

GREENING JALAMEH

Treated Wastewater Reuse for Agricultural Development In the West Bank (Phase Two)



FINAL REPORT

December 2015



NEAR EAST FOUNDATION



PALESTINIAN CENTER FOR
AGRICULTURAL RESEARCH
AND DEVELOPMENT
(PCARD)

NEF West Bank/Gaza: Trust Building – 3rd Floor, Nablus
Tel: +970 9 2396961 • Fax: +970 9 2396965

NEF Headquarters: 230 Euclid Avenue
Syracuse, NY 13210 • (315) 428-8670

www.neareast.org

PCARD: 3rd Floor Trust Building, Nablus

GREENING JALAMEH (GJ): Treated Wastewater Reuse for Agricultural Development in the West Bank

Final Report – October 2014 - December 2015

Near East Foundation and PCARD

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Cover Photo: Avocado crops [NEF].

ACRONYMS

GJ	Greening Jalameh
HDPE	High-Density Polyethylene Pipes
MoA	Ministry of Agriculture
NEF	Near East Foundation
PA	Palestinian Authority
PCARD	Palestinian Center for Agricultural Research and Development
TWW	Treated Wastewater
USAID	United States Agency for International Development

I. PROJECT OVERVIEW

The Near East Foundation (NEF) and the Palestinian Center for Agricultural Research and Development (PCARD) proposed the first initiative in the Palestinian Territories to systematically use treated wastewater for agricultural purposes. Working through Development Alternatives Inc.'s USAID-funded Compete Project and in collaboration with ANERA and OFID, the *Greening Jalameh* project established a network of agriculture innovation sites to introduce and adapt the practice of wastewater reuse for irrigated agriculture in the West Bank. Using wastewater from the Jenin Treatment Plant, the project worked closely with farmers and community leaders in the northern West Bank to demonstrate how treated wastewater can be used safely in agricultural production and to begin to build Palestinian experience in this area. The project has generated data, lessons, and shared experiences among local farmers that will provide a model for the expansion of wastewater reuse to “green” the 500-hectare valley area in Jenin.

The project responded to the scarcity of water resources in the area and the dependence of many Palestinians on agriculture as the major source of income. Reuse of treated wastewater is one of the few feasible means of increasing the availability of agricultural water. Introducing irrigation with wastewater from two new treatment plants represents a significant opportunity to improve food production and to reduce poverty in the West Bank. This project represented the first effort in the Palestinian Territories to systematically use treated wastewater for agricultural purposes.

II. PROJECT IMPLEMENTATION OVERVIEW

A. Phase September – December 2013

A three-month preparation stage (Project Phase 1) preceded the implementation of the *Greening Jalameh* project. The goal of Phase 1 was to introduce treated wastewater reuse techniques to local farmers and community leaders, to develop practical technical and management guidelines for using wastewater, and to create a foundation for the expansion of these practices to the entire valley. Achievements included the following:

1. *Awareness Raising.* An Awareness Program on the use of Treated Wastewater for Agriculture project was conducted as the first effort in the Palestinian Territories to systematically use treated wastewater for agricultural purposes. It was designed to introduce the technique to agronomists, local farmers and community leaders, to develop practical technical and management guidelines for using wastewater for agriculture in a large scale.

PCARD organized an intensive training course for a group of Ministry of Agriculture (MoA) extension staff and other agronomists on the use of treated wastewater for agriculture. The training was held in Israeli wastewater treatment facilities and farms irrigated with treated wastewater (TWW). In addition, PCARD organized field visits for approximately 80 lead farmers to treatment facilities and farms inside Israel, with the objective of building awareness of TWW use.

2. *Design irrigation networks.* The NEF and PCARD teams used contour maps and aerial photos of the treatment plants and surrounding areas to discuss the potential design of

the irrigation networks in both sites. Meetings were held with the Mayor and with the treatment plant manager and Coop for this purpose. Additionally, several field visits were conducted with the Israeli Irrigations Network Designer Company to discuss the potential design of the irrigation network in Jalameh. There had been no documented lab analysis for treated water in both treatment plants. A full monitoring and evaluation plan of the plants discharged water was designed by project's experts to be conducted during irrigation; the quality of water will be monitored carefully at this stage.

3. *Economic and Financial Study Conducted.* Findings showed that utilizing treated wastewater in agriculture will increase agricultural productivity, improve farmers' incomes, create additional jobs in agriculture, and make agriculture a more reliable source of income that will encourage investments.

B. Phase 2: October 1, 2014 – July 31, 2015

OBJECTIVE 1: Establish farm innovation sites in Jalameh Valleys to test a model for wastewater reuse in agriculture.

Activity 1.1 Build a network of tanks, pumps, and conduits to distribute water from treatment plan to pilot fields.

Based on studies conducted during Phase 1 of the project, the team installed a water distribution network to connect the Jenin Treatment Plant to seven pilot fields. The Jalameh Pilot Project installed a complete water and irrigation distribution system to convey and distribute treated wastewater from the Jenin Treatment Plant to an area of 100 dunums planted with fruit trees.

Pumping Station. The team installed a pumping station at the treatment plant site, capable of delivering water to targeted farms with a pressure head appropriate for trickle irrigation systems.

The station includes a submersible pump installed in the treated water storage pool and a booster pump to distribute treated water through installed pipelines to different farms. The system is capable of pumping 30-40 m³ of water per hour with a pressure head of 7-9 bars at the pumping station. The station includes a complete electric control unit to safely operate the pumps with all relays, controls, protection, and electric parts – including flow and pressure switches. The system includes hydro-mechanical protection to control flow and to relieve pressure if there is any malfunction in the system.

The project also installed an automatic Disc-Kleen Filter in the system. This micro-filter allows flushing at a lower pressure and maintains water flow to the field during the flushing cycle for crop uniformity. This filter will improve the quality of treated water and ensure it is suitable for application through the trickle irrigation systems.



Earth pond reservoir constructed by ANERA through funding from OFID.

Water Distribution System. The project installed a water distribution system to distribute treated water to targeted farms. The distribution system includes 5200 meters of 99mm High-Density Polyethylene Pipes (HDPE) and 1000 meters of 75mm HDPE pipes, all rated at 10 bars. Following local specifications and international best practices, the pipes are all light purple in color to distinguish the water carried from potable water. The water distribution system also includes gate valves and water meters at all farms served to allow for optimal operation, control, and the measurement of flow.

Subsurface Trickle Irrigation Systems Installed at Farms. The project installed 32,000 trickle irrigation lateral lines in targeted farms, all with inline self-cleaning, anti-syphonage, pressure-compensating drippers. The lateral lines were placed at a depth of 30-40cm to allow farming operations without disturbing the irrigation system. The system also includes 2000 meters of 50mm-HDPE, 200 meters of 63mm-HDPE and 450 meters of 75mm-HDPE pipes at the farm level as manifolds and distribution lines with all necessary fittings, connections, and valves.

The project also supplied and installed 3800 meters of galvanized steel wire mesh fences along the boundaries of the targeted farms, along with 8 steel gates. The fence and gates provide full protection from intruders and animals that might otherwise enter the farmland.

Activity 1.2 Operate farm innovation sites.

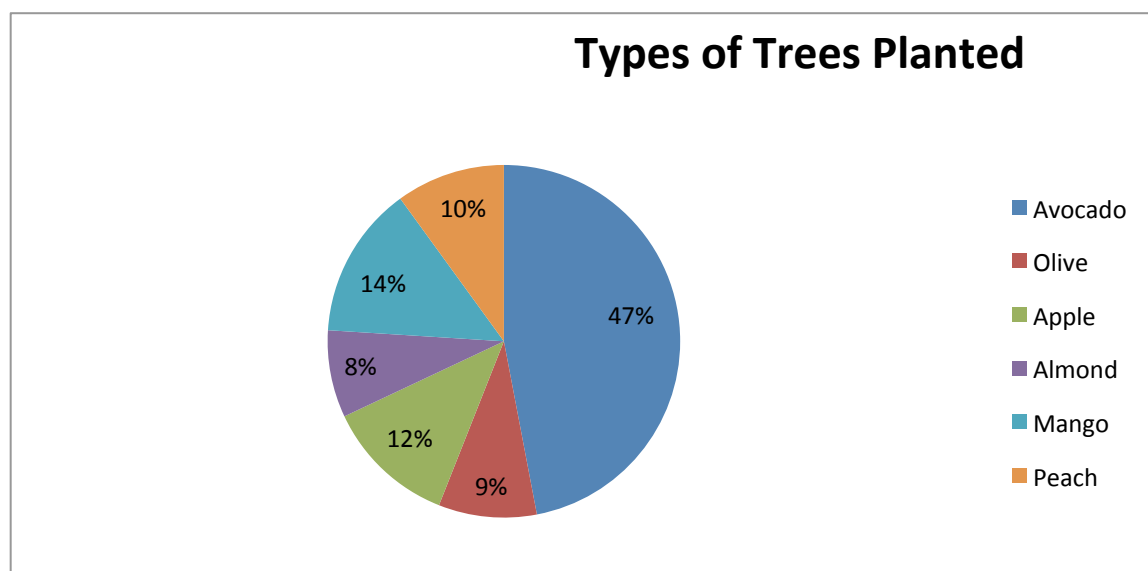
The project team selected seven pilot farms for innovation sites. Beneficiaries were selected based on: (1) distance from water treatment plant; (2) having land suitable for cultivating proposed trees and crops; (3) having at least 5 dunums of land under their legal ownership; (4) willingness to work with project team and follow activities; (5) willingness to contribute to related expenses; (6) membership in Marj Bin Amer Association; and (7) compliance with USAID regulations.

Land Preparations. Under the guidance of project agronomists, the project team completed land preparations in all seven sites. Preparations included clearing old trees, rocks, debris, wild plants, and other agricultural residues. The team also undertook a deep cultivation and disking of the land to ensure a smooth surface for planting. The team determined planting lines for each type of tree in the seven plots, and dug holes for planting.

Plant seedlings. Based on the plan developed by project agronomists, seedlings were planted in each of the sites. Prior to planting these trees, the Coop and farmers submitted a formal request to the Palestinian Ministry of Agriculture (MoA) to obtain approval for the use of treated wastewater for irrigation. The MoA verbally approved this request.

The table below shows the seedlings and area planted by each farmer.

Eyad Omar As'ad Bsher	83	200	42	82			15
Sa'eed Naser Saeed Naffa'	180	180			210		15
Emad Al Deen Saleh Musleh	200						5
Fa'oor Husain Mohamad Suboh					40	300	8
Salah Ahmad Yousef Obeidi	320						8
Allam Ameen Taher Khlouf	280						10
Fo'ad Mohamad Fo'ad Jarrar	708	170	420		285	170	39



OBJECTIVE 2: Build capacity in agriculture techniques and wastewater reuse.**Activity 2.1: Train 20 farmers and 25 MoA extension agents in agricultural techniques and wastewater reuse.**

The project completed a capacity building program for 20 targeted farmers and 25 extension agents from the MoA in agricultural techniques and wastewater reuse. Training topics included:

- Use of treated wastewater (TWW): quality; risks; impact on soil and plants; human exposure control; irrigation scheduling; nutrients in TWW;
- Irrigation Systems: Design of trickle irrigation systems; trouble shooting with irrigation systems; performance of irrigation systems with TWW.
- Irrigation system design and scheduling: state of the art methods and tools (computer software in irrigation design and management)
- Supplementary irrigation of olive trees in the West Bank.
- Farm management using TWW: irrigation approach and seedling specifications.

Training Summary

1	Seedlings specifications, nurseries, and establishing new farms	22/7/2015	Al- Junaidi Nursery/ Jenin	25
2	Reuse of TWW	27/7/2015	NEF Office	30
3	Reuse of TWW	28/7/2015	NEF Office	30
4	Study Tour/ Israel	18/8/2015	Israel	24
5	Land preparation for planting	25/8/2015	Jalameh/ in the field	21
6	Managing avocado and mango farms	30/9/2015	Jenin MoA Dept.	25

Activity 2.2: Organize study tours for 25 community leaders to learn from similar projects in the region.

The project team organized a study tour for agronomists, farmers, and community leaders to Kibutzes Mejal, Habiba and Miser in Israel in August of 2015. The tour addressed the following topics:

- Management of TWW for irrigation
- Storage of irrigation water
- Maintenance of irrigation system when TWW is used
- Soil problems related to irrigation with TWW
- Irrigation of avocado and mango trees with TWW



Farmers during visit to treatment plant in Israel.



Farmers during study tour to Israeli avocado farm.

Activity 2.3 Facilitate creation of Valley Irrigation Cooperative.

The project planned to create a cooperative to organize the process of buying water from Jenin Municipality and redistributing it to farmers in the valley with a small margin of profit. However, as the Marj Ben Amer Cooperative already existed in the same area and had similar objectives, the project management decided to work with this cooperative to be more efficient and avoid registration challenges with the Palestinian Authority (the PA restricts the registration of new cooperatives with the same objectives in the same targeted areas).

The Cooperative was involved in the project and helped in the development and installation of the irrigation system. Moving forward, the Cooperative will manage and maintain this system. The Cooperative will cover the cost of water pumping through the collection of fees from members, and will ensure maintenance for the irrigation system where needed.

In coordination with the Cooperative, an agreement was signed with Al-Masri Labs in Nablus to provide monitoring and testing of TWW. The lab will periodically test water according to best practices for TWW monitoring systems. The Cooperative will work closely with the lab in taking samples, monitoring results and take actions when needed.

The Cooperative also hired a technical coordinator to provide support for farmers in the field and help in organizing the irrigation system. The position has initially been supported through DAI funding.

Activity 2.4 Share experience through collaboration between faculty and staff of local universities and the Volcani Institute of Agricultural Research.

The project management team held several meetings with the Water and Environment Studies Institute (WESI) at An-Najah University in Nablus. Masters students in the Environmental Sciences and Agriculture Department at the university will work with the project, applying research in the areas of reuse and wastewater treatment. All targeted plots and treatment plant data will be made available for researchers from the university.

A representative from the Volcani Institute joined the participants in the study tour and provided information to participants on advanced technology for water reuse. The representative also promised to invite the Marj Ben Amer Cooperative and PCARD to participate in training programs the Volcani Institute organizes periodically.

III. PROJECT SUSTAINABILITY

The sustainability of activities and systems was a key focus of the project. The Marj Ben Amer Cooperative, local farmers, the MoA, and the Jenin Municipality have all shown commitment to the project and its objectives. The following points demonstrate the actions taken to promote the sustainability of project activities.

- The Marj Ben Amer Cooperative was involved in project activities and is prepared to manage the irrigation system. The cooperative will cover the cost of water pumping through the collection of fees from members. The cooperative will also undertake maintenance for the irrigation system where needed.
- The Jenin Municipality has committed to providing water free of charge to farmers who are members of the Marj Ben Amer Cooperative for three years. This will encourage participants

and other farmers in the area to adopt the use of treated wastewater for their farms and agribusiness ventures.

- Farmers were involved in all stages of the project, including the selection of trees planted on their land. This involvement has motivated farmers to continue caring for this investment and to improve their farming management.
- Intensive trainings and awareness sessions on the use of TWW will enable farmers to manage their crops effectively and share information with their peers.
- The agreement signed with Al-Masri Labs in Nablus will provide periodical lab tests for the water and will ensure quality before use on trees for irrigation. Water testing protocols were established according to the project environmental assessment approved by USAID. The agreement will last for three months beyond the close of the project, and will be managed closely by the Marj Ben Amer Cooperative and the MoA.
- The technical field coordinator hired by the Marj Ben Amer Cooperative, and funded by DAI for six months, will help in providing technical support for farmers in the field and help in organizing the irrigation system.



Avocado and mango seedlings are transported for planting.

IV. PROJECT CHALLENGES & LESSONS LEARNED

The project faced several obstacles and challenges in implementation.

First, the Jenin Treatment Plant was not ready at the beginning of implementation. The infrastructure at the plant was not functioning (lack of electricity supply for pumping) and the quality of water produced was not appropriate. In coordination with the ANERA project, the project team worked to overcome these challenges and ensure that the treatment plant could meet the requirements of the project and its objectives.

Secondly, the project team had challenges in securing seedlings that matched project specifications. Because these seedlings took some time for delivery, some delays were experienced.

V. RECOMMENDATIONS

Based on the implementation of this project, this project team provides the following recommendations for the Palestinian Ministry of Agriculture, Water Authority, donors, municipalities and other community institutions working to scale the use of treated wastewater in the Palestinian territories:

1. Upgrade treatment plants to tertiary level of water treatment in order to produce high quality water and expand the reuse to irrigate different kinds of crops, including vegetables.
2. Support the generation of alternative energy out of treatment to be used in pumping water and other treatment activities, especially during periods of low energy levels.
3. Create storage facilities (open water reservoirs) to store the surplus of treated water that is produced in winter for use when demand increases during the summer.
4. Support creation or maintenance of agricultural infrastructure in areas near the treatment plants (for example, agricultural roads and electricity networks).
5. Expand the use of supplementary irrigation using TWW in current olives farms and other orchards.
6. Support the creation of local irrigation cooperatives and train them on managing collective irrigation systems.
7. Conduct awareness campaigns for farmers and consumers to improve their capacities and experience in the area of TWW use.
8. Focus on crops that have competitive advantages as exports to compete with other products in neighboring and global markets.
9. Support applied research in the areas of treatment techniques, the reuse of treated water in different crops, and recycling of treatment remains.