Treated Wastewater Use in Gaza District: The Question of Public Acceptance

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Abstract

The Gaza District faces a crucial water shortage problem. The problem characterised by a total water demand of about 120 Million cubic meter (120 Mm^3), associated with a limited sustainable water resources of about 60 Mm^3. The Palestinian water sector planners consider the reuse of treated wastewater as an option to cover part of the demand. The question of the public acceptance for reuse of treated wastewater is investigated in this article.

A questionnaire was designed to study the public attitudes toward the reuse of treated wastewater for different purposes: domestic, industrial and agricultural. Some 201 persons were interviewed all over the Gaza District, of which 85 females and 116 males. The questionnaire was conducted through personal interview.

59% agreed for use the treated wastewater, while 41%, refuse the use of treated wastewater, but there was a variation of acceptance between the Northern and Southern part of the Gaza District. The results show that the health aspect is the major concern of people, followed by the religious aspect

A complete list for the different domestic, industrial and agricultural possible usage of treated wastewater was presented to the sample. For domestic purpose 40% of the sample considered flushing toilet is the most potential use. The concrete and construction industries were considered by about 40% of the sample as the potential industrial use. The different agricultural usage of treated wastewater nearly has the same priority among the public, from which parks and gardens irrigation considered a good option for reuse by about 50%, while citrus trees irrigation was accepted by about 30 % of population.

Introduction

Gaza District is situated on the south west of Palestine. The total area of Gaza District is 365 (km^2), 40 km long and average 7 –12 km wide. The District consists of five Governorates (Northern, Gaza, Middle, Khan Yunis and Rafah) Fig.1. The population is about 1.023 Million with growth rate 3.2 % annually. The Gaza District society is considered a very young with 75 % of population less than 35 year old, and it is a highly educated society [(1)].

The Gaza District is located in the semi-arid zone, with a very limited water resources where the ground water is the only water source for fresh water. Salinity of the groundwater increases by time due to seawater intrusion and mobilisation of incident deep brackish water, caused by over-abstraction of the groundwater. The groundwater salinity varies from the north with acceptable level about 200 ppm to the south with about 1000-ppm. The groundwater is also polluted due to infiltration of disposed raw sewage and the commonly used cesspits where only 35% of the population are served with sewage systems. The present water demand for water is about 121 Million cubic meter per year (121Mm^3/year.) The sustainable recharge of ground water is about 60 Mm^3/year where the water budget deficit is covered through ground water over abstraction and importing water from Israel.

The water shortage is an increasingly urgent problem in the Gaza District as a result of the previous characteristics, which is expected to have critical social, economical and political impacts in the near future. So the nation clearly faces a situation in which rapid progress must be made in the inventory of the non-conventional water resources such as the treated wastewater.

The reuse of treated wastewater was considered as one of the promising alternatives sources for water. Presently, the reuse of treated wastewater is limited to a few illegal irrigation sites beside the treatment plants. The present treated wastewater production is about 11 Mm^3/year which is expected to raise up to 50 Mm^3/year by year 2010 due to high population growth and the coverage of sewer system[(2)].

Figure 1: Gaza District base map.

Back Ground

The recent United Nation's WHO/UNICFF Joint Monitoring Programme[4] and the World Bank[3] reports indicate that, in year 1995 about 35 million people in Middle East & North Africa remained without safe and sufficient drinking water supply and about 87 million lived without proper sanitation facilities.

As a result, the water resources planners considered treated wastewater as an important resource for non-potable purpose rather than as only a mean of wastewater disposal. Source substitution is not a new idea. The UN Economic and Social Council in 1958[5] advised that " *No higher quality water, unless there is a surplus of it, should be used for a purpose that can tolerate a lower grade".* Traditionally wastewater reuse systems have been ruled out for socio-economic reasons, but increased benefits and rapid developments in modern treatment technology and materials of construction make this area worthily of re-investigation. In 1992 the International Conference on Water and Environment[6] (Dublin Principles) emphasis on the important of the involvement of stakeholders in any water resources plan. The second statement stated that "*Water resources development and management should be based on a participatory approach, involving all relevant stakeholders"* . The question of public acceptance for reuse has great important, since the public people is the final consumers for the products produced by treated wastewater, and there acceptance will paint the final picture of any reuse project. So, the public acceptance for the use of treated wastewater is a crucial aspect to ensure the success of any reuse project.

Objective and Method of Research

The research reported in this article aims to measure the public acceptance of treated wastewater use and the willingness of the public to pay for wastewater treatment.

To achieve the objective a questionnaire was designed. A 20 pilot questionnaire was conducted as a pilot survey to evaluate the questionnaire capability and effectiveness. The Contingent Valuation Method (CVM) was used as a protocol for the survey. The CVM is a survey method in which respondents are asked directly through designed questions and answers to select from. The questionnaire was analysed through simple statistical analysis approach.

Results and Discussion

Sample characteristics

A total of 201 respondents were interviewed, 85 females and 116 males. The sample is characterised by their living area, age group, and education. Figure 2,3, and 4 shows the sample characteristics. The sample is considered a good representative of the Gaza District Society.

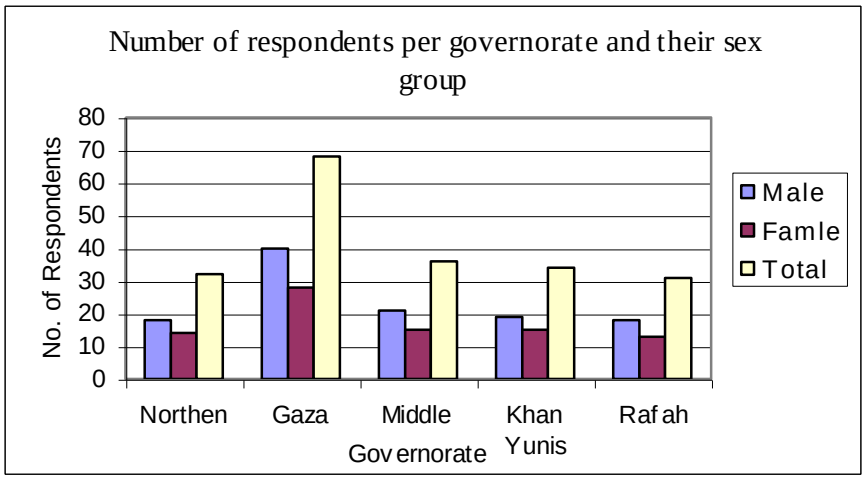


Figure 2

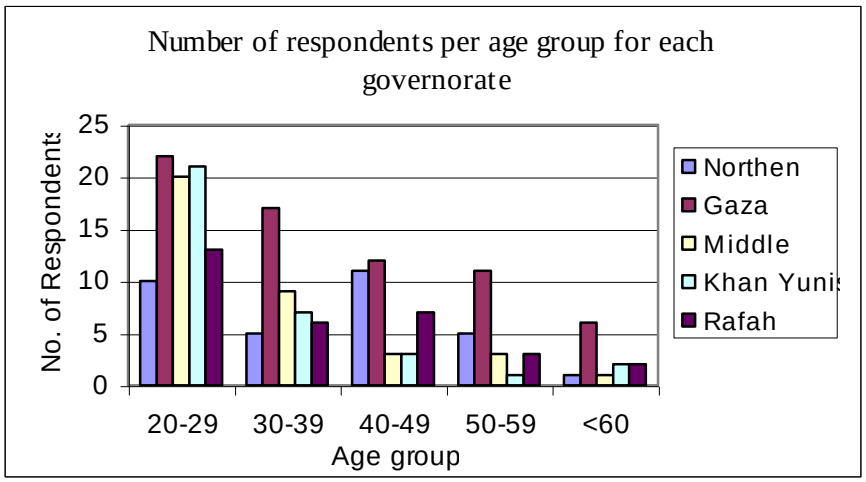


Figure 3

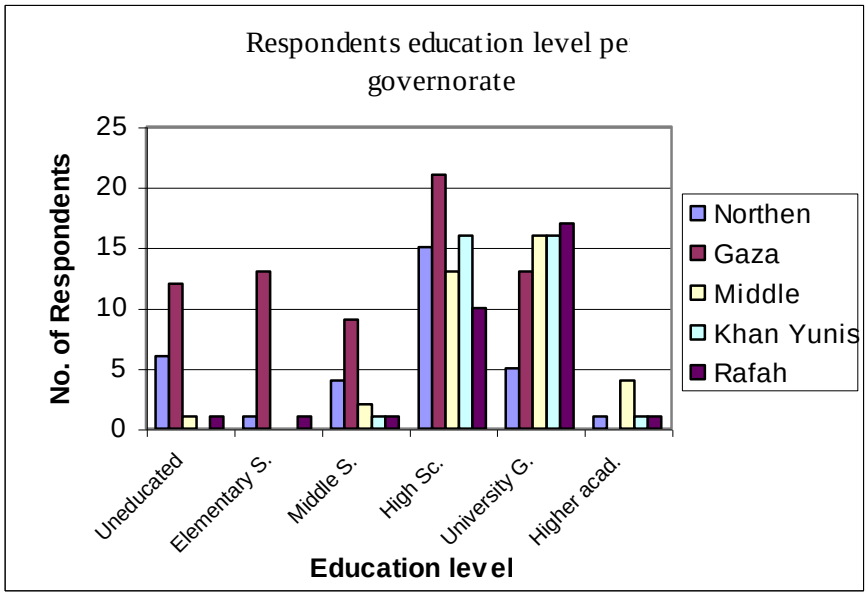


Figure 4

Water supply quality and quantity

The water supply departments at the municipalities are responsible for domestic water supply in the Gaza District. The water quality is varied spatially among the Gaza District and the quantity of water is also varied among the different municipalities. The consumer satisfactory with their water quantity and quality is an important aspect in their response toward the reuse of treated wastewater.

The respondents were asked about the quality of their tap water. As shown in Figure 5 the majority of the Northern Governorate respondents are considered their tap water fresh, while the rest considered their water quality brackish and/or polluted. It is clear that, the respondents from the Middle to Rafah Governorate considered their tap water as polluted water.

For the whole Gaza District 111 persons (55% of respondents) have brackish tap water, 35 persons (18 %) have polluted water, and 55 persons (27%) have fresh water.

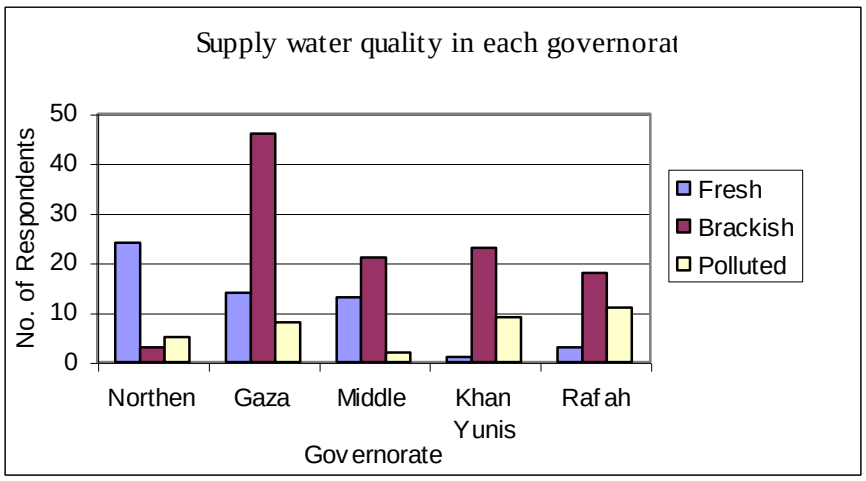


Figure 5

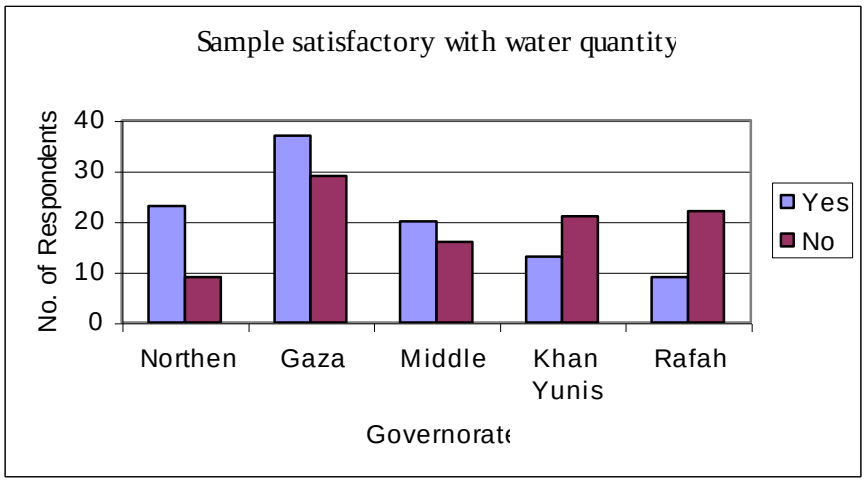
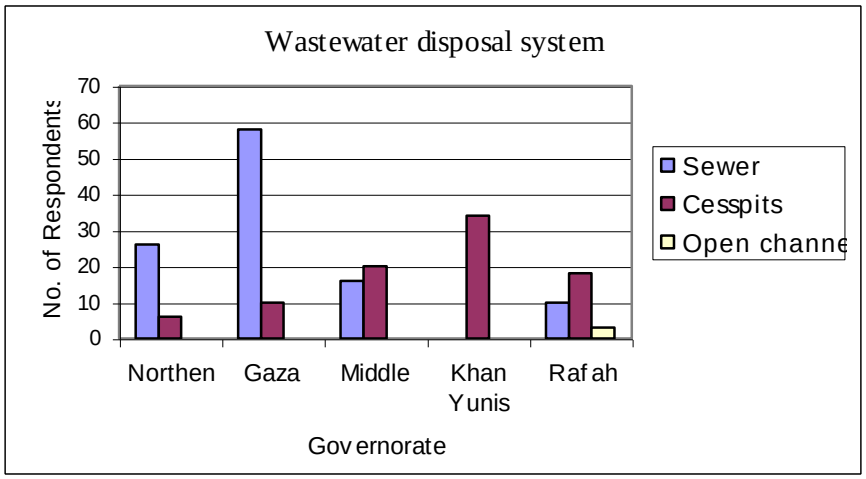


Figure 6

The respondents were asked if they are satisfied with the quantities of water they receive. It is also clear from Figure 6 that, the level of satisfactory varied from the Northern to Rafah Governorates. In the whole Gaza District 102 persons (51%) are satisfied with the quantity of water that they received.

Wastewater disposal and treatment

The sewer system in the Gaza District was completely deteriorated during the long Israeli occupation. The sewer system covers only 31% of the urban area in the Gaza District.[7] The majority of Palestinian society disposed of their wastewater mainly in cesspits or through drainage open channels. These situations come out with a high degree of water born diseases and raise the pubic concern about wastewater collection and treatment. The respondents were asked about their disposal of wastewater. Figure 7 shows the main of wastewater disposal of the sample. As show in Figure 7 the majority of Gaza Governorate people are served by sewer system. 110 persons of the sample (55%) are served by sewer system, while 88 persons (44%) are used



cesspits for their wastewater disposal.
Figure 7

The public awareness of the effectiveness of wastewater treatment is an important aspect in their attitudes for wastewater reuse. The respondents were asked if they considered the modern wastewater treatment plant produces a good water quality.
The answer was Yes by 46 persons (23%) of the respondents, No by75 persons (37%) of the respondents and Do not know by 80 persons (40%) of the respondents.

The most acceptable level of treatment from the respondents point of view was investigated through presenting the following question.

Millions of cubic meters of wastewater wasted are wasted every year, in spite of the existing of various options for treatment, reclaiming and disposing of this water. In your opinion what is the most acceptable way to deal with such problem?

I- No treatment (no reuse)

II- Low degree of treatment – should be released into ground or sea without any further reuse

III- Moderate degree of treatment – reuse for purpose that do not involve direct human contact

IV- High degree of treatment – reuse for purpose than involve direct human contact

V- Very high degree of treatment – reuse for purpose including human consumption.

About 45% of the respondents as shown in Figure 8 consider the option of moderate degree of treatment as the suitable main of treatment, while about 10% consider no treatment option as the suitable option. It should be noticed that about 15 % of the respondents consider the option of very high degree of treatment as suitable main of treatment.

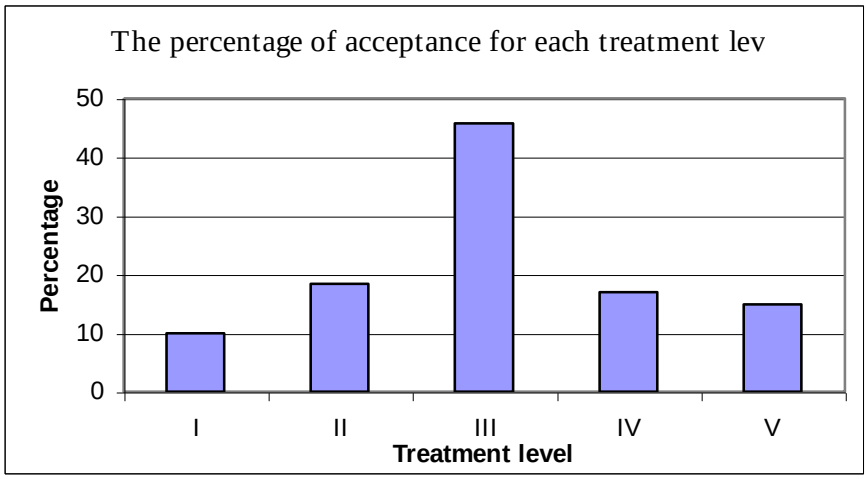


Figure 8

The public participation in wastewater treatment cost is an important aspect for the sustainability of any treatment project. The respondents were asked if they are willing to pay the cost of wastewater treatment. The level of willingness for paying wastewater treatment cost was highly spatially varied between the Northern and Gaza Governorate to the southern part of Gaza District as shown in Figure 9. This could be related to the availability of sewer system in each area, where as shown in Figure 7 the majority of population in the Northern and Gaza Governorate were served by sewer system. In the Gaza District 115 persons of the sample (57%) of are willing to pay the cost of treatment. The respondents whose refused to pay the cost of treatment refer their refusing to the bad economical situation.

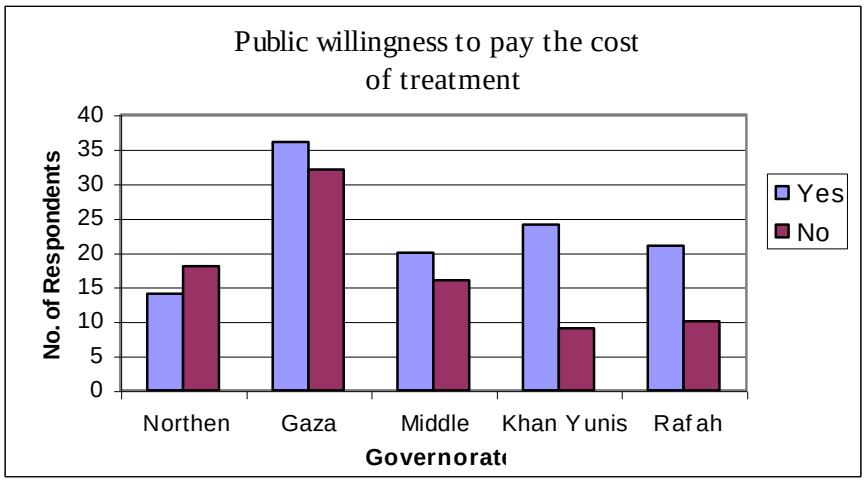


Figure 9

Treated wastewater use

To investigate the public acceptance for the use of treated wastewater the respondents were asked if they accept the idea of using treated wastewater. The answer of was spatially varied with a high level of acceptance in the southern part of the Gaza District to moderate level in the northern part as shown in Figure 10. About 59 % of the respondents accept the idea for reuse while, 41 % refuse the idea.

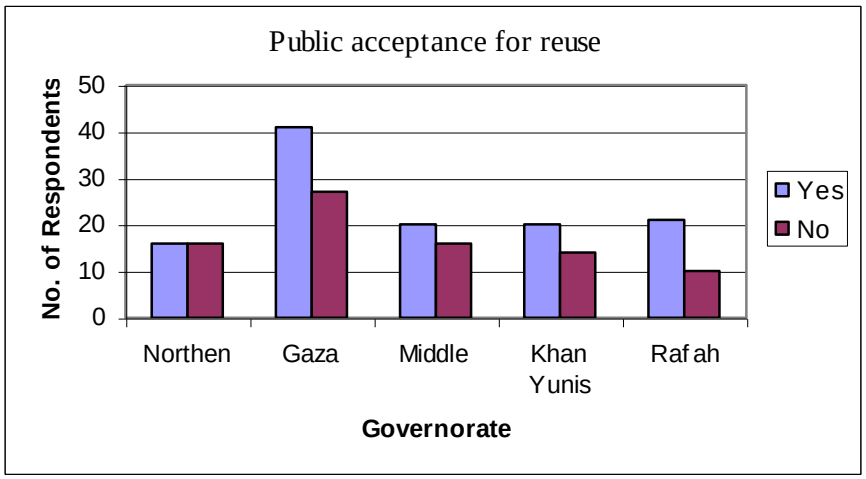
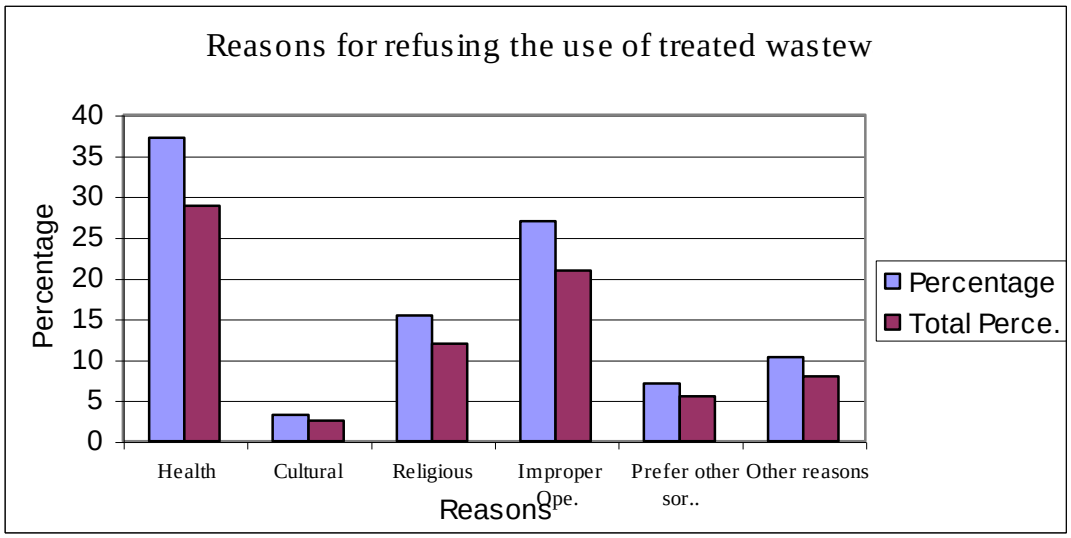


Figure 10

The refusing group was asked about the reasons of their rejection. A list of the possible reasons for refusing was presented to the respondents, It was included the following: I – Health aspect, II- Cultural aspects, III- Religious aspects, IV- Afraid of danger through improper plant operation, V- Basically prefers other resource.

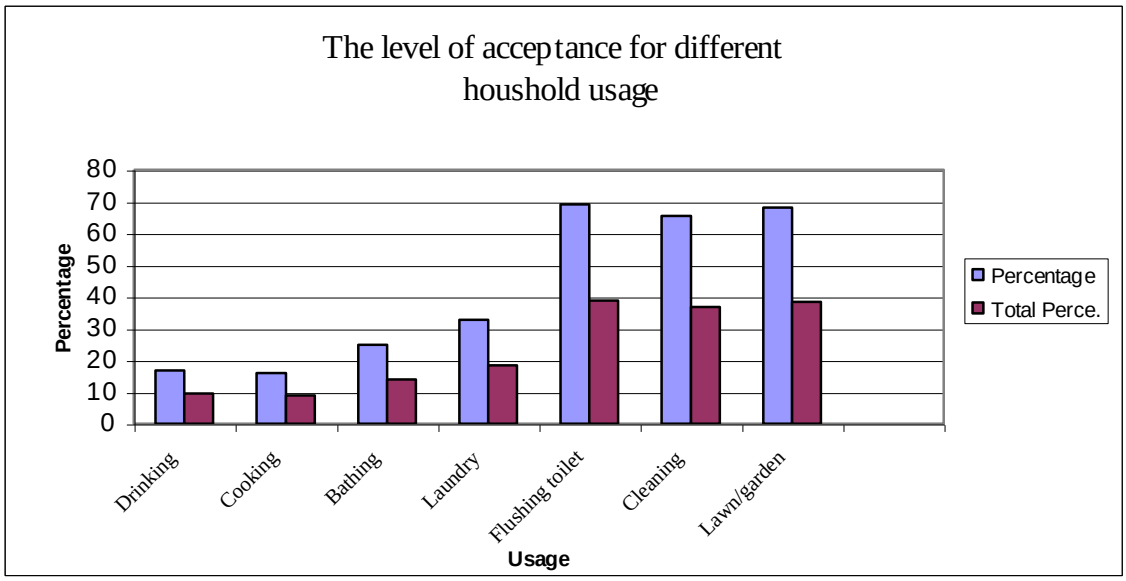
The main concern of respondents with regard to the use of treated wastewater was the health aspect as shown in Figure 11, while the danger of improper plant operation is the second concern. The religious concern is also an important aspect where 15% of the sample shows concern about it.



Total perce. Is the total percentage from the interviewed sample

Figure 11

A different potential list household, agricultural and industrial usage of treated wastewater was presented to the respondents. The flushing toilet usage was considered as the most potential household usage of treated wastewater with about 39% of the respondents as shown in Figure 11. The use of treated wastewater for drinking was accepted by 9% of the sample.



Total perce. Is the total percentage form the interviewed sample.

Figure 11

The agricultural usage of treated wastewater was highly accepted by the Gaza District society as shown in Figure 12. Of which parks and garden irrigation is the most acceptable usage which accepted by about 50% of the sample. The other potential usage of treated wastewater nearly have the same level of acceptance about 30%. The usage of treated wastewater for vegetable irrigation was the least accepted type of usage for the treated wastewater.

The industrial usage of treated wastewater was also highly accepted by the Gaza District society as shown in Figure 13. Of which the concrete and construction industries are the most acceptable type, while the food canning industry has a very low level of acceptance about 9%.

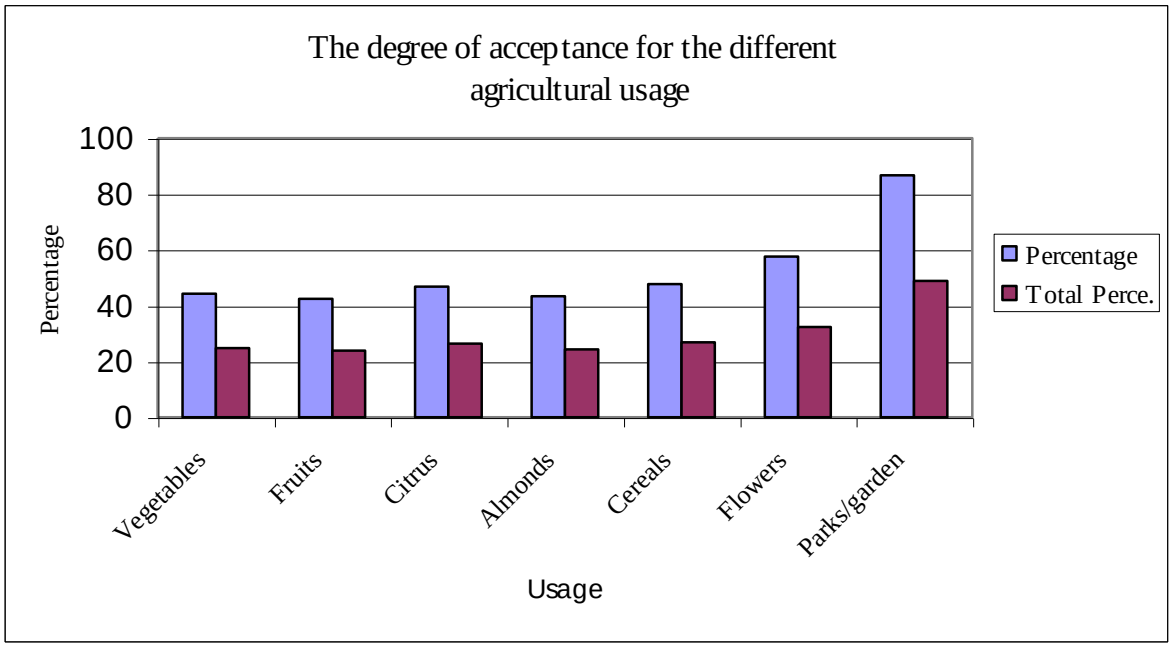


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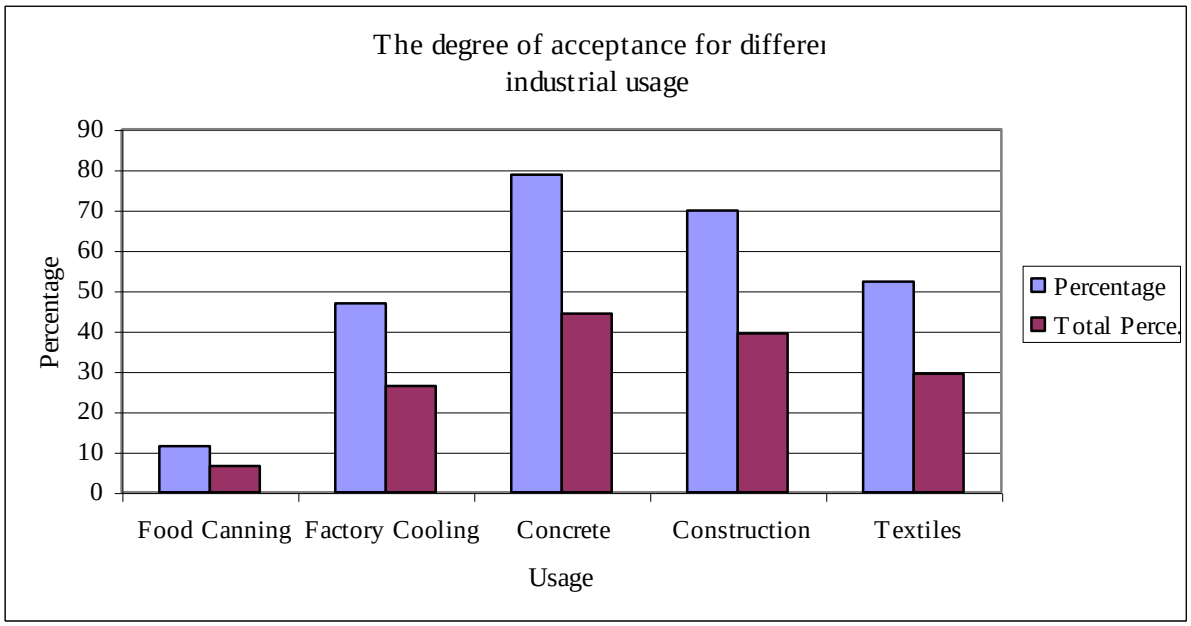
Figure 12



Total perce. Is the total percentage from the interviewed sample

Figure 13

Conclusion

The Gaza District faces a severe water crisis, which is expected to escalate in the next few years. This article examines the public acceptance of the people to use the treated wastewater. The study was designed through a questionnaire distributed on 201 respondents all over the Gaza District. The results show a good level of acceptance for the use of treated wastewater where about 59% of the sample agreed to use this resource. The degree of acceptance increases from the north to the south. The health and religious concerns are the main reasons by which the public justified their rejection to use treated wastewater. The majority of population (58%) accepts to pay the cost of treatment. The percentage of acceptance to pay varies from the south (74%) to the north (44%). A moderate degree of treatment with reuse for purposes that do not involve direct human contact was recommended by about 45% of population.

Recommendation

- Public awareness campaigns should be held in parallel with any reuse project. The campaigns must concentrate on the health aspect and religious opinion in the use of treated wastewater.
- The reuse project is recommended to be implemented firstly in the southern part of Gaza District, where there is a higher level of acceptance to use treated wastewater
- Public participation in the cost of treatment should be taken into consideration , since there is a high acceptance among population to pay the cost of treatment.

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