A SOCIO-ECOLOGICAL APPROACH TO COMBAT DESERTIFICATION FOR SUSTAINABLE FUTURE

EcoFuture

Work Package Number 4

Deliverable 4.1 Description of Pilot Demonstrations in Jordan, Israel, and Palestine

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Executive Summary

The following report describes the design process of the three pilot demonstrations developed in Jordan, Israel, and Palestine. Work Package 2 established Living Labs for each jurisdiction to help identify the priority Security-of-Supply (SoS) issues to be addressed through the pilot demonstrations. The Living Labs helped identify constraints due to local conditions such as water quality and or, availability. A review of potential technologies was conducted for the 3 demonstration pilots. Additional technical experts were and are being consulted and engaged in finding the best technologies available to address the priority SoS issues taking into consideration local constraints for each jurisdiction. Different technology configurations for each pilot demonstration were presented to the Living Labs in each jurisdiction for feedback and prioritization. The three sites identified for the pilots are Deir Alla, in Jordan, Eden Farms, in Israel and Marj Naje, in Palestine (see figure ES-1). In the case of Israel, two pilots were designed to test two different approaches to fish farming.

Google Maps – accessed 25/05/2024

Figure ES- 0.1 Map of Pilot Demonstration Sites in the Jordan Valley

1. Jordan Pilot Demonstration

The Jordanian part of Jordan Valley suffers from serious agricultural issues influenced by water scarcity, changing environmental and climatic scenarios, and socio-economic factors impacting the agricultural community. Thus, it is facing escalating agricultural problems influenced by shifting climatic conditions, and socio-economic dynamics that shape its farming community. Jordan's National living lab was established to bring together a diverse range of stakeholders in the pursuit of comprehensive and actionable strategies and solutions to the various identified problems. The first Jordan Living Lab meeting was held on September 20th, 2023. This meeting discussed the problems facing farming in the Jordan Valley and proposed several solutions and recommendations to solve the identified problems. The second Living Lab meeting ranked the challenges facing Jordan Valley in importance and discussed the location of the pilot site and the activities that will be tested and thus initiating the design process of the pilot site.

Pilot Co-Design: The first national living lab initiated the pilot site design by identifying the problems facing the agricultural activities. During this meeting 19 problems were identified. These problems were summarized as following:

- 9 out of 19 problems were water quality related problems.
- 7 out of 19 problems were soil quality related problems.
- 5 out of 19 problems were on-farm management related problems including irrigation management and irrigation requirements of crops.
- 4 out of 19 problems were related to the misuse of agricultural inputs and marketing.

The recommendations of this meeting were:

- Converting King Abdullah Canal to pipes to decrease water losses through evaporation, contamination, and encroachments. This action has already started and parts of the canal was converted to pipes.
- Improving water distribution schedules between JVA and farmers through water user associations.
- Proposing water harvesting from plastic houses to be used for lowering the soil salinity inside the plastic houses.
- Re-activate the agricultural pattern in liaison with farmers to solve marketing problems. This issue is related to the Ministry of Agriculture and to some extent the Jordan Valley Authority.
- Fostering the foundation of a nursery to provide suitable varieties of seeds and seedlings that perform better under the changing climatic conditions.
- Prioritizing integrated management through collaboration between government (several related ministries) and farmers.
- Promoting the use of treated water or mixed water in farming and addressing societal objections particularly in the northern Jordan Valley.
- Promote the use of solar energy inside farms.
- Improving the fatigued soils in the Jordan Valley due to continuous use over the years.
- Ensuring farmers receive timely notifications about water shortages.

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- Incorporating advanced irrigation techniques to maximize irrigation efficiency and improve on-farm irrigation water management.

After that meeting the project tried to select a pilot site were most of these problems can be addressed. Tal AlMantah site was the first choice where treated wastewater is available and can be used in an adjacent land near the treatment plant. The project investigated this location and tried to design the pilot site there. The second national living lab meeting went a step further and discussed ranking the main challenges in importance through voting. The results were as follows:

- Water Quality: was selected as the most important challenge.
- Demand on Water: was selected as number 2.
- Soil Quality: was selected as number 3.
- Biodiversity: was selected as number 5.
- Rural Development: was ranked as number 4.
- Climate Change: was ranked as number 6.
- Renewable Energy: was ranked as number 7.
- Governance: was ranked as number 8.
- Population Increase: was ranked as number 9.
- Seed Quality: was ranked as number 11.
- Food Processing: was ranked as number 10.

In this meeting, the pilot site location was also discussed and the result was that the Pilot site will address water quality improvement, water harvesting, soil improvement, efficient irrigation equipment using sensors to control irrigation, controlled fertilizer applications, use of compost to improve soil quality, and use of solar energy. The Living Lab members preferred Deir Alla location for the pilot site instead of Tal Almantah as Deir Allah represents the middle and the larger part of the Jordan Valley and has the same water quality as the majority of Jordan Valley areas (figure 1). Some of the living lab members did not like the idea of water quality improvement using RO and preferred to use filters instead. Most of the members of the living lab liked the idea of water harvesting.
At this stage, the pilot site was selected to be plastic houses in Deir Allah. The Pilot site will address water quality improvement, soil improvement, efficient irrigation systems, controlled fertilizer application, and the use of solar energy.

Pilot Site Design Process: The second Living Lab meeting triggered the design process for the pilot site. The first step in the design process was the selection of a suitable area at Deir Alla center. The focus was to use four plastic houses to be planted with a vegetable crop using improved water quality, improved soil quality and irrigate the planted crop with an improved irrigation system depending on real-time soil moisture readings together with controlling fertilizer application and at the time using solar energy for running all required equipment and pumps. Additional two plastic houses will be used with the same crop planted using the common practices that Deir Alla farmers use for comparison.
The location of the pilot site was selected inside Deir Alla center. Six plastic houses were placed in the location. An existing Capacitive Deionization (CDI) desalination unit is adjacent to the site with a capacity to produce 10 cubic meters per hour. A new irrigation pond was implemented near the site that will be used to supply the desalination unit with water, as well as a source of irrigation water for the two

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comparison plastic houses. The location also has two adjacent plastic multi-spans with one of them provided with a water harvesting system and a water storage tank. The tank required maintenance work and a new one with a higher storage capacity will be installed to store enough rainwater to provide 2 plastic houses with irrigation water. Another water storage tank will be placed close to the desalination unit to supply another 2 plastic houses with irrigation water as well as providing additional water in case rainfall is not enough (figure 1. 1).

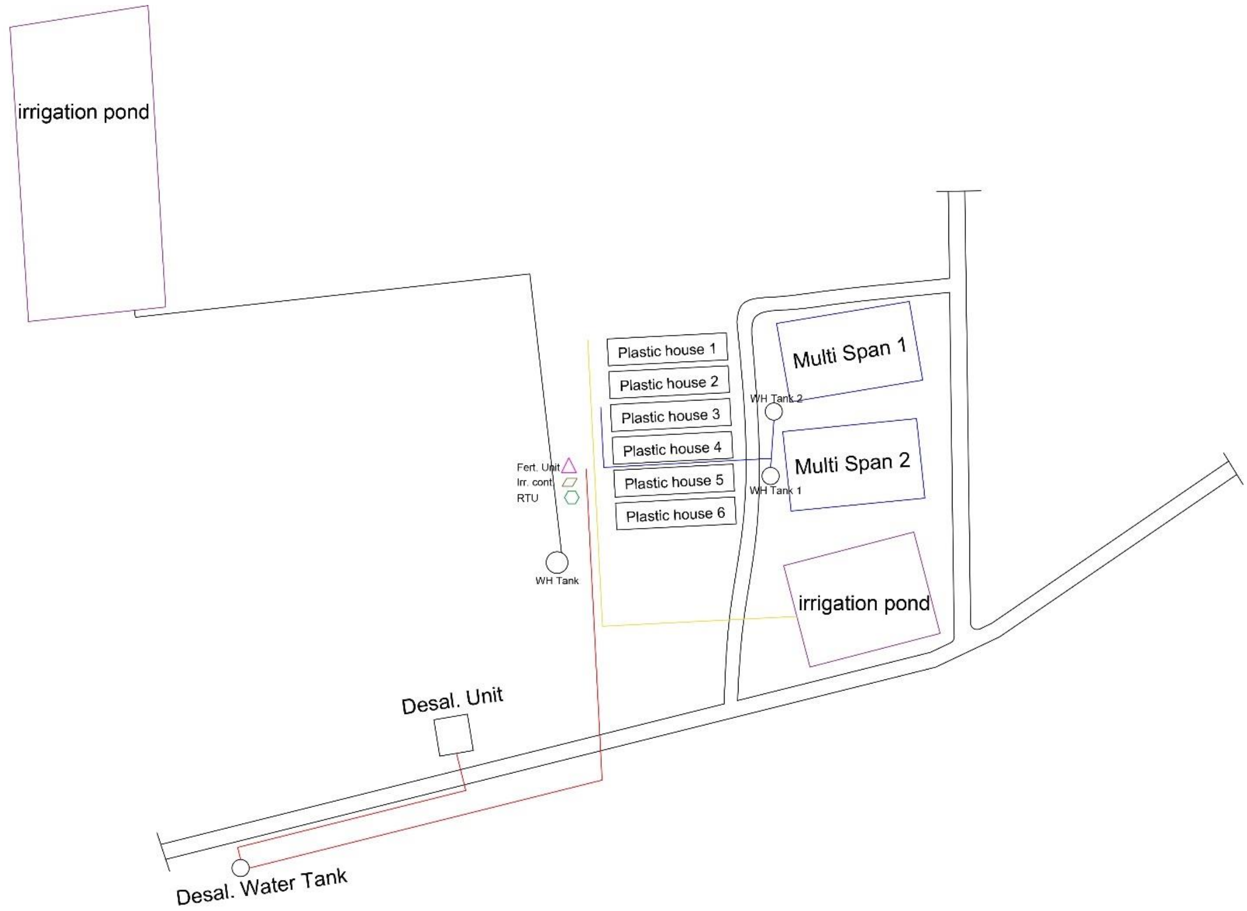

Figure 1.1: A sketch showing the main components of the pilot site at Deir Alla.

Therefore, the activities to be carried out at the Pilot site can be summarized as follows:

1. Use of efficient irrigation system and irrigation based on soil moisture measurement.
2. Use of improved irrigation water quality with harvested rainwater from the two existing multi-spans for direct irrigation, rain water harvested from the 6 plastic houses to be pumped to another existing irrigation pond, and desalinated water for irrigation using existing desalination unit very close to the selected pilot site area.
3. Use of Compost (80%) and Manure (20%) to improve soil quality on the plastic houses (4 plastic houses) with improved irrigation water quality and efficient irrigation management and efficient irrigation system.
4. Use of Floating PV panels installed over the irrigation pond to provide enough power to all used equipment including the desalination plant and at the same time decrease

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evaporation water losses from the pond as well as decrease algae growth at the water surface inside the irrigation pond.
5. Addition of fertilizers according to requirement – available in soil and automatically injected with the irrigation water while controlling both the EC and pH of the injected fertilizer solution.
6. Monitoring soil salinity and pH during and after the end of the season in all the 6 plastic houses.
7. Comparing the volume of irrigation water used and yield obtained from each plastic house.

Irrigation system used and irrigation details:

- Drip irrigation system is designed for higher efficiency compared to traditional systems and using two no-drain lines for each planted row equipped with pressure compensating and low flow rate drippers.
- Irrigation using harvested rainwater from two green houses to irrigate 2 plastic houses with desalinated water if required before rainfall occurrence.
- Irrigation using desalinated water (capacitive de-ionization) for 2 plastic houses.
- Automated irrigation depending on measurements of soil moisture measurements using soil moisture sensors installed at 3 soil depth intervals in each of the improved water quality plastic houses in addition to pH and EC sensors installed in each of the six plastic houses. The sensors will be connected to a Remote Terminal Unit that (RTU) transmits the information to the internet and to the irrigation controller (4 plastic houses). Each plastic house will be equipped with a water meter.
- Irrigation with available irrigation water for farmers (mixed water from King Talal Dam) for comparison (2 plastic houses).
- Improving the irrigation water used in Deir Alla Center from harvested rainwater collected from the surface of all 6 plastic greenhouses.

The pilot site activities will address the WEFE as follows:

- Improving the soil quality using the compost-manure mixture will improve the soil moisture holding capacity of the soil and together with using efficient irrigation system and managing irrigation through soil moisture measurements will reduce the amount of irrigation water used in the plastic house as well as improving the fertilizer use efficiency.
- Using an efficient fertilizer injector and having the amounts required considering the amounts available in the soil will improve the environment and reduce the amounts of chemicals added (improve environment).
- Use of pesticides cleverly and as required to minimize their use (improve environment).
- Higher yield from the plastic house (higher food) is expected from better irrigation management, better water quality, and better soil quality.
- Using harvested rainwater and desalinated water will lower soil salinity under plastic houses and improve soil productivity (better environment).
- Using solar energy (floating system) over the surface of an irrigation pond will save grid electric power and thus improve environment and provide an energy source. Additional benefits are decreasing water evaporation losses from the pond (an average depth of 6.7mm/day) as well as

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lower algae growth that will have a negative effect on the water filters and on the drip irrigation system. These are the existing problems for irrigation ponds in Jordan Valley.

- Improved water quality through water harvesting and the use of desalination.

The information to be gathered from the pilot site will be as follows:

- Hourly measurements of soil moisture at three soil depth intervals in 4 plastic houses.
- Recording the volume of irrigation water used for all 6 plastic houses.
- Monitoring the soil salinity (EC) and soil pH in all 6 plastic houses.
- Recording the amount of fertilizer used for each of the 6 plastic houses.
- Recording the used amounts of pesticides for each plastic house.
- Recording the yield obtained from each plastic house.

Pilot Site Operational Plan: The vegetable planting season under plastic houses in the Jordan Valley will start in the period from mid-September to mid-October. The first season the crop to be planted will be Tomato. The procurement and tendering processes for all the required equipment and materials will be finished during the period from mid-June to mid-July. The irrigation systems including all the required parts and fittings plus the soil sensors will be installed by the end of July 2024 together with the Remote terminal unit and irrigation controller. The project team in Deir Alla During July will apply the compost and manure mixture to the four designated plastic houses and the soil will be prepared for planting around the beginning of October 2024.

During August 2024, the equipment for rainwater harvesting from the 6 plastic houses will be installed and ready to function before the start of the rainy season together with the conveyance pipes to the irrigation pond. Also, during this month the floating solar energy system will be installed, and electric power connected to all used equipment.

Before planting, soil samples will be collected from the 4 plastic houses with improved soil, improved irrigation system, improved water quality, and irrigated depending on soil moisture level to determine the field capacity and wilting point soil moisture content. After planting, the 4 plastic houses with improved irrigation water quality and improved soil quality will be independently automatically irrigated when the soil moisture level reach the designated soil moisture content (50% depletion of available soil moisture). The remaining 2 plastic houses will be irrigated depending on traditional farmer experience in the area. All agricultural inputs will be recorded during the season for each plastic house and compared with each other at the end of the season. Finally, the next season's crop will be cucumber with a shorter season length that will end at the beginning of the hot summer season.

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2. Israeli Pilot Demonstration

The Israeli area of the Jordan Valley extends from south of the Sea of Galilee to the north border of the West Bank (the Green Line) and from the Jordan River in the east to the Jezreel Valley in the west. The area is blessed with large amounts of natural spring water from the Gilboa mountains and is an important agricultural area for Israel, especially for freshwater fishponds.

The Israeli living lab was launched in August 2023 and included 28 participants from government (local and national), fish farming, academics, and the private sector. The focus of the Israeli living lab was fishpond farming because the area called Valley of the Springs is economically dependent on aquaculture with 60% of Israel's fishpond farms located in the region. The main concerns raised by the Israeli living lab were about competition from imports, the high cost of inputs and government regulations, especially around the release of water from the ponds into the environment which serve as a barrier to efficient production. The Israeli Ministry of Agriculture has asked the fish farmers to develop a strategic plan for the future of aquaculture in Israel and therefore, the EcoFuture initiative can be seen as a welcome addition to the process. During the Israeli living lab, a disagreement arose among the farmers and experts as to the future direction of fish farming in Israel. Some advocated for regulations and technology which would improve the economic performance of conventional open fishponds, while others advocated for intensive fish farming called Recirculatory Aquaculture System (RAS).

During subsequent meetings of the Israeli living lab in November 2023 and again in January 2024 a proposal emerged to operate two pilot demonstrations, one in a traditional open fishpond setting and one using RAS.

Open Fishpond Pilot Demonstration: The thin profit margin in traditional open fishpond farming means that to survive, the fish industry must lower costs, increase productivity or achieve higher prices. Higher priced fish require more expensive food. Other challenges are the variation in the size of fish, the ability to monitor water quality and the ability to analyze data to understand how water quality impacts economic results. Among the environmental challenges mentioned were the quality of water released back into the ecosystem and water loss from evaporation and leakage into the ground, which requires the purchase of new water. A proposal was made to pilot a fishpond system developed in the 90s in the US. The principle of the system is to separate the fish raising area from the water treatment area of the ponds. A large pond is used as a reservoir for regulating and treating water, while small satellite ponds are used to grow fish in a larger biomass to water ratio with more control over water quality and temperature, and less food waste. The large reserve pond can be covered by solar panels to provide electricity for the water pumps and will reduce water loss from evaporation. Previous attempts at covering fishponds with solar ponds have been less successful due to the bird population which feeds off the fish and leaves their droppings on the panels, rendering the panels ineffective in producing electricity. If the large ponds no-longer contain fish, the bird population around the pond will be significantly reduced. The smaller ponds can be covered by nets to prevent attracting bird populations. The pilot will be implemented in an existing fishpond at the Nir David fish farm in the Valley of the Springs not far from Eden Farm Agricultural Research Station. A series of small ponds adjacent to and east of a large 135 dunam fishpond will serve as the open fishpond pilot demonstration (see figure 2.1). As most of the infrastructure for the pilot exists, EcoFutures will provide the sensors for the pilot demonstration.

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Google Maps – accessed 25/05/2024.

Figure 2.1 Satellite image of Nir David fish farm

Pilot Design – Open Fishpond: The open fishpond pilot will include:

- 150 dunams reservoir for water regulation.
- 15.7 dunams of floating solar panel array producing approximately 4.5 MW of electricity.
- 5 - 1,200 CM ponds which can produce 100 tons of fish (tilapia) annually (20 tons each pond).
- Pumps for circulating the water between the small ponds and the large reservoir.
- Sensors to monitor the oxygen levels in the reservoir and small ponds.
- Mechanism for collecting, storing, and analyzing data.

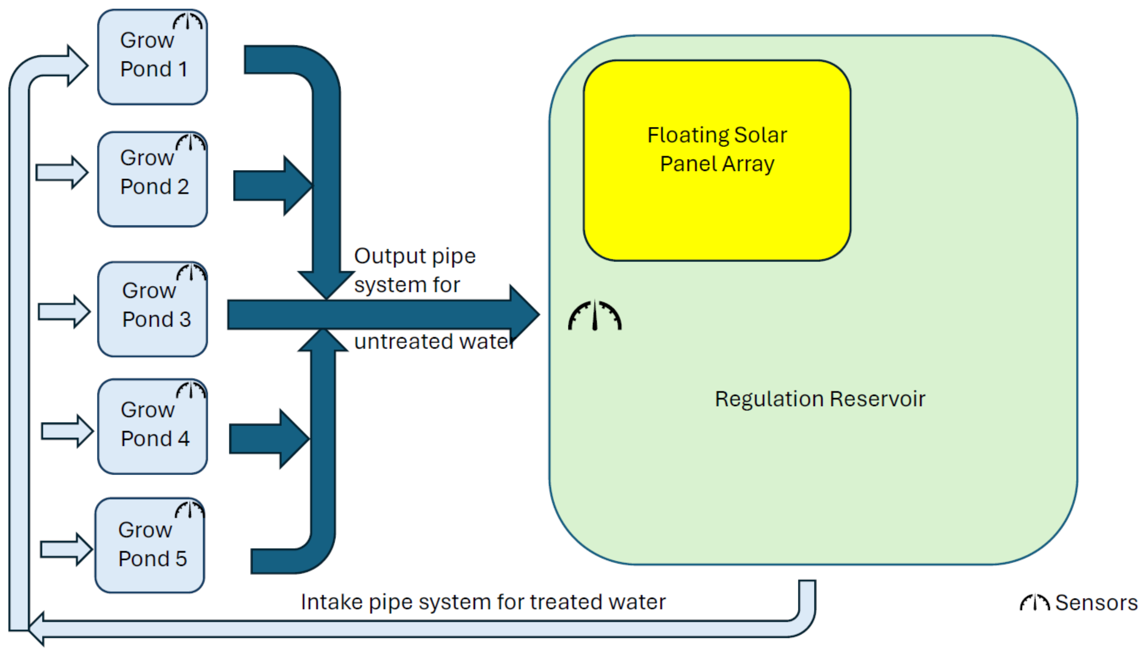


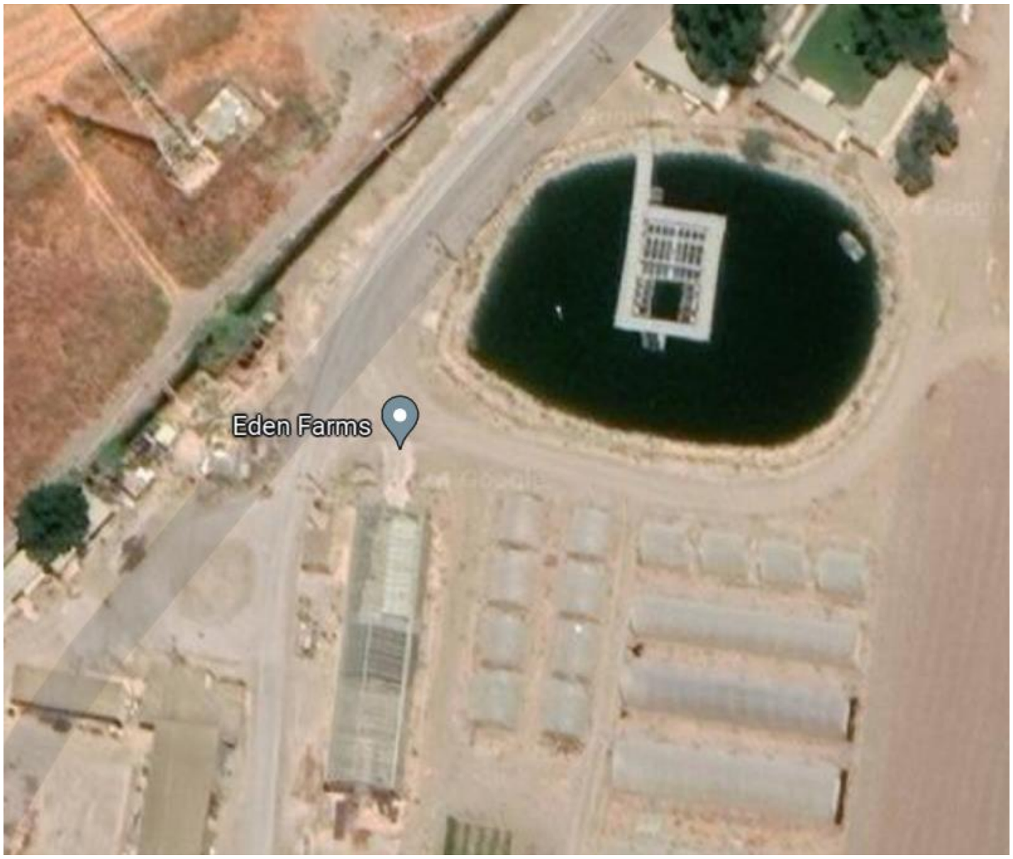
Figure 2.2 Open Fishpond Pilot Demonstration Schematic

<u>Open Fishpond Pilot Timeline</u>

- March 2024 – purchase sensors.
- April - May 2024 – Installation of sensors and preparation of growing ponds.
- June 2024 – populate growing ponds and begin collecting data.
- June 2024 – March 2026 collect data – daily measurements of water quality.
- December 2024 – begin harvesting fish.
- March – April 2026 – analyze data and compare results to control conventional fishpond results.

<u>Addressing WEFE Nexus:</u> The open fishpond pilot demonstrates the nexus between water, energy, food security and environmental services. With the decline in the economic viability of open fishpond farming, according to Israel's Ministry of Agriculture, the amount of dunams of fishponds in the Valley of the Springs has been in steady decline over the past few years. While fish farming had many negative externalities including ground water degradation and stimulation of the jackal population due to the ready availability of dead fish, the ponds also served as natural habitat for many species, having replaced the original wetlands which thrived in the region before human settlement. When the fish farms are abandoned due to economic infeasibility, they are not returned to their natural wetland status but converted to more profitable housing and commercial developments resulting biodiversity loss. If the open fishpond pilot is a success, the methodology demonstrated will raise profitability by increasing yield per input, enabling fish farming to continue to flourish and provide fresh fish to the Israeli market. Converting large fishponds into regulation reservoirs reduces the negative environmental externalities while preserving the status of the ponds as natural habitats for species in the area. The use of solar panels will provide clean energy to run the circulation pumps and will reduce evaporation in the ponds. The panels will be more effective since the reservoirs will attract less birds than they did as large fish growing ponds, so the panels will remain cleaner.

Recirculatory Aquaculture System (RAS): Innovalley, the Valley of the Springs, regional innovation center and the Eden Farm Agricultural Research Station are planning to develop an RAS pilot to grow salmon. The high value of salmon on the Israeli fresh fish market is expected to justify the high costs of intensive fish farming. If the pilot succeeds, other high value fish can be introduced into the fish farming industry offering a new lease on life for an industry which is threatened by imports, high input costs, environmental pressures, and lack of interest on the part of the next generation in conventional fish farming. EcoFutures will join the Innovalley and Eden Farm's RAS initiative funding the sensors and heating and cooling systems. The pilot demonstration of RAS will be implemented in an existing structure inside the property of Eden Farm. The structure was formally used as a quarantine site and is adjacent to a small reservoir which will be used to regulate the water and will also produce electricity for the pilot based on floating solar panels (see figure 2.3). The pilot itself will be inside an enclosed building to regulate climate conditions and include fish tanks for growing fish at different stages of development.



Google Maps – accessed 25/05/2024.

Figure 2.3 Satellite image of Eden Farms facility

Pilot Design – RAS: The pilot demonstration RAS at the Eden Farm will include the following elements:

- Insulated wall panels, doors, windows, and construction
- Heating and cooling systems and storage tanks
- Breeding tanks
    - 6 – 4 CM tanks for salmon
    - 12- 1 CM tanks for sea bream or crabs
- Control and monitor system measuring:
    - Oxygen level
    - Temperature
    - PH – Acidic level
    - ORP – Oxidation Reduction Potential
    - CO_2 – Carbon Dioxide level
- Oxygen system
- Sterilization system
- Mechanical filters
- Pipes
- Incubator
- Circulation pumps
- Charcoal filter
- Treatment tanks
- Air conditioners
- Lighting and electricity
- Concrete
- Emergency generator
- Moving bed biofilm reactors
- 1.7 dunam open pond

Ecofutures will provide the funding for the heating and cooling systems and storage tanks and for the control and monitoring system. All other construction and equipment will be purchased by Eden Farm and Innovalley.

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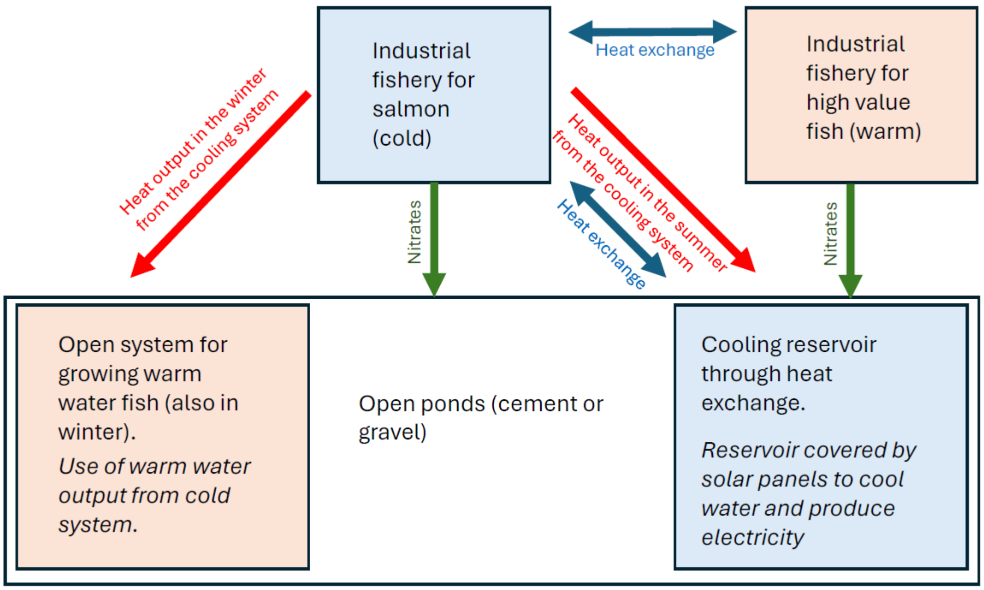

Figure 2.4 RAS Pilot Demonstration Schematic

RAS Pilot Timeline

- March 2024 – Equipment purchase.
- April and May 2024 – Construction and installation.
- July 2024 – Populate tanks with fish eggs.
- July 2024 – April 2026 – Data collection.
- March – April 2026 – analyze data and compare results to control industrial fishpond results.
- April 2026 – Harvest and market salmon.

Addressing WEFE Nexus: The RAS pilot demonstrates the nexus between water, energy, food security and environmental services. By enabling fish farmers to grow high value fish, such as salmon, sea bream and crabs, the RAS pilot can demonstrate improved profitability and attract a new generation of fish farmers in the Valley of the Springs while providing locally grown fresh fish to the Israeli market. The closed Recirculatory Aquaculture System (RAS) prevents nutrient laden wastewater produced by conventional fish farming from polluting the groundwater. Recirculation of the water will also reduce dramatically; water use in fish farming. As with the open fishpond pilot, a large open reservoir will be utilized as a regulating body of water absorbing and treating nutrients while continuing to serve as a natural habitat to some local species. Floating solar panels on the reservoir will reduce evaporation, cool down the water and provide enough clean electricity for the pumps, air conditioning and heat exchange systems.

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3. Palestinian Pilot Demonstration

Palestinian Pilot Demonstration – Marj Naje: The Palestinian Living Lab suffered several unexpected delays in the summer and fall of 2023 which directly impacted the launch of the Palestinian Pilot. Damour for Community Development had hoped to establish the Palestinian Pilot at the Eco Center in Al Auja, but due to personnel conflicts and lack of enthusiasm on the part of the municipality, Dr. Shaddad Attili Primary Investigator and Mr. Ashraf Ajrami, Head of Damour decided to search for a better site. This delayed the establishment of the Palestinian Living Lab because it was felt that it was critical to engage the local municipality and local farmers in the design of the pilot demonstration. The Israel-Hamas war which broke out in the beginning of October further delayed matters. Due to restrictions on travel in the West Bank in the fall of 2023, Damour staff had a difficult time engaging with local municipal leaders in the Jordan Valley. After several fruitful discussions with the Mayor of Marj Naje and other municipal leaders, an agreement was reached to establish the Pilot Demonstration in Marj Naje. Marj Najeh is a Palestinian village in Jericho Governorate located (horizontally) 34.8km north of Jericho City. Marj Najeh is bordered by the Jordan River to the east, Az Zubeidat village to the north, and Al Jiftlik village to the west and south (figure 1).

Marj Najeh, a village of approximately 800 people, lacks a proper sanitary sewage system. Instead, residents are forced to rely on primitive methods for waste disposal, such as cesspits, increasing the risk of disease and groundwater contamination. In addition, the village is economically dependent on agricultural and due to Israeli control of water resources and the increased impact of climate change on precipitation in the region, water for agriculture is scarce. The current water supply comes from wells which are highly saline and can no longer support cash crops.

The Living Lab met in January 2024 and included the Mayor of Marj Naje, Mr. Kayed Masoud, the municipal engineer, Eng. Thaer Bsharat and a member of the municipal council, Mr. Othman Abu Joudeh. The Damour team included Dr. Shaddad Attili, Mr. Ashraf Ajrami, Ms. Mariam Abu Daqa. Dr. Jawad Shuqair represented the Arava Institute. Mr.Adel Yassin represented the Palestinian Water Authority and Mr. Ismael Abu Sarhan represented the Palestinian Ministry of Agriculture. The Living Lab agreed that the priority for the village is to solve the wastewater treatment problem and to provide additional water for agriculture. The constraints are that the groundwater is highly saline and must be desalinated to provide water for cash crops, electricity is expensive and unreliable, the village lacks a sewage grid and will not be able to get a permit to build a sewage line across route 90. A desalination unit was installed in 2014 for a local well but the unit does not function.

The general outline of the pilot will be to lay a main sewage line, which residents of a specific neighborhood will be able to connect from their homes. The sewage line will convey sewage from the neighborhood under route 90 through an existing pipeline to avoid the need for permission from the Israeli authorities (see figure 3.1). The wastewater will be treated in an off grid solar powered 10 CM/d wastewater treatment facility developed by the Arava Institute. The water will be treated to the level of agricultural water according to Israeli standards. The municipal engineer and Damour will explore the possibility of reconditioning or replacing the desalination unit to generate additional desalinated water. Water from the two sources will be mixed and stored in a reservoir tank.

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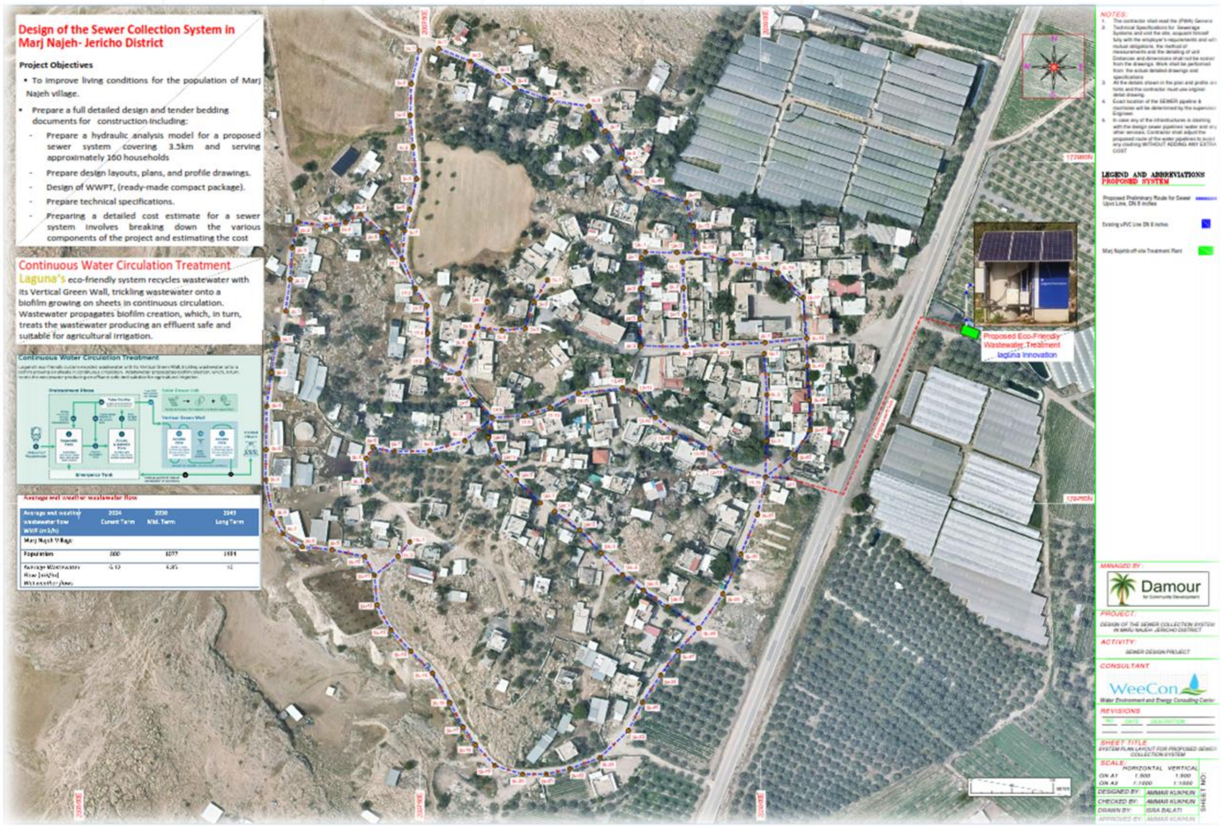

Figure 3.1 Satellite image of Marj Naje with design of sewer system

<u>Pilot Design:</u> Designing a sewer collection system in Marj Naje involves several key steps to ensure effectiveness, efficiency, and environmental sustainability. Site Assessment and Data Collection: Conduct a thorough assessment of the area to understand topography, soil conditions, land use, and population density. Gather data on existing infrastructure, including roads, utilities, and potential obstacles. The proposed Pilot Demonstration comprises several key components:

- A main sewer line.
- Secondary sewer lines from homes to the main sewer lines
- Pumping stations - the topography of the village should allow most of the sewage to flow by gravitation but there may be some areas which require pumping.
- Ten CM/d wastewater treatment plant
- Desalination pump for local well.
- Storage tanks for mixed water.
- Solar panel array for operating the desalination pump.
- Treated wastewater pipelines to convey water to agricultural plot to be used in adjacent green houses.

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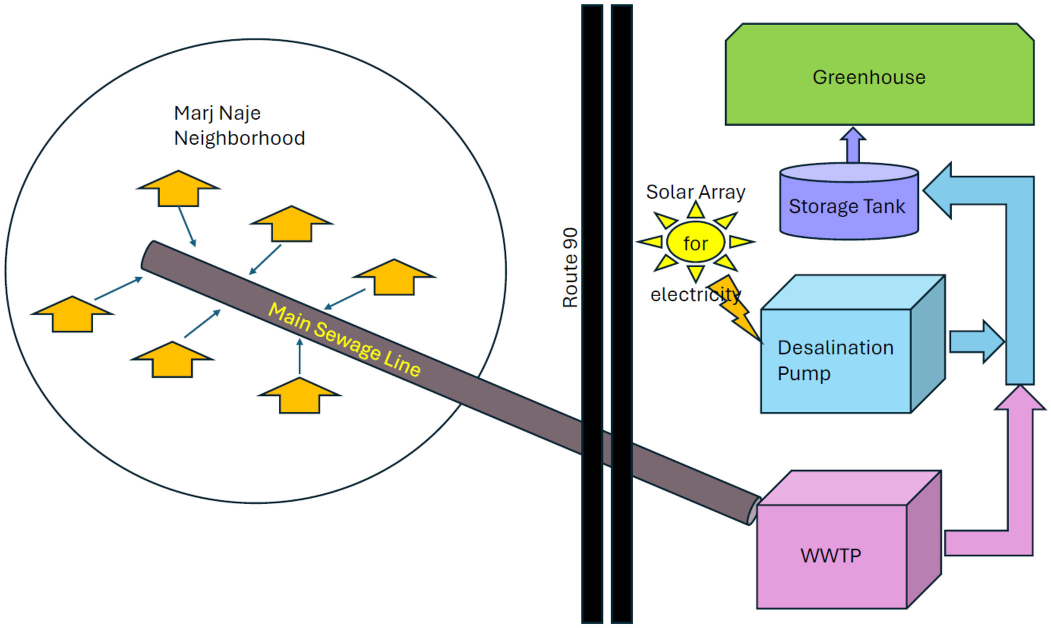

Figure 3.2 Marj Naje Pilot Demonstration Schematic

Marj Naja Pilot Timeline: Damour engaged Eng. Amar Kukh to create the technical report for the Marj Naje Pilot Demonstration Project. The technical report was due in February but has been delayed. Once the technical report is finalized, Damour will initiate a procurement process and the Arava Institute will assist in securing transfer of equipment and licensing. Installation of the equipment was projected for May or early June 2024. The major barrier to progress on the Pilot Demonstration is whether one of the pipelines which crosses route 90 can be used to convey wastewater from the Marj Naje neighborhood to the WWTP. To determine if one of the pipelines can be used requires earthwork to expose the pipelines, a complicated and expensive process. Once the pipeline is identified, the technical report can be completed. The report will identify houses to be connected and the cost of connecting houses to the main sewer line; the required power needed and required solar panel array; the possibility of repairing or replacing the desalination unit to provide more water for agriculture; the parameters of the needed wastewater treatment facility; size of the water storage tank and the irrigation pipes needed to convey agricultural water to the greenhouse. The report will also provide an estimation on scaling up the system to cover the needs of the entire village, overall cost and required infrastructure (transmission pipe, house connection, capacity of WWTP, reservoir and reuse plan). Project inauguration with participation of the Palestinian Water Authority and the Ministry of Agriculture is planned for July.

Addressing WEFE Nexus: The Marj Naje pilot demonstrates the nexus between water, energy, food security and environmental services. The focus of the pilot is to turn wastewater which is polluting the groundwater due to a lack of centralized sewage, into agricultural water. Desalinization of local groundwater mixed with the treated wastewater will increase the amount of water available for agriculture and enable farmers to produce cash crops in greenhouses, increasing local food supplies. The power needed to run the WWTP, and the desalination pump will be supplied through clean solar energy. Preventing groundwater degradation, providing water for agriculture, and utilizing solar energy are good examples of a WEFE nexus.

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Project Coordinator

Project Partners

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