

# Assessment Study on the Socio-Economic and Environmental Impact of Comprehensive On-site Wastewater Management and Reuse in Rural Areas

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## Abstract

During the last 4 years Palestinian Wastewater Engineers Group (PWEG) has succeeded in implementing a comprehensive low cost and low tech. decentralized wastewater management and reuse scheme in Marj Al Ghazal village in the arid Jordan Valley (JV) improving the access to non-conventional water resources. This was achieved by the construction of 11 household grey wastewater treatment plants and 11 modified septic tanks serving 47 households hosting 228 persons. Water consumption in the JV is above average national consumption amounting to 190 L/C/day, a total of 34,200 L/day of treated grey wastewater (GWW) is reused in irrigation of medjul date orchard 13500m<sup>2</sup> (135 medium age tree), 2 greenhouses of 300m<sup>2</sup> each. The saved water cost (0.25 Euro/m<sup>3</sup>) is 3,121 Euro per year. The total cost of septic tanks suction amounting to 16,000 Euro/ year is saved. 10,800 Kg of medjul date with a total average cost of 27,340 Euro is yearly harvested thanks to the continuous availability of the treated GWW. A total cost of 3,000 Euro/ year is spent over the operation and maintenance of the treatment plants. In addition, a total cost of 5,468 Euro/ year is spent over the medjul trees growing and harvesting. A net yearly profit of 37,993 Euro is made available due to the reuse of the treated GWW in the whole village. An average yearly profit per household of 808 Euro is achieved. The beneficiaries' satisfaction was tested.

## Keywords:

Rural, Onsite, Grey-wastewater, Environment, Socio-Economic.

## 1. Introduction

During the last year PWEG have succeeded in finalizing the construction of a comprehensive Wastewater Management scheme (WWM) contributing to food security and climate change abatement in the village of Marj Al Ghazal in the Palestinian part of the Jordan Valley. This was possible thanks to the financial support

of Osprey Foundation. The project includes the construction of 11 Grey Wastewater Treatment Plants (GWWT) and 11 modified septic tanks (MST), the project provides 12,483 m<sup>3</sup> per year of non conventional water, that enabled to produce 10,800 Kg of medjul date and an average of 60 kg/day of vegetables cultivated in 2 green houses of 300m<sup>2</sup> each for family's daily consumption.

In addition, training workshops and extension visits and services were made for the benefited households. The purpose of the extension and training support is to deal with GWWT and to extend improved cultivation practices using non-conventional water resource to household members; to optimize water usage for maximum output and conservation, as well as improving water sanitation and developing sound environmental practices.

These project activities were implemented in the village of Marj Al Ghazal 35 kilometers north of Jericho in the Palestinian part of the Jordan Valley. This community suffers shortage of water and high-water salinity, the deteriorated water quality affected the crop patter where it is not fit to irrigate cash crops but rather date which tolerate certain medium levels of water salinity.

The project aimed to improve food security and livelihood within the villages by contributing to a sustainable income, agricultural production security, gray wastewater management, drought mitigation, capacity and skills development.

The benefited households expressed their high satisfaction of the implemented GWWT. Additionally; the demand on the project activities was very high. The project witnessed many success stories through which the beneficiaries proved the feasibility of these activities.

This study is conducted in order to measure the feasibility of such comprehensive WWM for rural areas; the contribution of these activities to socio-economic conditions; how these activities have assisted the benefited village to mitigate the impact of drought and

contributed to the village food security; and to measure the functionality and the sustainability of the GWWTs.

## 2. Goal and Objectives of the Study:

The main Goal of this study is to assess and audit the impacts of GWWT on environment, and on socio-economic factors at household level. Within the framework of this study 11 pilots GWWT and reuse systems serving 47 households were investigated through field survey by using questionnaire and sampling and testing. PWEG implemented this project aiming at making valuable improvements to existing sanitation system in Marj Al Ghazal households, which are threatening, fresh water sources and public health, PWEG aimed also at creating new source of water to be used for irrigation and to contribute to the village food security.

While the specific objective of the study is to provide the project beneficiaries and other local farmers, other NGOs, governmental bodies like the Palestinian Water Authority, Ministry of Agriculture, and other research institutions as well as the donors, with a clear vision about the feasibility of development activities in the rural areas which deal with non-conventional water sources, gray wastewater and agro-production as well as their functionality and sustainability.

## 3. Analysis, Results and Discussion

### 3.1 Water and Waste Water Management in Rural Areas

Water scarcity in the Palestinian territories is one of the main problems facing Palestinian people. This comes as a result of a growing demand on water resources; the competition among different uses i.e. domestic, agricultural and industrial is increasing with time; as well as inaccessibility to water resources under Israeli control, around 82% of the Palestinian water rights are being taken by the occupation authorities.

Cesspits are mainly used by Palestinians in areas where sewage networks are unavailable, especially in rural areas, and are contributing to the pollution of ground water aquifers. These cesspits also put a big burden on the Palestinian families' income, costing some families up to 20% of their monthly income to empty their cesspits. Additionally, the flooded cesspits create environmental problems, health hazard, encouraging the presence of insects and polluting the neighborhood and nearby cultivations.

### 3.2 Socio-Economic Information:

The results of the surveyed beneficiary households showed that the average family size is 4.85 people. 75% of labor force work in agriculture without any person full time employed, 20% employed in Israeli market and 5% are public servants. The average monthly income of the surveyed families is 500 Euro. Only 75% of their agriculture land is used for agriculture activities mainly because of the lack of water and investment ability.

### 3.3 The Socio-Economic Results of the Constructed Gray wastewater Treatment Systems:

All of the farmers interviewed believed that the construction of GWWT have improved their social relationship with their neighbors as the problems of bad smells, insects and cesspit flooding have been solved.

The average treated gray wastewater that is generated from the village reaches 34,200 L/day equivalent to 12,483m<sup>3</sup> annually. This amount of water is being easily treated using natural mechanisms with very low energy consumption that are easy to operate and maintain. This amount of generated water is sufficient to irrigate 13500m<sup>2</sup> (135 medium age date tree), 2 greenhouses of 300m<sup>2</sup> each. Considering an average 10 medjul date trees cultivated in 1000m<sup>2</sup>, 135 medium age medjul trees are enjoying a permanent source of non-conventional water source producing 10,800 Kg of medjul date per year, average selling price of medjul date per kilo considering the range of all medjul classes is 2.53 Euro/ Kg, a total of 27,340 Euro is gained by the farmers due to the use of treated GWW. Moreover, the treated gray wastewater contains natural fertilizers which enhance free chemical cultivation and reduce production costs. In addition to the above, 60 Kg of different kind of vegetables are produced on daily bases from 2 green houses of 300m<sup>2</sup> each, considering an average cost of 1,0 Euro/Kg, and the green houses are managed by the family members being installed in the home garden of the 2 beneficiary families, 16,000 Euro/ year is the cash return from the crops cultivated in the 2 green houses, usually a minor part of the vegetables are consumed at the house of the beneficiaries and the remaining part is sold on daily basis generating continuous profit and a certain level of food security to the families direct beneficiaries and to the remaining parts of the village families. The yearly return from the use of treated GWW in irrigating 135 medjul trees and 2 greenhouses of 300m<sup>2</sup> is estimated to be 37,993 Euro. An average yearly profit per household of 808 Euro is achieved.

In addition to the above, a saving of 16,000 Euro on septic tanks emptying is estimated for the whole village on yearly basis.

In former times, 47 household's beneficiaries in the village were using water lose septic tanks that means the average annual infiltration of wastewater to the ground is reduced by at least 80% which is the percentage of the treated and reused wastewater (total wastewater = 80% GWW + 20% black wastewater).

100% of the benefited households stated that the established WWM has improved their environmental conditions and assisted in their food security even during the warm and drought seasons. Generally, the environmental impacts for treated gray waste water and reuse in agriculture include the followings:

- Reduce freshwater use;
- Reduce salts in the soil;
- Eliminate flies, mosquitoes and insect outbreaks;
- Provide nutritional elements for soil and plants;

- Assist in greening the dry areas;
- Reduce health risks.

All constructed GWWT are working since 3 years with high efficiency, regular function of the unique mechanical equipment which is the submersible pump is achieved, and good amounts of GWW are permanently delivered from the houses.

Description	Unit	Quantity
Number of village households	Number	47
Number of village inhabitants	Number	228
Quantity of treated water	m <sup>3</sup> / year	12,483
Cost of irrigation water	Euro/m <sup>3</sup>	0.25
Cost of recovered treated water	Euro/year	3,121
Irrigated open area	m <sup>2</sup>	13,500
Number of irrigated date trees	Number	135
Date tree production capacity	Kg/tree	80
Cost of medjul date	Euro/Kg	2.53
Total revenue irrigated trees	Euro/year	27,340
Irrigated greenhouses area	m <sup>2</sup>	600
Vegetables in green houses	Kg/day	60
Cost of vegetables	Euro/Kg	1
Revenue from greenhouses	Euro/year	16,000
Cost of GWWT O&M	Euro/ year	3000
Orchards & greenhouses O&M	Euro/year	5,468
Total net revenue	Euro/year	37,993
<b>Net revenue per household</b>	<b>Euro/year</b>	<b>808</b>

**Table 1.** Summary calculation of household revenue

The above is a direct revenue estimation per household resulted from the reuse of treated grey wastewater in irrigation. A total saving on cesspit tanks emptying is estimated to be 16,000 Euro/year, this tops the household net revenue by an additional 340 Euro/year.

The quality of treated grey wastewater is in line with the Palestinian National Standards and guidelines and World Health Organization standards and guidelines for reuse of treated wastewater in agriculture.

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