

## **Public Perceptions and Knowledge towards Wastewater Reuse in Agriculture in Deir Debwan**

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### **Abstract**

The Occupied Palestinian Territory is facing a rapid population growth with limited water resources. The continuous demand for water forces Palestinians to look for alternative water recourses. Wastewater reuse in agriculture is one of the strategic alternatives. A cross sectional survey took place in one of Ramallah villages to investigate people's perception toward wastewater reuse in agriculture in 2007. Over all, participants had good knowledge about the general water crisis, 93 % were aware of the water crisis in Palestine, and 90 % were aware of water crisis in their village. Interestingly, 73 % knew that there are negative impacts from using untreated wastewater in irrigation and 24% knew that there are negative impacts from using treated wastewater. Further, only 40 % knew that there are special standards for wastewater reuse and 42 % did not know if there should be special standards for wastewater reuse. It was obvious that participants are willing to use treated wastewater (87 %) and products irrigated with it (85 %). However, the situation was opposite concerning untreated wastewater with only 6 % are willing to use it and 10 % are willing to use products irrigated with it. Health was the main reason followed by environmental and economical reasons for not accepting the reuse of wastewater.

**Keywords:** Wastewater, reuse, agriculture, public perceptions, Deir Debwan.

### **Introduction**

Water scarcity is a major constraint for economic and social development and sustainability of the agricultural sector in arid and semi-arid areas such as the Palestinian Territories. Such water scarcity will become more critical as domestic and industrial sectors place higher and higher demand on water; Palestine will experience serious water deficit which will be about 271 MCM in year 2020 (PWA, 2005). The severely limited water resources in Palestine forced the search for other water resources, even those with inferior quality; in several locations, raw sewage is used by farmers for irrigation of fruit trees and vegetables. Various alternatives including inter-basin water transfers and desalination have been recognized for augmenting water availability. However, in most cases, these alternatives are expensive and face daunting logistical and political constraints. The reuse of treated wastewater and water demand management, particularly in irrigated agriculture, are the most recommended alternatives for alleviation of the sever water shortage in Palestine. This is mainly because agriculture dominates the Palestinian water consumption with about 70%, while leaving 30% for domestic and industrial purposes (RAND, 2007). Reuse of treated wastewater in irrigated agriculture would, on one hand, provide additional water supplies and, on the other hand, it would reduce environmental pollution caused by untreated/poorly treated wastewater.

Al-Bireh WWTP was planned and implemented with the objective to apply its treated effluent for agricultural irrigation at Deir Debwan town (Al-Sa'ed, 2001). Now, after 8 years of project operation, most of the treated effluent from Al-Bireh WWTP is discharged into the nearby Wadi without utilizing This water which is valuable for agricultural irrigation, despite many facts: (i) water scarcity in the Palestinian Territories and the need for additional water supplies, (ii) availability of agricultural lands, (iii) availability of large amounts of high quality treated wastewater, and (iv) availability of poor people in the nearby communities (Burqa, Betein, Ramon, and Deir Debwan). The WWTP produces on average 3,200 m<sup>3</sup>/day (1.2 MCM/yr) which is potentially appropriate for irrigation of about 230 ha of agricultural land (Al-Sa'ed, 2007). The agronomics of such irrigated land can provide food security and contribute to poverty alleviation for a large number of poor households. Very little has been done to understand the reasons standing behind not using the reclaimed wastewater in the area.

Successful implementation of a wastewater reuse project depends on -in addition to its economical and environmental feasibility- the support of the farmers and general public, who, ultimately, pay for, and might be affected by, the treatment and reuse project. Irrespective of scientific and engineering-based considerations, public opposition has the potential to cause a wastewater reuse project to fail, before, during, or after its execution. Reuse schemes may face public opposition resulting from a combination of prejudiced beliefs, fear, attitudes, lack of knowledge and general distrust, which is often not unjustified, judging by the frequent (and highly publicized) failures of wastewater treatment facilities worldwide. In Palestine, Al-Bireh wastewater treatment and reuse project applies activated sludge treatment system with the objective to produce treated effluent for reuse in irrigated agriculture in Deir Debwan town. Despite the high technical performance of the WWTP, the reuse component of the project did not achieve its objectives, and the reasons yet are not clear.

The study aims at studying the perceptions of Deir Debwan farmers and public towards wastewater reuse for agricultural irrigation.

### **Characteristics of the study area: Deir Debwan town**

According to the Palestinian Central Bureau of Statistics (PCBS, 2007), the estimated population of the Deir Debwan is about 6,928 inhabitants in mid 2006, of which 47 % are males and 53 % of are females with a sex ratio (males/females) of 88.8. The population of Deir Debwan represents about 2.4 % of total population in Ramallah and Al-Bireh governorate. About 20 % of town population is classified as refugees. The average household size of Deir Debwan is 5.6 persons per household. About 30.8 % of the total number of Deir Debwan households is female-headed households. About 35.1 % of town population (10 yrs+) is classified as economically active, of them are 24.3 % are employed and 10.8 % are unemployed. About 41.7 % of employed persons are classified as employers, while 58.3 % are classified as employees. About 45.5 % of the households have monthly income less than NIS 2,000 (about 500 US\$), while per household needs are not less than NIS 3,500 per month to cover its living conditions basic needs. About 13.0 % of town population is suffering from poverty (PCBS, 2007).

There are more than 900 buildings in this town with more than one thousand housing units. The total area of Deir Debwan is about 76,908 Donums (7,690.8 hectares). The agricultural land covers about 10,000 Donums of the total area of the town. The area of forests and wooded land is about 43,145 Donums. The built-up area is about 765 Donums of which 735 are used for housing, industry and commercial services while 30 Donums are used for roads, public and

services. The majority of the agricultural land is un irrigated areas. The length of the agricultural roads is about 30 kms, and can be used just only for tractors and animals. There are no agricultural unions and associations in this town. This town faces a lot of agricultural problems represented by: (i) lack of water for irrigation, (ii) closed areas by Israeli occupation forces, (iii) no agricultural unions or agricultural advice unions, and (iv) marketing problems. More than 94.3 % of Deir Debwan housing units are connected to public water network (Jerusalem Water Undertaking), 1.3 % is connected to private network, and 4.5 % of them are with no piped water.

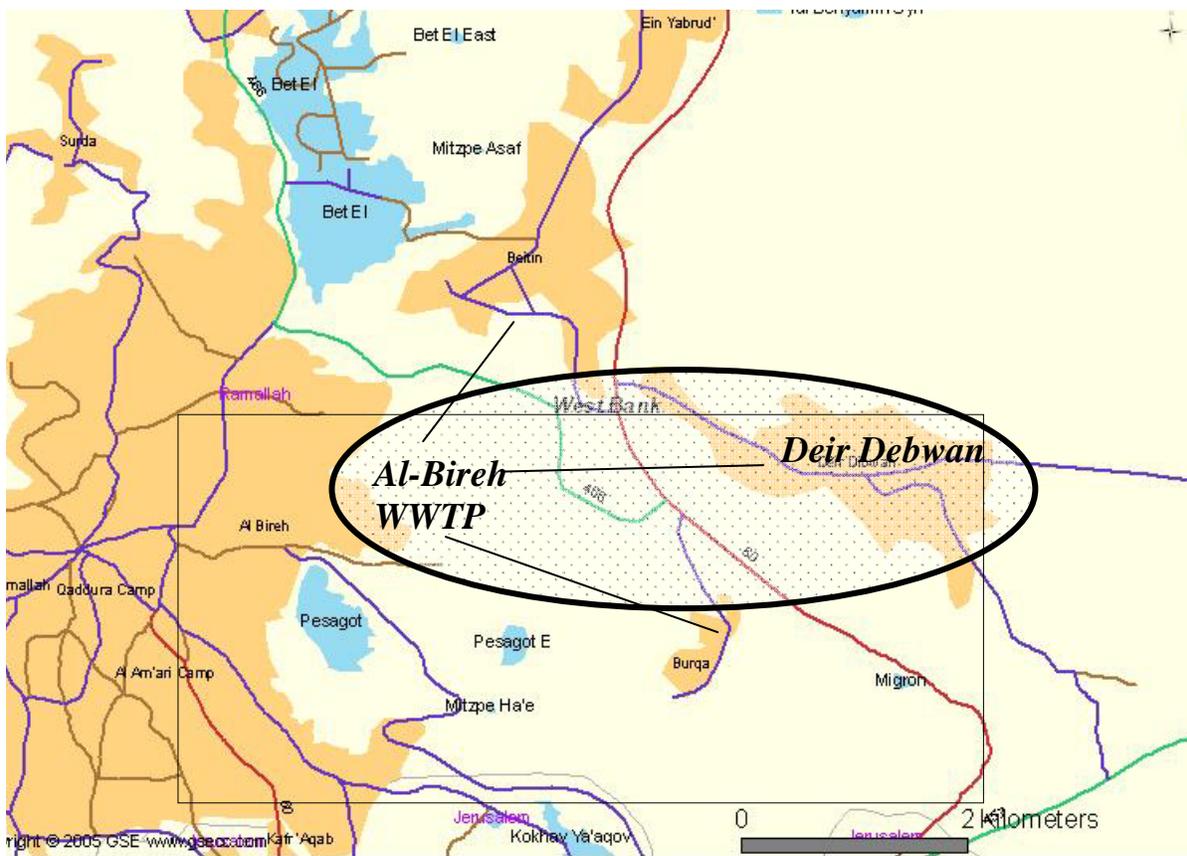


Figure 1: Location of Al-Bireh WWTP and Deir Debwan town.

### Approach and Methodology

A questionnaire survey was carried out by a group of 6 persons that belong to the targeted community. A total of 320 households (individuals) have participated in the study. The questionnaire was prepared by active participation of stakeholders and was pilot-tested on about 15% of the sample size. Perception was assessed using several questions on acceptance to use treated and untreated wastewater as well as related crops or products.

To ensure collection of reliable data and filling the questionnaire correctly, the survey team was trained by a group of water and statistics experts. The survey applied the Kish method in order to allow the data collection team to randomly select participants from the household. The method is easy, does not allow data collection bias, and provides proper documentation so the sample can be weighted during data analysis. Each household in the cluster received a number and the Kish household list determined which Kish table should be used for each household based on the number of the household. The Kish household coversheet was prepared for the data collection team for each cluster prior to the interviews taking place. The data collection team filled out the

household information on the coversheet and selected a participant based on the Kish table available on the coversheet.

The variables were combined into four variables which include (i) perception toward reusing treated wastewater, (ii) perception toward reusing products of reused treated wastewater, (iii) perception toward reusing untreated wastewater, and (iv) perception toward reusing products of reused untreated wastewater. These variables are recoded into two groups: at least accepting one question and not accepting any question.

Descriptive analysis included frequencies of variables of interest. The association between people perception and selected socio-economic variables were assessed using chi-square test. Data entry and analysis were completed using the Statistical Package for Social Sciences (SPSS).

## Results and Discussion

### *Sample characteristics*

The baseline characteristics of the study population were very much similar to Ramallah district population characteristics. Around half of the sample population is males, and two thirds are married (Table 1). The employment status does not reflect the participation in labor force as the not working category includes in addition to the unemployed housewives and students.

*Table 1: Baseline characteristics of the participants.*

<b>Characteristics</b>		<b>Percentage</b>
Sex	Male	50.8 %
	Female	49.2 %
Marital status	Single	35.3 %
	Married	64.7 %
Age	< 24	27.5 %
	24-33	23.6 %
	33-50	26.9 %
	> 50	22.0 %
Employment	Working	31.3 %
	Not working*	68.8 %

\*not working category includes housewives and students in addition to the unemployed.

### *Knowledge about water crisis*

People showed high level of knowledge about water crisis (Figure 2). Around 90 % realized the water crisis in the Middle East, 93 % realized the water crisis in Palestine and 90 % realized the water crisis in their village.

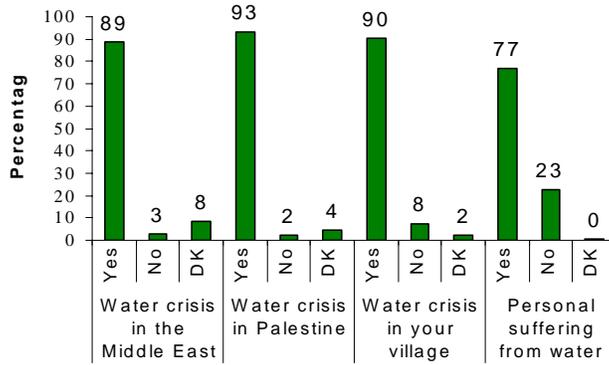


Figure 2: People's knowledge about water crises.

### Knowledge about wastewater reuse

As expected, people knew that wastewater can be used for agricultural and industrial application but not for drinking of human beings. People were divided in two groups regarding using wastewater as drinking water for animals (Figure 3). Seventy-three percent of the sample knew about the harmful effect of using untreated wastewater in agriculture and less than two-thirds knew that reuse of treated wastewater in agriculture is not harmful. Interestingly, only 40% of the sample knew that there are standards and regulations concerning reuse of treated wastewater.

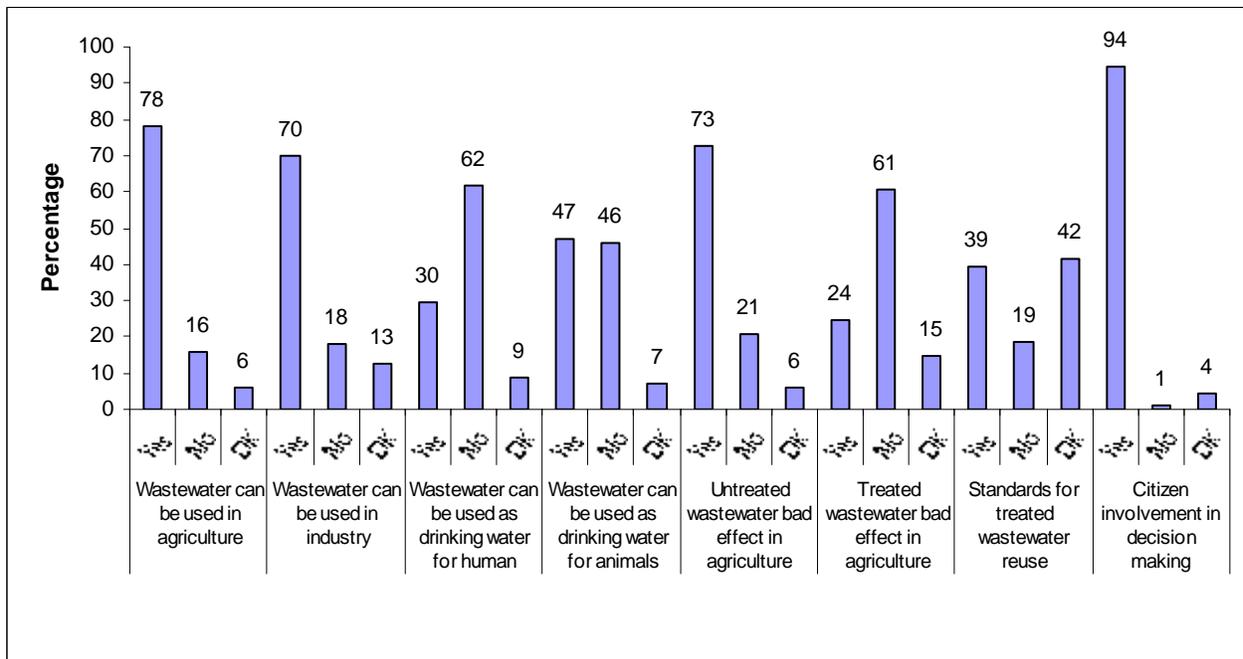


Figure 3: Knowledge about wastewater reuse.

### Public perception towards reuse of treated and untreated wastewater

Given the good level of knowledge about wastewater reuse, it was important to know whether their knowledge would influence their perception. Only 10 % of the people accept to reuse untreated wastewater while 85% accept to reuse treated wastewater (Figure 4). This variable includes all the questions addressing people perception including the wastewater reuse and irrigated products.

Most of the participants refuse to use untreated wastewater. There were insignificant differences between males and females, employment status, and land ownership. There was significant difference in the monthly income as those with lower income were more likely to accept using wastewater than those with higher income (Table 2).

Overall, people refusal to use products irrigated with untreated wastewater was less than them using it. The main difference was among land owners and those with low income. The differences were not clear with age and education (Table 3).

The main reason for not accepting untreated wastewater was health issues. Around 95% of the participants refuse to use untreated wastewater for health reasons (Figure 5). However, no further information was collected regarding types of health problems. Environmental reasons accounted for 13% and social reasons were minor.

As mentioned earlier, people perception toward treated wastewater was different from their perception toward untreated one. Those not accepting to use treated wastewater were mainly working, do not own a land, older than 50 years old, and with preparatory education. The reasons for not accepting to use treated wastewater were similar to those mentioned for untreated wastewater. The concern for potential health impact was the main reason followed by environmental and social reasons (Figure 6).

*Table 2: Characteristics of those accepting to use untreated wastewater.*

<b>Characteristics</b>		<b>Do not accept</b>	<b>At least one positive response</b>
Sex	Male	95.7 %	4.3 %
	Female	93.6 %	6.4 %
Employment	Working	97.0 %	3.0 %
	Not working	93.6 %	6.4 %
Land ownership	Land owner	94.3 %	5.7 %
	Not land owner	100.0 %	—
Age	<24	91.7 %	8.3 %
	24-33	94.4 %	5.6 %
	33-50	100.0 %	—
	> 50	91.0 %	9.0 %
Qualifications	Not educated	95.8 %	4.2 %
	Preparatory	94.8 %	5.2 %
	Secondary	93.3 %	6.7 %
	Bachelor	96.0 %	4.0 %
Monthly income (NIS)	> 4,500+	96.3 %	3.8 %
	2,000 – 4,499	94.6 %	5.4 %
	Less than 1,999	92.9 %	7.1 %

\* NIS = News Israeli Shekels = about 0.25 US\$

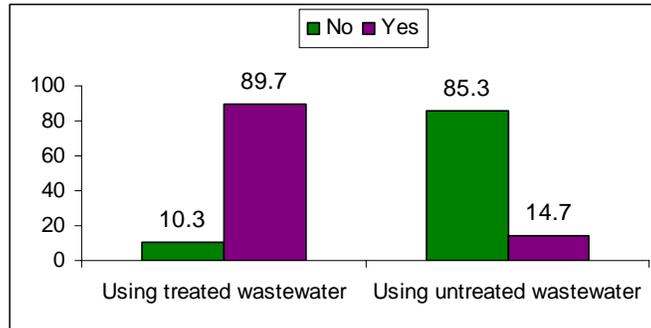


Figure 4: People's perception toward treated and untreated wastewater reuse.

Table 3: Characteristics of those accepting to used products irrigated by untreated wastewater.

Characteristics		Do not accept	Accept at least one positive answer
Sex	Male	88.9 %	11.1 %
	Female	90.4 %	9.6 %
Employment	Working	86.0 %	14.0 %
	Not working	91.4 %	8.6 %
Land ownership	Land owner	90.2 %	9.8 %
	Not land owner	82.6 %	17.4 %
Age	<24	92.9 %	7.1 %
	24-33	87.5 %	12.5 %
	33-50	85.4 %	14.6 %
	50+	92.5 %	7.5 %
Qualifications	Not educated	91.7 %	8.3 %
	Preparatory	85.7 %	14.3 %
	Secondary	88.2 %	11.8 %
	Bachelor	96.0 %	4.0 %
Monthly income	> 4,500	83.8 %	16.3 %
	2,000 – 4,499	91.2 %	8.8 %
	Less than 1,999	87.5 %	14.3 %

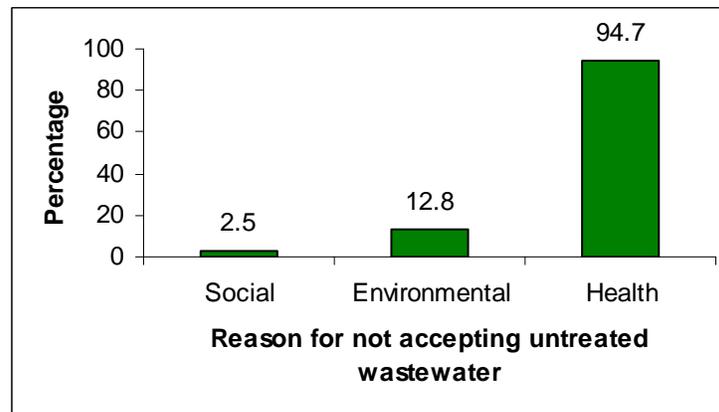


Figure 5: The main reasons for not accepting untreated wastewater.

Table 4: Characteristics of those accepting to use treated wastewater.

Characteristics		Do not accept	Accept at least one positive answer
Sex	Male	13.6%	86.4%
	Female	13.4%	86.6%
Employment	Working	26.4%	73.6%
	Not working	5.2%	94.8%
Land ownership	Land owner	9.2%	90.8%
	Not land owner	16.0%	84.0%
Age	<24	9.5%	90.5%
	24-33	11.1%	88.9%
	33-50	12.2%	87.8%
	>50	22.4%	77.6%
Qualifications	Not educated	12.5%	87.5%
	Preparatory	26.1%	73.9%
	Secondary	16.0%	84.0%
	Bachelor	12.3%	87.7%

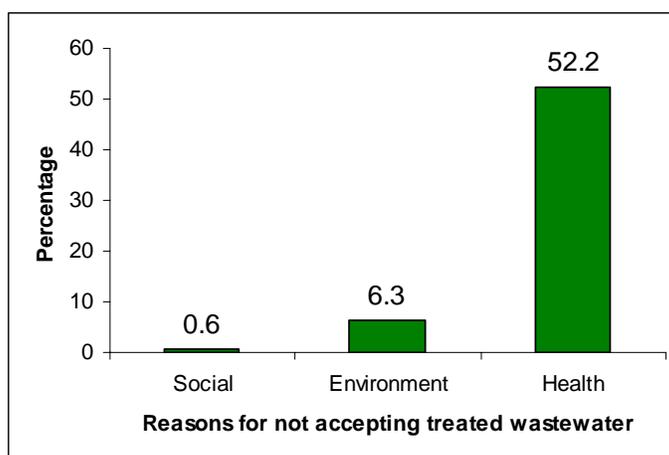


Figure 6: The main reasons for not accepting treated wastewater

## Conclusions and Recommendations

- All results of this study are valid only when the wastewater is produced by the community itself. People of Deir Debwan in principle refuse to use treated wastewater that is generated from other communities such as Al-Bireh.
- There is good public knowledge on the pressing water scarcity in the region and the country in general, and in the Deir Debwan town in particular.
- There is public acceptance for using treated wastewater for agricultural irrigation. There is very low level of acceptance towards reuse of untreated wastewater.
- There is good level of awareness of the risks associated with misuse of treated and untreated wastewater.
- The public perceptions towards wastewater reuse are driven mainly by health and environmental considerations.
- Future health education should target all the population since there were no differences between different groups.

## **Acknowledgements**

The authors acknowledge the financial support of IDRC within the context of WaDImena research project. The authors also thank Deir Debwan municipality and Women Association for their valuable support during all stages of the research implementation.

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