

Evaluating farmers' attitudes toward raw wastewater irrigation in Wadi Al- Far'a, Palestine

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Abstract: this study aimed to determine how Palestinian farmers' attitudes toward raw wastewater (RWW) utilization. The study provided the socio- economic benefits, health, and environmental risks for reusing raw wastewater in crops irrigation. The survey of 100 farmers in the Wadi Al Far'a area, the sample selected randomly, revealed several significant knowledge gaps among RWW users., Farmers sometimes expressed contradictory views on the impact of irrigation from this source on the quality and quantity of the crop. However, they almost unanimously agreed on the value of wastewater as a source of providing fertilizers for the soil and that they had no choice because of the water scarcity. However, they were concerned about the harmful effects on their health and the environment. The regression study show, partial least squares route modeling with knowledge, proximity to wastewater canal, and value orientation were the most influential factors in determining perceived hazards of wastewater use. Consequently, results indicated that the farmers' awareness, ethical standard, communal unity, and willingness to continue planting statistically significantly impact their behaviors towards using RWW in irrigation. About 60% of the respondent farmers had a relatively moderate awareness about the quality of RWW and its adverse impacts on environmental aspects. In conclusion, some suggestions were made to increase the understanding of farmers which they not have other options from other water sources due to balance the harmful effects of raw wastewater with the potential economic benefits.

Keywords: Attitude; Raw wastewater irrigation; Awareness; Environment; Palestine.

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المستخلص: هدفت هذه الدراسة إلى تحديد موقف المزارعين الفلسطينيين من استخدام مياه الصرف الصحي الخام. عرضت الدراسة الفوائد الاجتماعية والاقتصادية والصحية والمخاطر البيئية المحتملة من إعادة استخدام مياه الصرف الصحي الخام لري المحاصيل. كشف مسح مكون من 100 مزارع في منطقة وادي الفارعة- حيث تم اختيار العينة بشكل عشوائي- كشفت النتائج عن العديد من الفجوات المعرفية الهامة بين مستخدمي المياه العادمة غير المعالجة. أعرب المزارعون في بعض الأحيان عن آراء متناقضة حول تأثير الري على المزروعات من هذا المصدر على جودة وكمية المحصول. ومع ذلك فقد اتفقوا بالإجماع تقريبًا على قيمة المياه العادمة كمصدر لتوفير الأسمدة التي يجب اضافتها للتربة في حالة أنه لا يوجد لديهم خيار نتيجة ندرة المياه. ومع ذلك، فقد كانوا قلقين بشأن الآثار الضارة على صحتهم وبيئتهم. أشارت دراسة الانحدار إلى أن نمذجة مسارات المربعات الصغرى الجزئية مع المعرفة، والقرب من قناة الصرف الصحي، وتوجيه القيمة كانت من أكثر العوامل المؤثرة في تحديد المخاطر المتصورة لاستخدام المياه العادمة. وهكذا أشارت النتائج إلى أن وعي المزارعين، والمعايير الأخلاقية، ووحدة المجتمع، والاستعداد لمواصلة الزراعة تؤثر بشكل كبير على سلوكياتهم تجاه استخدام المياه العادمة الخام في الري. حوالي 60% من المزارعين المستجيبين لديهم وعي معتدل نسبيًا حول جودة مياه الصرف الصحي وأثارها البيئية السلبية المحتملة. في الختام تم تقديم بعض الاقتراحات لزيادة فهم المزارعين في التعامل مع هذا المصدر من المياه عند الضرورة من أجل موازنة الآثار الضارة لمياه الصرف الصحي الخام مع الفوائد الاقتصادية المحتملة.

الكلمات المفتاحية: السلوك، الري بمياه الصرف الصحي الخام، الوعي، الإدراك، البيئة، فلسطين.

INTRODUCTION.

Climate change, water scarcity, population inflation, rising food demands, and accelerated urbanization are all global issues, need to find alternate sources of water for sustainable water management. Recently, there has been renewed interest in wastewater irrigation (treated or untreated) is widely applied either in arid and semi- arid countries that experience a lack of freshwater resources or in low- income communities to cut freshwater and fertilizing costs. (Clemens et al., 2020; Darvishi et al., 2010; Ghanem, 2012; Qadir et al., 2010),

Agriculture is the largest water consumer comprising 70% of global withdrawals (Ardakanian, 2016). With limited water resources, the use of wastewater can play an essential role in addressing the issue of rising demands of freshwater. Prohibition on the development of new groundwater resources will raise population demand for present freshwater supplies (Anayah and Almasri, 2009). The issue of raw wastewater has received considerable critical attention nowadays because about 20 million hectares in 50 developing countries are irrigated with raw wastewater, notwithstanding, most studies in the field of wastewater irrigation have only focused on partially treated or diluted wastewater (Bougnom et al., 2020; Hussain et al., 2001). The arid and semi- arid regions are considered the largest wastewater users because water scarcity is significant. Therefore farmers will take health risks and use RWW when there is an opportunity for direct economic benefits (Inyinbor et al., 2019).

The local authorities are responsible for RWW collection and treatment services in the West Bank, except in the refugee camps. The United Nations Relief and Works Agency is in charge of these services.

Of the 76.7 million cubic meters of RWW generated annually in the West Bank, only 21 and 9.5 MCM are collected and treated, respectively (PCBS, 2012). barely 30% of the population in the West Bank is connected to sewerage networks (Daghara et al., 2019). As a result, one of the most significant challenges for the success of wastewater- use projects is contingent on the support of the farmers directly affected by these projects.

On the other hand, attention should also be paid to the opposition of some farmers to these projects and their fear of the expected effects; perhaps there is little published data on complete knowledge and lack of confidence. It is noted that research to date has not yet determined Palestinian farmers' opinion surveys on the issue of raw wastewater use in all literature. In addition to that, almost all studies were conducted in the USA, Australia, and Western Europe, while less information is available on the position of farmers in other regions (Hanjra et al., 2012; Ahsan et al., 2018). Because of the wide range of culture, climate, water supply, economy, and other factors, farmer attitudes must be studied in diverse regions and under varying environmental and climatic situations. This diversity hampers the transferability of individual findings and conclusions. From one region to the next is a concern.

In Palestine, most studies focus on the effects of treated or untreated wastewater on the soil properties and heavy metals accumulation in the soil and in the plants. The study of Al Qorom and Abu Sharar (2021) estimated the health risk index of the accumulation of heavy metals in selected crops (zucchini and eggplant) due to long- time irrigation with raw wastewater. However, very few valid surveys or studies have been carried out to document the socio- economic and health repercussions of such practices (Maleksaeidi et al., 2018). That discusses the level of awareness of Palestinian farmers towards environmental issues and determines the key factors that affect their general behaviors. Because Their knowledge and views of situations primarily influence people's behaviors, improving their knowledge and perceptions will change their behaviors. Studies of (Rashid et al., 2017; Rashidul Alam, 2017; Salem et al., 2021) show the importance of evaluating People's attitudes on using RWW irrigation, Moreover are viewed as an undesirable phenomenon in society, while changing as a result of increased understanding (Maleksaeidi et al., 2018). So, this paper attempts to show one of the most significant current discussions in using Raw wastewater for irrigation, besides to, farmers' knowledge and drivers about the subject. The specific objective of this study was to (a) determine Palestinian farmers' attitudes concerning wastewater irrigation problems and challenges and (b) study the elements that influence farmers' attitudes. In favor of irrigating with wastewater, this case study- style research begins by discussing the current condition of wastewater use in Palestine. The concerns to human health and the environment connected with wastewater application are then highlighted. The adjustments to survey data and valuation tasks will follow, followed by a results analysis and conclusion.

MATERIALS AND METHODS.

Study Area:

The total area of the city of Nablus represents (14%) of the total area of the West Bank, while the area of Wadi Al- Far'a is approximately (6%) of the same total area. Wadi Al- Far'a is a confined area between the Nablus Mountain range in the west and the Jordan Valley in the east. This region contains the principal aquifers. In Wadi Al- Far'a, there are 61 agricultural wells with an annual average abstraction of 6.2 MCM and 13 springs with an annual average discharge of 14.4 MCM (Salem et al., 2021; Tiehatten et al., 2017), so it is a vital groundwater resource in feeding several cities such as Nablus, Tubas, and Jericho. The nature of the geographical area contains a slop that starts at an altitude of 460 meters above the sea level (ASL) from the west to 189 meters Below Sea level (BSL) to the east near the Jordan River. The climate of the region is dry in summer and cold in winter. The rainfall season from October to March occurs over a transitional zone of 150 mm in the east and increases to 600 mm towards the west of Nablus.

Nablus district is divided into two main parts in terms of wastewater discharge. The Wadi Al- Far'a represents the eastern part in which wastewater coming from the city is caused by industrial and commercial activities along the valley's course. However, the wastewater is treated in the western part of the city. The portion of the wastewater discharge is used in agriculture irrigation. The remaining discharge runs along the Wadi Al Zomer as treated flow. The local study indicates several types of soils composed of Wadi Al- Far'a, the most important of which are Clay loam, whose primary source is rocks and dolomites as parent material constituting about 6% of the total area of the land. It also has an area of about (115,447) dunum distributed to several divisions, such as lands planted with fruit trees and lands cultivated with field crops and forest lands (Shadeed, 2008). The primary sources of discharging raw wastewater are divided into Domestic wastewater and sewage emitted from solid waste landfills from the eastern industrial area of Nablus. Still, there are about (115) Industrial Establishments, and due to the deterioration of the economic situation, some groups of these industrial facilities were closed (Shadeed, 2008). In the industrial zone, factories are classified into several types: cutting stones, quarries, concrete, tiles, concrete blocks, plastic, paper, fodder, metals, furniture, chemical industries, food, slaughterhouse, medicine, and pesticide industry. Most of them are connected directly to the sewage pipes. Some have internal treatment plants, so industrial facilities are an essential RWW source generated from Wadi Al- Far'a. (Shadeed, 2008; Abboushi et al., 2015)

Population and sampling:

The study is conducted using a cross- sectional survey. The research population was chosen after several field visits to several types of farms across Wadi Al- Far'a catchment monitoring irrigation applications. Compared to other farmers, vegetable farmers in Al- Badhan, Al- Jeftlik, An- Nassaria, and

Izmut use raw wastewater for intensive irrigation. Typically, local farmers in the catchment grow multiple vegetable crops such as Onions, Eggplant, Mallow, Zucchini, and Corn. In total, a sample of (100) questionnaires from 139 farmers as total number of vegetable farmers in all villages was distributed to the targeted farmers in the study area as shown in Table 1 The wastewater infrastructure in the research area is considered frail as RWW leaks from cesspits and pollutes the water and groundwater networks. Gomathi et al, (2017) found that more than 46% of the local communities suffer from leakage cesspits which can be considered the primary source of pollution in the West Bank. Even tight cesspits (or septic tanks) might cause severe contamination to the surrounding environment. Once tight cesspits (or septic tanks) overflow, RWW pollutes nearby spaces However, when full cesspits (or septic tanks) are emptied before overflowing, vacuum tankers directly release the RWW into open lands and valleys (Fan et al., 2021). As a result, proper RWW management is urgently required to protect human health and the environment (Al- Qorom and Abu Sharer, 2021)

Table (1) Characteristics of different wastewater resources and number of prepared questionnaires at major study villages of Wadi Al- Far'a.

Village	Population*	Water network condition**	RWW network coverage (%)**	Cesspits or septic tanks coverage (%)**	Open RWW coverage (%)**	Number of Questionnaires
Al- Badhan	3,171	Good	0	95	0	16
Al- Jeftlik	3,100	Leaking	0	100	0	45
Al- Nassaria	1,889	Good	0	100	0	30
Izmut	3,440	Leaking	0	100	0	9
*(PCBS, 2012)			**(Gomathi et al., 2017)			

Data collection tools and measures:

One of the most well- known tools for conducting a questionnaire is the stratified random sampling technique utilized on farmers who used raw wastewater in irrigation. The sample size was determined by the formula proposed by Krejcie and Morgan (1970). Initially, the participants in this study were recruited from four villages Izmut, Badhan, Nassaria, and Jeftlik. From each village, a proportional sample was chosen at random. Before starting data collection, questioner statements are explained to farmers. Due to the presence of Israeli occupation troops in the villages of the research region, which restrict movement between villages on some days, and the concern of many farmers speaking to people about the secrets of their job, collecting survey data was difficult and time- consuming.

The design of the questionnaires was based on dividing into four sections with (70) questions; the first part included general inquiries about the demographic characteristics of the study community and the

farmers' degree of awareness of several issues. Then, the second part was to measure the effects of RWW irrigation on the economic and social situation. The third one assessed the impacts of RWW irrigation on health and the environment. The last section dealt with the effects of RWW irrigation on soil and vegetation besides opening questions about the farmers' drivers towards using raw wastewater in irrigation.

The knowledge variables were measured by an ordinal variable ranging from 1 (very low) to 5 (very high), and attitude variables were measured by a Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Accordingly, for attitude questions, a Likert scale was used. A Likert scale assumes that the strength/intensity of an attitude is linear, i.e., on a continuum from strongly agree to disagree strongly, and makes the assumption that attitudes can be measured. Furthermore, a panel of academic specialists was hired to assess the apparent validity of the scales used. Moreover, a pilot study involving 30 farmers using raw wastewater for irrigation was conducted in Wadi Al Far'a to evaluate the instrument. The Cronbach's alpha coefficients method is one of the more practical ways to measure the internal consistency or reliability of the research tool, i.e., the questionnaire; accordingly, Cronbach's alpha coefficients were computed to the variable topics of the questionnaire. Generally, a Cronbach's alpha value of (0.74) is adequate for a good research tool. However, values above 0.6 are also acceptable (Taber, 2018; Van Griethuijsen et al., 2015). The farmer's education and personal information heterogeneity, ordinarily, Cronbach's alpha coefficients ranged from (0.68) to (0.86). As a result, the research tool, i.e., the questionnaire of the present research, is reliable and consistent; therefore, the applicability of the research results to other parts of Palestine and neighboring countries of similar circumstances is considerable. To conclude, several concepts and variables include awareness, ethical standards, community unity, and willingness to continue farming (Peng et al., 2020). were used as illustrated with Cronbach's alpha reliability coefficient in Table 2.

Table (2) Summary of various knowledge variables and their corresponding Cronbach's alpha coefficient used in evaluating farmer knowledge responses toward using RWW at Wadi Al- Far'a.

variables	definition	alpha coefficient
knowledge	Farmer's understanding of wastewater use and health and environmental concerns.	0.68
Economic benefits	Farmers' financial gain from wastewater- use programs.	0.72
Environmental risks	The magnitude of the wastewater environmental concerns.	0.70
Health risks	The magnitude of the health dangers posed by wastewater use.	0.72
Willingness	Values that place a premium on achieving the best possible results for each individual.	0.68
Social- altruistic	Values that indicate care for the well- being of others.	0.74
Public acceptability	Public acceptance of the development of wastewater- use programs.	0.78

variables	definition	alpha coefficient
Ethicality	Farmers' perceptions of their level of responsibility, accountability for items under their control and management.	0.70
Risk perception	Farmers subjective assessment of the qualities and severity of a risk.	0.82
Trust	Farmer's views on whether or not the authorities promote wastewater- use plans.	0.86
Communal context	Attitudes about population changes such as mortality, fertility, and migration rates, which increase the requirement for wastewater treatment.	0.84
Organizational context	Attitudes toward the relevant institutions' ability to maintain high effluent quality.	0.68
Environmental context	Attitudes toward the significance of the natural environment in influencing how farmers use wastewater.	0.70
Technological context	Attitudes toward mechanical technology that provide low- cost solutions.	0.75

* knowledge variables measured by an ordinal variable ranging from 1 (very low) to 5 (very high), and attitude variables measured by a Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). (Source: Sheidaei et al., 2015)

RESULTS AND DISCUSSION.

Farmer's knowledge about wastewater use:

The RWW utilized by local farmers has a high percentage of nitrogen and salts (e.g., nitrates), which may be causing severe harm to plants. Due to the over- nitrification of soil and deteriorating human health, if these salts accumulate inside plant tissues (Al Qorom and Abu Sharar, 2021), a significant percentage of iron can accumulate in the soil and plants compared to the maximum amounts permitted by the Palestinian guidelines. Following broad characteristics of farmers in the questionnaire, the first set of questions attempted to measure knowledge factors using ordinal variables ranging from 1 (very low) to 5 (extremely high) figure 4. Around 59% of farmers were highly aware of the legislation and regulations governing the safe disposal of wastewater in agriculture. A medium percentage of farmers (45%) recognized the impacts of RWW on the fertility and productivity of soil irrigated with raw wastewater. The vast majority (70 %) know the chemical compounds absorbed by plants and the contents of irrigation water. The other questions examined the impact of RWW's harmful effects on soil and environmental quality to 62 % of farmers. The purpose of this study was to see if the participants were aware of the effects of long- term and short- term raw wastewater irrigation. Some questions asked the participant, just 27% were aware of the long- term consequences of wastewater irrigation on heavy metal levels and kinds of soils. Despite having years of experience with wastewater application, 73 % of farmers were aware of

the potential health dangers. Some farmers 44% argued that crop irrigation by raw wastewater does not have harmful effects of wastewater on farmworkers and customers, while others 56% agreed that using RWW for irrigation of vegetables and other crops is unsafe at all,

Overall, these results indicate knowledge about the nutrient content of wastewater and the health risks associated with using this water source due to sufficient information dissemination to farmers. Consequently, these results suggest that learning from experience and discussion with other farmers are the most desirable ways for receiving information about wastewater in the absence of well- managed public awareness programs (78% of farmers never participate in environmental and health awareness programs). Furthermore, just 15% of farmers could participate in agricultural extension courses. Extension efforts, they concluded, were ineffectual in enhancing wastewater information. Indeed, vegetable farmers were using RWW while they were aware of this contaminated water source's undesirable quality and adverse health and environmental impacts. According to the findings, most farmers (more than 80%) have an economic driver. They are interested in the economic aspect and the expected earnings from producing the crop utilizing this type of water. These findings are congruent with the results of the (Rutkowski et al., 2007) study, which revealed that most farmers who use RWW for irrigation are well aware of this water resource's negative environmental and health impacts related to skin infections. However, they still had different perspectives and attitudes toward this water resource.

Highlights on farmers' attitudes towards wastewater use.

Socio- economic farmers characteristics:

The farmers responded to several inquiries about their socio- economic characteristics at the beginning of the questionnaire. These characteristics include age, gender, education level, employment status, income, experience, locality. Accordingly, the analysis results about 63% of the respondent's farmers are aged between 20- 40 years old. Consequently, these farmers are still young people who are generally productive, economically active, and technically efficient. Notwithstanding, about 60 % of them had less than five years of experience in growing vegetable crops. Moreover, (75 % of them) were smallholders who had at most five- dunum farms to plant. In addition, findings indicated that the family sizes of 64 % of the vegetable farmers were five people or fewer, and half of the farmers' questioners, about 47%, had a university degree. In conclusion, this indicates that young, educated farmers are more likely to adopt new agriculture techniques and understand the consequences of their farm decisions on society and the environment.

Economic benefits and risks of wastewater:

Irrigated vegetables such as zucchini, eggplant, onions, mallow, and maize are mostly irrigated with RWW. At the same time, some farmers prefer to use RWW water to irrigate animal feeds such as

maize and barley because local authorities prohibit using raw wastewater to irrigate vegetables before treatment. Despite this, 75% of farmers expressed that the grain is lower quality than the grain irrigated with fresh water and farmers saw a significant loss in the production of maize, eggplant, and onion crops when irrigated with wastewater compared to irrigation with fresh water, as shown in (Table 3).

A slight majority of farmers (10%) believed that RWW irrigation was responsible for increasing the fertility of their land. Although they could not measure the contribution of fertilizers to wastewater, they found that when raw wastewater is used, the need to use fertilizers decreases. Thus, while saving fertilizer, wastewater has reduced its production expenses. The results also showed that the productivity of some crops (e.g., mallow) had a significant impact on people's perceptions of economic rewards (Table 3).

Farmers in peri-urban areas had conflicting opinions about crop production produced under RWW irrigation. Furthermore, 70% of farmers believed that when corn or crops, in general, is irrigated with wastewater, it grows well and has a greater yield, as data in Table 10, than when it was irrigated with fresh water. At the same time, practically other findings claimed lower yields as in Table 4, and this indicates that farmers have varying trends and behaviors regarding the economic aspect.

Table (3) Crop average yields (tons per dunum) under irrigation with wastewater (RWW) and freshwater (FW).

Crops	Irrigated by FW	Irrigated by RWW	t- test	Significance
Corn	1.2	0.8	6.324	0.002
Onion	4.8	3.5	4.654	0.002
Eggplant	1.5	0.9	6.432	0.007
Mallow	2.7	2.1	7.435	0.010
Zucchini	4.1	3.8	5.432	0.009

(Source: farmers questioners)

The results also revealed that the mentioned variables explained 52% of the overall variance in attitudes towards wastewater's economic advantages and risks. The most important determinant of the economic benefits of wastewater was the distance of the farm to the RWW channel (proximity), followed by orientation of productivity and selfish value, according to standard regression coefficients (Table 4).

The one closer to the wastewater canal has RWW for more consistent irrigation than the outlying farms. As the wastewater travels a certain distance, some waterborne fertilizers are deposited, increasing the money spent on fertilizers. The data also indicate that a single value orientation (i.e., selfish beliefs) significantly influences a single attitude about the economic advantages of wastewater (Table 4).

However, reducing irrigation water use is a frequent form of good environmental action in the face of increasing water scarcity and Israeli control of fresh wells, and selfish farmers have shown an

excessive tendency to expand their cultivated area. Other farmers' access to raw wastewater has been tangentially restricted by expanding the cultivated areas.

One of the most compelling reasons to use RWW in irrigation is the profit potential. In general, farmers' attitudes about this alternative water source are still unfavorable, consistent with the study results (Owusu et al., 2012)

Table (4) Determinants of farmers' attitude towards economic benefits and risks of wastewater irrigation in Wadi Al- Far'a

Independent variables	Standardized coefficients (Beta)	Sig.
Closeness to canal	0.431	0.001
Productivity	0.429	0.001
Willingness to maximizing outcomes	0.362	0.004

$$R^2 = 0.62.$$

Environmental risks of wastewater:

Table (5) illustrates that wastewater use can reduce soil quality by raising salt and heavy metal levels and lowering production over time. In addition, 93 % of farmers agree that wastewater is a significant environmental issue through increased environmental degradation. To meet the water demands while avoiding long- term harm to the soil structure, few farmers plant water- stress- tolerant crops, crop rotation, and reduced irrigation frequency.

Table (5) Perceived negative impacts of Raw wastewater irrigation on the environment. in Wadi Al-Far'a.

Environmental risks			
Elements	Low	Medium	High
Reduced soil quality	28 %)	44.0 %	28.0%
Increased environmental degradation	7.0 %	39.0 %	54.0.0%
Degraded water resources	7.0%	46.0%	47.0%

The independent variables explained 65 % of the overall variance in attitude toward environmental threats, as indicated in Table 6. Consequently, Table 6 shows that a willingness to value, communal unity, awareness, and proximity to the canal are the strongest predictors of perceived environmental threats. Also, knowledge of wastewater usage significantly impacts perceived environmental concerns consisting with the findings of the (Mojid et al., 2010). Ordinarily, farms near main wastewater canals receive water with a high concentration of contaminants, the most significant of which are salts. Table 6 shows that willingness value played a significant effect in affecting attitudes concerning wastewater environmental concerns. Nevertheless, they persisted in expanding the

agricultural area to maximize their short- term earnings, although the long- term application of raw wastewater can harm soil quality.

In conclusion, the findings revealed that communal context substantially impacts attitudes concerning wastewater's environmental dangers. However, farmers frequently have little choice but to use raw wastewater in the face of water constraints. (Almanaseer et al., 2020)

Table (6) Determinants of farmers' attitude towards environmental risks of wastewater in Wadi Al-Far'a.

Independent variables	Standardized coefficients (Beta)	Sig.
Ethical standards	- 0. 919	0.001
Willingness value	0.551	0.001
Communal context	- 0.411	0.021
Awareness	- 0.294	0.011
Closeness to canal	- 0.229	0.001

(R² = 0.81)

Health risks of wastewater

According to Table (7), the farmers knew raw wastewater quality's potential adverse health effects. The majority of the respondents (53% to 70%) believed that the wastewater contains parasites and harmful bacteria that cause many diseases and the possibility of these microbes reaching consumers if they did not use appropriate protection methods such as washing and sterilization. Some farmers see a low possibility of infection, and this, of course, reflects the extent of the farmers' scientific knowledge and the degree of education, and this is also in line with the study (Maleksaeidi et al., 2018; Mojid et al., 2010, which emphasizes the importance of awareness and preventive measures in reducing Parasitic infections in society.

Table (7) Farmers perceived health risks of wastewater in Wadi Al- Far'a.

Health Risks			
Wastewater increases	Low	Medium	High
Microbial infection among consumers	15.0%	32.0%	53.0%
Prevalence of infectious diseases	13.0 %	22.0 %	65.0%
Toxicity of crops and vegetables	14.0 %	16.0 %	70.0%
Health risks for farmers and their families	18.0%	14.0%	68.0%

findings depict the various environmental, social, economic, and health effects on respondents' behaviors in accepting the use of raw wastewater for irrigation, using questions and sentences that reveal the importance of previous perspectives in their lives, such as the foul smell of raw wastewater sanitary pads increases the local Population upset,

RWW health issues also generate an air of uneasiness, and its use has frowned upon in- home culture. According to Figure 9, the economic aspect is the most important in the lives of farmers. Given the current conditions in which people are racing under the high prices of basic materials and the exploitation of traders, despite their knowledge of the potential health risks, which had little impact on their attitudes toward use.

Confirms that health is still absent from the mind, which is expected given the general behavior. As a result, the social acceptance of farmers, and the willingness of consumers to buy, are also necessary (Maleksaeidi et al., 2018).

Farmers' views of health risks were predicted using regression analysis (see Table 1) to describe the variables and their measurements). Table (8) shows that the selected variables explained 61% of the overall variance in attitudes toward health risks. The results showed that proximity to a wastewater channel, environmental value orientation, and knowledge significantly impact the perception of health risks associated with wastewater use.

According to the results, the distance from the sewage channel significantly affects the attitude towards health concerns (Table 8). The farmers at the other end of the canal, supplied with inconsistent RWW, were less concerned about the uplift.

According to Table 8, the biosphere value trend significantly impacts attitudes towards health risks and, consequently, on perceptions of wastewater use. The application of environmental values inspires farmers. Wastewater is handled following ethical guidelines for human, plant, and animal health. Those farmers usually set up their irrigation activities based on the safe use of wastewater to reduce potential health risks. Studies also indicate that wastewater is dangerous to an individual's health. It is greatly influenced by knowledge (Table 8). When it came to the health risks, farmers familiar with them seemed to realize that they were significant. Although some farmers were aware of the harmful consequences of raw wastewater on their health, they continued to use it because there were no other water sources available for agriculture and the economic aspect.

Table (8) Determinants of farmers' attitude towards health risks of wastewater in Wadi Al- Far'a.

Independent variables	Standardized coefficients (Beta)	Sig.
Closeness to canal	0.520	0.002
value orientation	- 0.471	0.006
Knowledge	- 0.362	0.009

(R² = 0.61)

4.1.9 Farmers drivers of using RWW irrigation:

Although farmers had enough awareness about the adverse effects of RWW on the environment and human health and their negative behaviors towards this contaminated water resource, continued

using RWW for irrigation crops, prompting to ask, "What are the factors that encourage farmers to employ RWW for irrigation?" Table 9 shows major drivers stated by the vegetable farmers in Wadi Al- Far'a themselves for using RWW for irrigation. The scarcity of water in the research region, according to the results, is the most significant cause for vegetable growers' employment of RWW. Water scarcity due to drought and the Israeli occupation's overexploitation of groundwater resources. Water scarcity has become a real issue for farmers, who are obligated to utilize RWW since they have no other options, affecting all aspects of their livelihood (Owusu et al., 2012).

Table (2) Farmers drivers to use RWW for crop irrigation in Wadi Al- Far'a.

No.	Element of motivation	Percentage (%)
1.	Water scarcity	88
2.	Difficulty in accessing freshwater	80
3.	Decreasing production costs	79
4.	Increasing crop yield	70
5.	Saving freshwater	64
6.	Increasing soil fertility	54

Based on Table (9), 70% of the respondents believed that vegetable crops grow well when irrigated with RWW rather than freshwater. Maleksaeidi et al. (2018) showed that raw wastewater irrigation is widespread in developing countries, where limited water resources exist. Farmers believed that RWW increases the production and productivity of vegetable crops (e.g., eggplant, onion, mallow, and corn). Moreover, 79% of the local farmers expressed that the low price of their production cost is another reason for using RWW.

In addition, Farmers believed that RWW provides the plants with necessary nutrients and reduces fertilizers needed by adding nutrients to the soil. Hence, using this water source for agricultural irrigation is economical, as seen in Darvishi et al. (2010).

Additionally, 80% of the vegetable farmers in Wadi Al- Far'a explained that another reason forcing them to apply RWW irrigation is the difficulty accessing freshwater resources. They claimed that the cost of pumping groundwater from underlying aquifers is relatively high. Moreover, 64% of farmers answered that one of the reasons driving them to use RWW is saving freshwater resources. These farmers probably belonged to farmers who had their water wells. Eventually, about 54% of the vegetable farmers believed that soil fertility increases progressively due to the irrigation with RWW. So, one of the reasons for using RWW irrigation is to improve the farm's soil fertility.

The research finding is congruent with the results study (Maleksaeidi et al., 2018). The study showed that the most critical drivers for farmers to utilize untreated wastewater for irrigation were water scarcity, greater crop output, lower production costs, difficulties in getting freshwater, preserving freshwater, and enhancing soil fertility. Also, the findings highlighted the necessity of adopting plans to improve wastewater treatment and proper legislation and practices to increase farmers' commitment to environmental conservation and human health.

Data analysis:

Collected data and questioners were used as the primary data. The collected primary data were coded, tabulated, and subjected to analysis through a Statistical Package for Social Science (SPSS). The results are presented in tables, graphs, and pie/bar charts. A block diagram is introduced in Figure 4, which presents the complete methodology of all the research.

Conclusion.

This study aimed to find out how Palestinian farmers' attitudes toward using raw wastewater. Few public opinion polls on wastewater use are undertaken around the world. Similarly, there has been no investigation of the attitudes of Palestinian wastewater users. Farmers' judgments of economic benefits, health, and Farmers' mental dangers result from a complex combination of factors, the most important of which are knowledge, farm distance from wastewater canal, and value orientation. While extension programs help farmers become more aware of wastewater issues, most farmers judge based on their inadequate understanding. Improved extension sees are also required to mitigate wastewater's detrimental effects. According to the findings of this study, vegetable producers are very concerned about the quality of RWW they use for irrigation. They identified the harmful effects of RWW on the ecosystem, which influences farmers' behavior to some extent. The adverse social, environmental, and health effects of exploiting this water supply are causing worry among vegetable farmers.

Data availability:

The data used to support the findings of this study are available upon request from the corresponding author.

Conflicts of interest:

The authors declare no conflicts of interest regarding the publication of this paper.

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