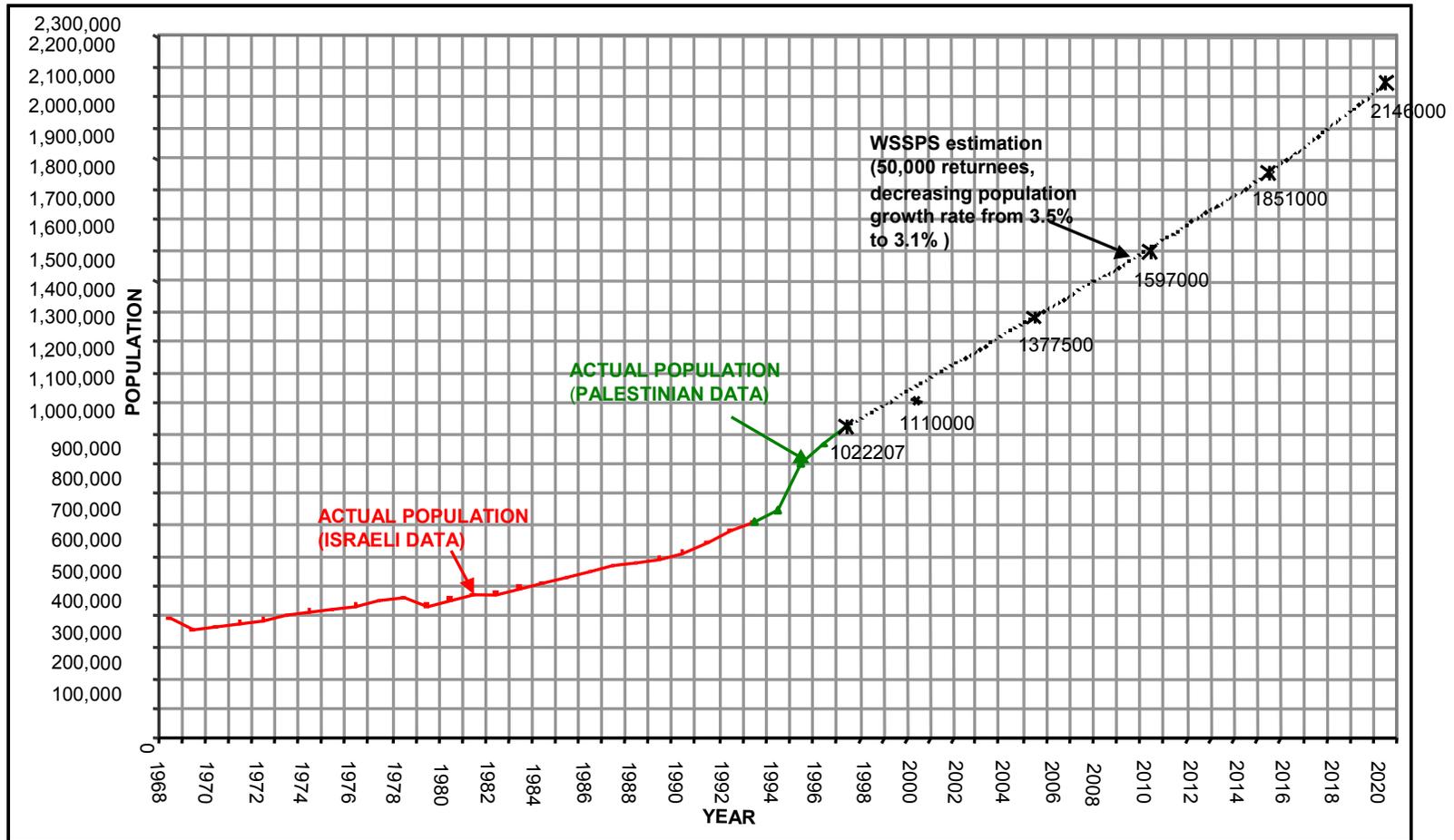
Main Features of Water Situation in GS

- The total abstraction of groundwater in Gaza Governorates exceeds 170 MCM/year.
- The agriculture consumes around 87MCM of pumped through more than 4600 wells located overall Gaza Strip.
- The reminder (83 MCM) is used for industrial and domestic water supplies. The aquifer is being over-exploited.
- The gap between water demand and water supply increases with time as a result of rapid population growth in this small area. The water balance record reveals a deficit of about 60-80 MCM/year.
- Reconciliation relies in the strategy of ensuring additional water supply and wastewater reuse schemes. The reuse of treated wastewater effluents represents a national interest and it is considered an important component of the overall maximization of water resources.

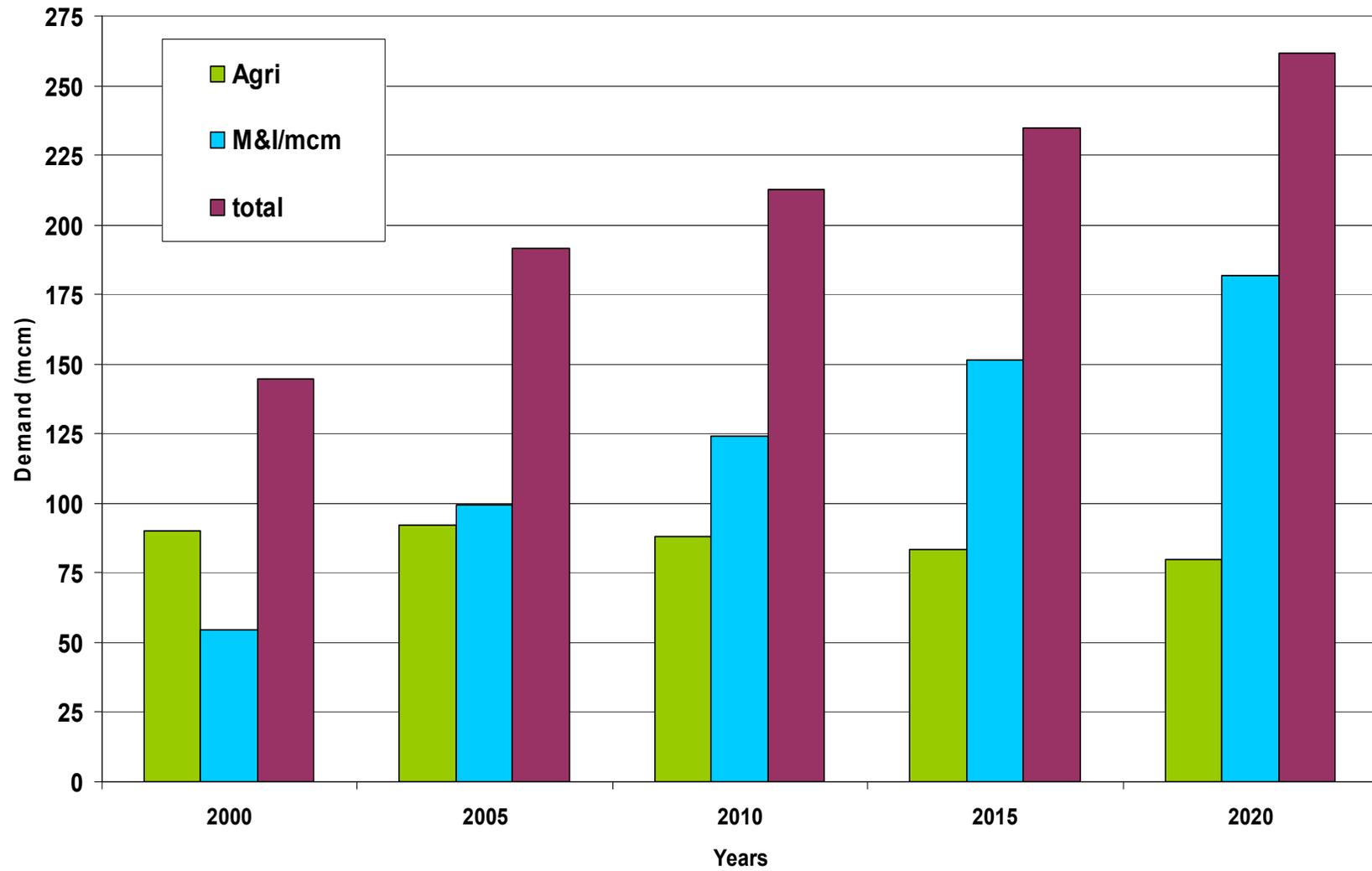
Total Municipal Consumption in Gaza Strip, 2009

| | | |
|--|-----------------|-----------------|
| Total Consumption (MCM) | | 91.3 |
| Mekorot Water (MCM³) | | 4.8 |
| Water Abstracted from Groundwater (m³) | | 86.5 |
| UNRWA wells Abstractions (m³) | North (Jabalia) | 1,485,550 |
| | Gaza | 571,427 |
| | KY | 104,384 |
| | Rafah | 108,000 |
| Total UNRWA Abstractions | | 2.3 |
| Total Water Consumption | | 93.6 MCM |

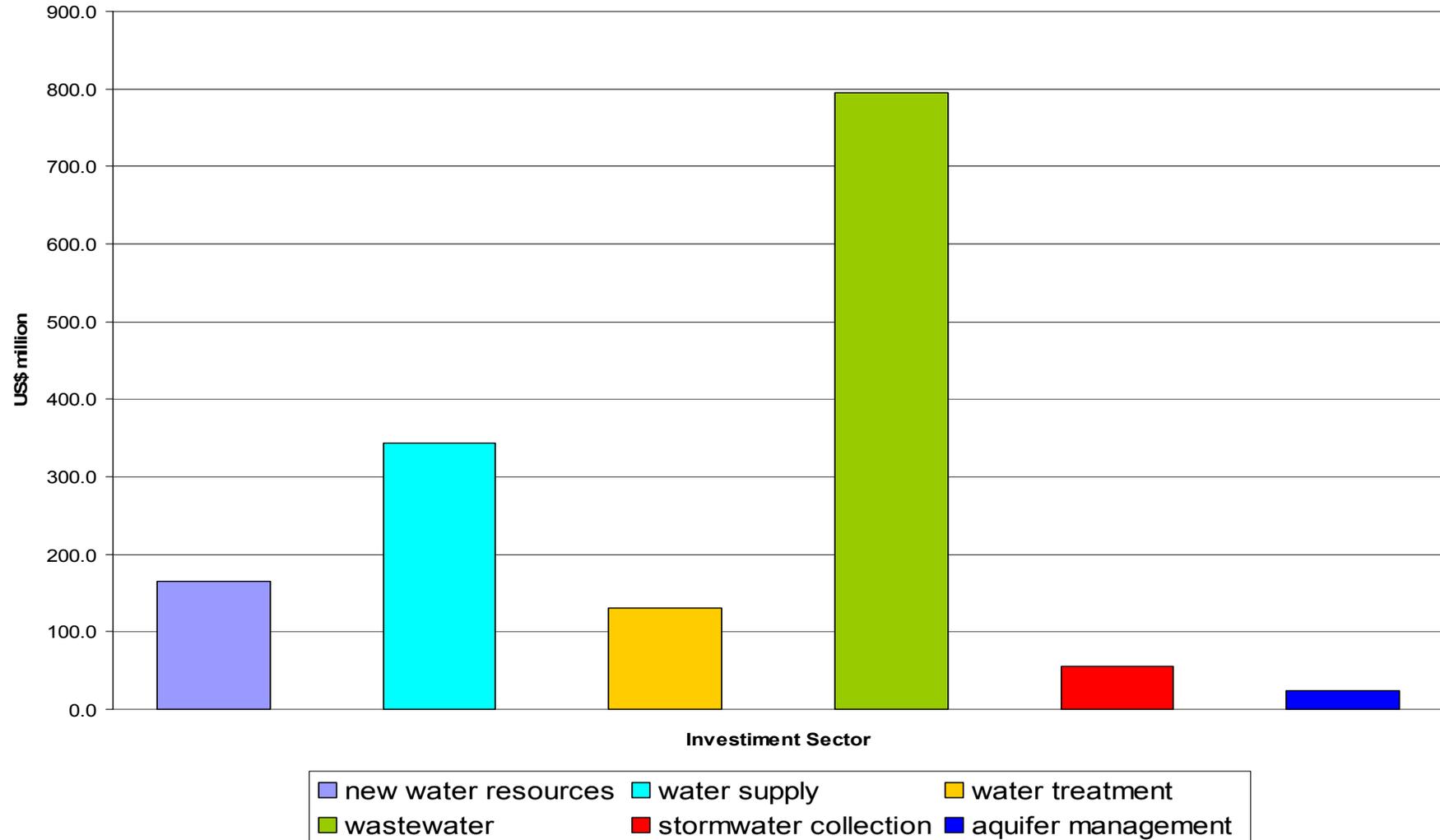
Population Projection



Projected Water Demand



Investment Management Plan(2000-2020)



| Govern. | Population Capita | Connect. to Sewage network % | Sewage Production M3/day | Treatment Availability | Final Distention |
|------------------------|------------------------------|---|---|--|--|
| Northern | 290,000 | 80% | 20,000 | Available Partially Treatment | 100% Infiltration basins East & North of Gaza Strip |
| Gaza | 550,000 | 90% | 60,000 | Available 80% Partially Treatment & 20% Raw | 100% to sea 50,000 partially 10,000 Raw |
| Middle | 220,000 | 55% | 10,000 | Not Available | 100 % Wadi Gaza and to the Sea 10,000 Raw |
| Khan Younis | 280,000 | 40% | 9,000 | Available Partially Treatment | 100 % to sea (30,000 cesspit) 9,000 Partially |
| Rafah | 185,000 | 65% | 10,000 | Available Partially Treatment | 100% to Sea 10,000 Partially |
| Total | 1,525,000 | | 0109,00 40 Mcm/yr | | r32 Mcm/Y To Sea |

Wastewater Info

Four main Treatment Plant

North •

Gaza •

Khan Younis Temporary WWTP •

Rafah •

Eight Points Disposal to Sea

Three in Gaza •

End of Wadi Gaza down stream •

One in Khanyounis •

One in Deir El Balah •

One in Rafah •

38 Sewage pumping stations distributed all over the Strip

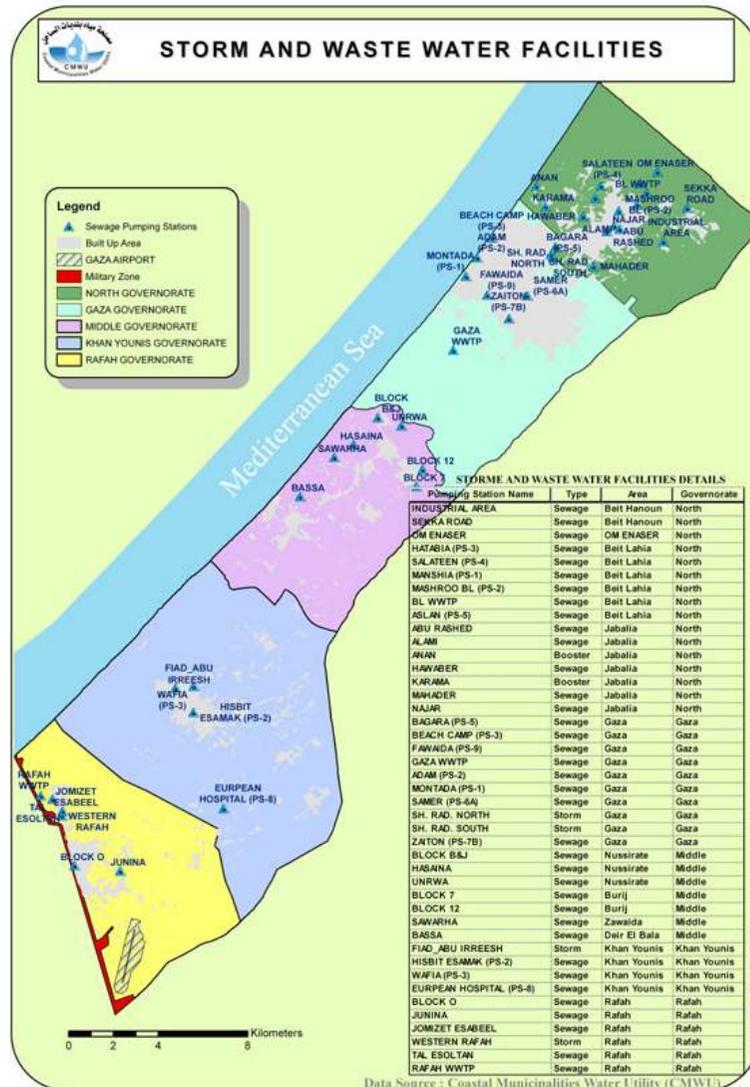
16 in the North •

8 in Gaza •

7 in the Middle •

3 in Khan Younis •

5 in Rafah •



Wastewater Plans & Projects

1. Short Term:
 - rehabilitation and upgrading of the existing treatment facilities
 - and carrying out small pilot projects reuse schemes

2. Long Term:
 - Regional WWTP with major reuse schemes

Wastewater Concerns

Many questions are to be addressed for any irrigation schemes:

- What crops could be irrigated (Crop Selection).
- How to irrigate the crops (irrigation techniques).
- Standards adopted.
- Parameters considered.
- Problems associated to wastewater reuse schemes.
- Carrying out a comprehensive monitoring program (crops, soil, effluent, groundwater).

WW Reuse Pilot Projects

1- Bedouin Village

- The first pilot location in Beit Lahia aims to demonstrate that use water from the artificial lake (constituted by the effluent of the Beit Lahia Lake water treatment).
- Fodder crops (alfalfa, Sudan grass and ray grass) irrigated and used for feeding the small animals. The total area cultivated by Alfalfa is extended to 45 dunums and enlarged to 140 dunums in 2010 by Italian fund.
- A comprehensive monitoring system is also carried out to examine and detect the hygienic and environmental problem and it is extended to cover crop, soil, ground water and the effluent.
- short training course for the farmers as well the agricultural engineers to qualify the target groups and strengthen the capacity building in PWA, MoA and NGO's beside launching public awareness for the interested farmers and agricultural associations.
- A field visit for 4 farmers to Jordan has been organized to introduce the Jordanian expertise and pilot projects funded by the French Embassy (MREA) in Jordan.

French project for the TWW reuse in Gaza, Bait Lahia, second site



26 1 2004

The French Project for the TWW reuse in northern of Gaza, Bait Labia area - first site.







2- Zaitoun Area

- It aimed to demonstrate the interest of using treated waste water for the irrigation of citrus and olive orchards. Farmers interested in experiencing this new source of water have been contacted in the area around the Gaza city treatment plant.
- This area is located around the Salah el Deen road, close to the network conveying the TWW from The Gaza city (WWTP) to the infiltration basins and wadis.
- In 2004, the Job Creation Program (JCP) in cooperation with Palestinian Hydrologists Group has proposed a project to use treated wastewater from Sheikh Ejleen WWTP for irrigating 100 dunums of citrus and olive trees.
- The project has been established under French fund and the supervision of PWA and Municipality of Gaza with coordination with MoH and MoA. This project was successful, thereafter, extension has made till the last Israeli invasion that led to the destruction of some of infrastructure of the project. However, rehabilitation is currently done under the French and Spanish funds. This project was operated again on November 2010 covering 186 dunums.



Malaysia
Kementerian Alam Sekeloa & Hidrologi
Jabatan Taman Negara & Konservasi Hidrologi
Taman Negara Pahang
The Pahang State Forest Reserve & Catchment
Kuching Branch - 22000 Kuching

10 9 2004













3- Al-Mawasi (SAT)

- With a fund of the Catalan Government, the JCP in close cooperation with PWA and CMWU, launched a small pilot project for reuse of treated effluent with Soil-Aquifer Treatment system or SAT system. The project started with 60 dunums in 2008 and expanded to 90 dunums in 2010 cultivated with Jawaffa and Palm trees. The BOD resulted from the recovery wells reaches 20-25 mg/l.

Components of Al-Mawasi project

- Two recovery wells constructed west of the KHTWW with a capacity of 50 m³/hr. The locations of these wells based on model simulation runs done by PWA with depth of 20 m.
- Soil Aquifer treatment is an infiltration (or injection) of the sewage effluent into the aquifer, and the natural movement of the effluent within the groundwater acts as a natural filter to treat wastewater, decreasing BOD, TSS, bacteriological presence and metal concentration.
- Since the soil and aquifer are used as natural treatment, such system is called Soil-Aquifer Treatment system or SAT system. Soil-aquifer treatment is, essentially, a low-cost, advanced wastewater treatment system. It also has an aesthetic advantage over conventionally treated sewage in that water recovered from a SAT system is not only clear and odor-free but it comes from a well, drain, or via natural drainage, rather than from a sewer treatment plant.

Areas & Beneficiaries

| Phase No. | Crop Patterns | | | | No. of beneficiaries |
|-----------------|---------------|------|--------|-------|----------------------|
| | Guava | Palm | Others | Total | |
| Phase 1 (2009) | 40 | 20 | | 60 | 11 |
| Phase 2 (2010) | 10 | 10 | 10 | 30 | 5 |
| Phase 3 (2011) | 10 | 5 | 5.5 | 20.5 | 7 |
| Total | 60 | 35 | 15.5 | 110.5 | 23 |

Efficiency of SAT (Shafdan)

| Parameter | Concentration Before SAT | Concentration after SAT | Average Relative Removal Efficiency |
|------------|--------------------------|-------------------------|-------------------------------------|
| SS | 10-80 | 0 | 100% |
| BOD | 5-40 | 0-5 | 98% |
| COD | 40-160 | 10-20 | 85% |
| DOC | 15-20 | 3-6 | 74% |
| Detergents | 0.4-1.0 | 0.05-0.2 | 82% |
| Total N | 5-30 | 5-10 | 57% |
| Total P | 3-10 | 0.01-0.03 | 99% |

Efficiency of SAT (Khan Younis, 2011)

| May | | | |
|------------------------------|-------------------|--------|------|
| BOD as O ₂ (mg/l) | 150 | 15.3 | 89.8 |
| COD as O ₂ (mg/l) | 390 | 36.7 | 90.5 |
| TSS (mg/l) | 160 | 20 | 87.5 |
| pH | 7.64 | 7.04 | 7.9 |
| EC (µS/cm) | 4830 | 4586.7 | 5 |
| TDS (mg/l) | 2890 | 2730 | 5.5 |
| Total Coliform (CFU/100ml) | 5x10 ⁷ | 50 | 99.9 |
| Fecal Coliform (CFU/100ml) | 8x10 ⁶ | 0 | 100 |
| Ammonium nitrogen (mg/l) | 69 | 48 | 30.4 |

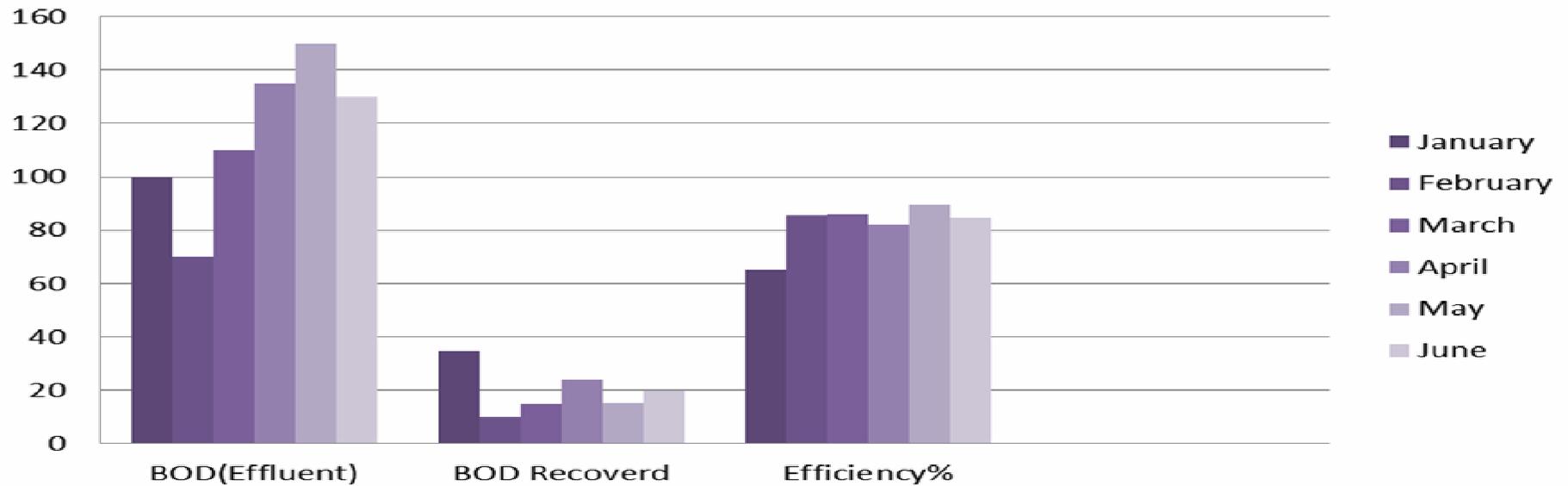
Efficiency of SAT

| June | | | |
|------------------------------|-------------------|--------|------|
| BOD as O ₂ (mg/l) | 130 | 20 | 84.6 |
| COD as O ₂ (mg/l) | 388 | 50 | 87.1 |
| TSS (mg/l) | 128 | 15 | 88.3 |
| pH | 7.8 | 7.31 | 6.3 |
| EC (µS/cm) | 4980 | 4583.3 | 8 |
| TDS (mg/l) | 3000 | 2700 | 10 |
| Total Coliform (CFU/100ml) | 4x10 ⁵ | 100 | 99.9 |
| Fecal Coliform (CFU/100ml) | 7x10 ³ | 7 | 99.9 |
| Ammonium nitrogen (mg/l) | 70 | 55 | 21.4 |

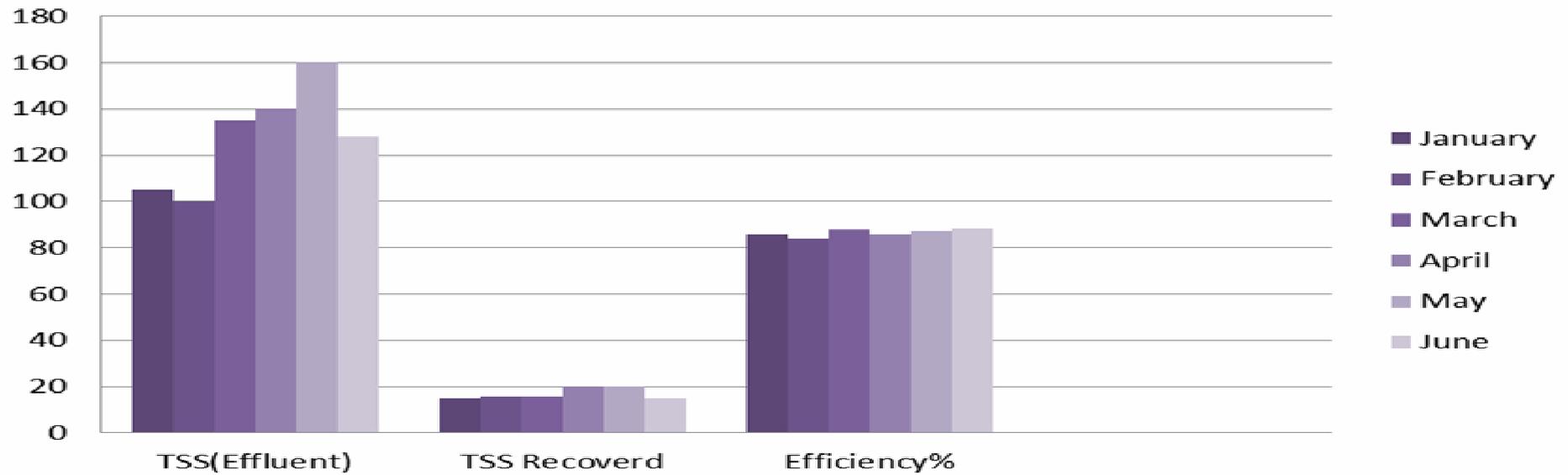
TDS(mg/l)



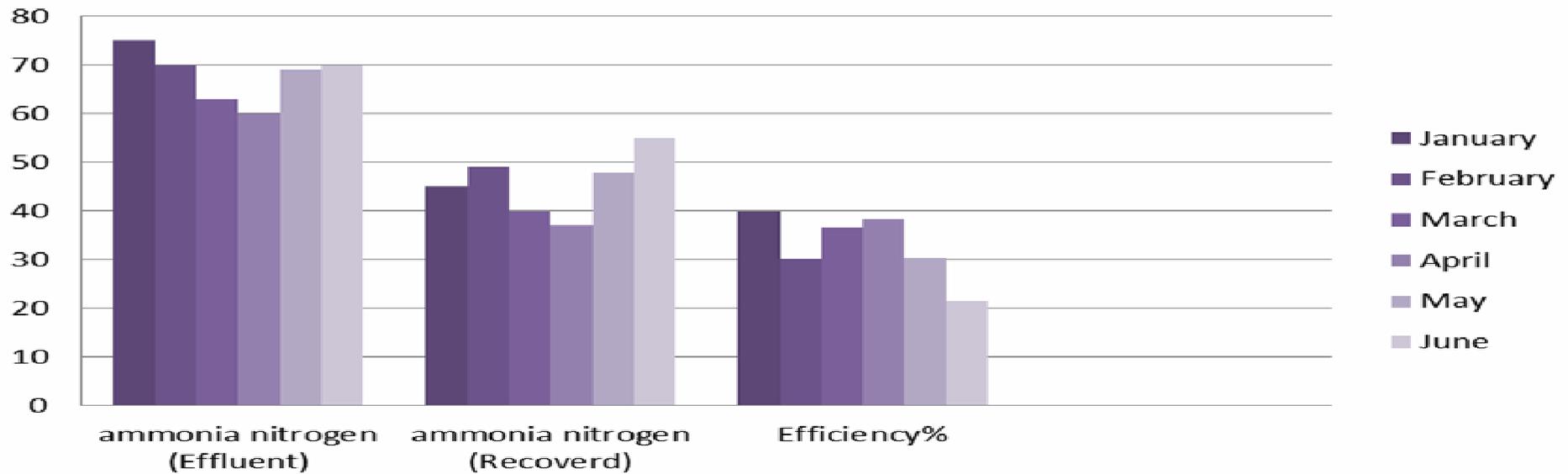
BOD as O₂(mg/l)



TSS(mg/l)



ammonia nitrogen (mg/l)



Water User Associations (WUA)

- WUAs are often formed by groups of farmers who have shared interests in irrigation supplies for cost and water-sharing, and to coordinate demand with irrigation water supplier. WUAs can be large or small, and may be formally constituted (as an NGO) or by informal arrangement. It can be small informal groups of cooperating farmers exist due to the sharing of wells, where cost-sharing is not equalized to avoid disadvantaging farmers further from the well.
- This approach would be appropriate for effluent supplies where a group of farmers may share an off-take and cooperate over the division of costs. These groups could provide focal points for the operator of the effluent conveyance system on issues covering water demand and scheduling, billing, complaints, etc.
- Two WUA formed, Al-Astal Charity Water Association (Al-Mawasi) and Zaitoun WUA.

3- ICARDA-PARC Project

- The proposed project aims to address the quality and quantity of wastewater and greywater available, improvement in wastewater and greywater quality, and interventions leading to safe and productive use of wastewater for crop production systems at the farm level and similar use of greywater at the household level.
- 8 farmers selected to model the TWW and grey water effects on soil and crops.

Photo Gallery of Project Sites

Wastewater



Photo Gallery of Project Sites

Greywater



Austrian WW reuse scheme

- The main objective of the pilot project is to assist establishing a certain national policy for long term distribution and management of the treated effluent for the Northern Gaza Wastewater system and to testify the management and operation setup that will be set according to the framework of this policy.
- The main goals are:
 1. to assist in establishing standards and regulations for reuse of treated waste water
 2. to study the impact of treated wastewater reuse on soil and plant.
 3. to study the feasibility of reuse of wastewater in reducing fertilizes use in agriculture

















Thank You