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SEZIONE FUORI LUOGO

Elena Giacomelli, Pierluigi Musarò, Valentina Cappi[1]

Perceptions and Attitudes Towards the Use of Treated Wastewater in Agriculture a Case Study from Beit Dajan Community, West Bank[2]

Introduction

We all generate waste, but where it goes next is frequently overlooked. For many of us, what happens to our waste once we have thrown it away has little bearing on our everyday lives. Little thought is usually given to where our waste ends up, or what impact it might have on the planet and on our lives: we could call this a sort of denial of waste. At the same time, the huge volumes of waste we produce pose major problems in terms of our ability to collect, treat, and manage it without endangering human and environmental health. Since waste management is so readily overlooked, treatment infrastructure is often neglected, and the global disparities in exposure to waste contamination are ignored. The use and reuse of waste, as a means of managing it, is becoming increasingly paramount.

Given that water is a scarce resource, this article focuses upon the reuse and treatment of wastewater, especially in semi-arid and arid contexts, such as Palestine. The area of Beit Dejan (Area B[3], Nablus Governorate, West Bank) is taken as a case study. Treated wastewater reuse is currently deployed here, and this area is part of a number of European Union programs at increasing the use of wastewater for agricultural purposes in Mediterranean countries, as a means of enhancing sustainable, clean, and environmentally friendly solutions to cope with water shortages. Wastewater treatment is a process used to remove contaminants from wastewater so that it can then be returned to the water cycle. Once returned to the water cycle, the decontaminated water can safely be used in agricultural environments or is reused for various other purposes.

Within the context of the project *ARPA - Wastewater for Agriculture (Acque Reflue per l'Agricoltura)*[4] - we conducted research to analyze the local community's perception and attitude towards treated wastewater in Beit Dajan (West Bank), where treated water available for agriculture has the potential to minimize freshwater extraction and, as a result, water stress in the area of the Nablus governorate. Here, environmental, political and social constraints, as well as the deterioration of water quality and a lack of effective water management exacerbate water stress. We adopted an applied sociological study, drawing upon sociological skills and knowledge with the aim of improving the well-being of a community in a policy-oriented and action-directed manner (Steele, Price, 2004).

The area of the Middle East, like many countries and regions throughout the world, is progressively facing severe water shortages, as well as wastewater contamination challenges, due to rapidly growing populations, increasing water consumption, climate change, rainfall distribution imbalances, and economic development (Bodin *et al.*, 2019; Chen *et al.*, 2018). One-fifth of the world's population lives in water-scarce areas, while one-third lives in areas with moderate to severe stress (International Organization for Standardization, 2019).

Water resource management is a controversial topic among parties sharing the same resources in the Middle East's semi-arid to dry climate. Water is both an object and a tool of conflict due to the

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2 Received: 16/11/2022. Revised: 29/12/2022. Accepted: 30/12/2022.

3 The Palestinian Authority exercises administrative control over Area B but shares security control with Israeli authorities. Interactive map: https://tinyurl.com/49c5wn6f

4 The research is part of the project ARPA - Wastewater for Agriculture (Acque Reflue per l'Agricoltura), funded by Emilia Romagna Region, in synergy with the project 'MENAWARA Non - Conventional Water Reuse in Agriculture in Mediterranean countries', funded by ENI CBC MED program of the European Union.

tension between the demand for water and its limited availability (European Parliament, 2015). The treatment of wastewater has been a circular solution to both water scarcity problems in times of climate change and to avoid direct discharge of untreated wastewater in the environment (Salem *et al.*, 2021). The critical increase in human demand for water has led to the use of treated wastewater (TWW) being identified as the main water resource in different parts of the world, and, interestingly, for national water resource management plans in the Mediterranean area.

The global and local freshwater scarcity in the world is exacerbated in the Palestinian context. It is estimated that about 1.35 million Palestinians in the West Bank and the Gaza Strip are in immediate need of humanitarian assistance due to public health concerns related to limited access to WASH services (OCHA, 2021). In this context, the reuse of TWW for agricultural irrigation would contribute to reducing pressure on freshwater, especially since 60-70% of clean water in the West Bank is used for irrigation purposes, forming approximately 160 MCM/yr (ARIJ, 2007; World Bank, 2009; Salem *et al.*, 2021).

Drier seasons and political obstacles to water access mean that Palestinian farming families face major challenges to their way of life and their livelihoods. The agricultural sector employs 13.4% of the population in the formal sector and over 90% of those who work informally (Mizyed, 2013; ANERA, 2020). While the World Health Organization (WHO) recommends that residential water consumption be kept to a level of 100 liters per person per day (lcd), available water resources for domestic consumption in the West Bank is only 62 lcd (World Bank, 2018). 600,000 Palestinians in the West Bank reside in areas that are not connected to piped water services or are poorly supplied; they consequently consume less than 50 liters of water per capita per day, well below the 100 liters recommended by WHO (OCHA, 2021).

Water scarcity and inadequate water management, low soil fertility, a lack of financial resources and low agricultural investments, unstable crop prices, and high risk owing to droughts and land fragmentation all pose challenges to agricultural development in the West Bank (Shadeed, 2013). Water scarcity is likely to be the most difficult of these issues.

As the agricultural sector is responsible for more than half of the total available water for Palestinians, during the summer, West Bank farmers experience regular cuts in piped water service. Villagers who still own agricultural lands mostly plant it with olives, citrus, and other trees and plants that do not require a lot of irrigation, while less land is planted with vegetables, grains and other local and traditional crops. Hence, in the West Bank, treated wastewater can be of substantial value to the agriculture sector and can complement rainwater harvesting and rainfed agriculture. However, there are several potential obstacles, owing both to the geopolitical situation and to cultural and religious concerns.

The right to water and sanitation is a fundamental human right enshrined in international conventions, such as the International Covenant on Civil and Political Rights (ICCPR) – signed by Israel in 1990 and ratified in 1991 - and the International Covenant on Economic, Social and Cultural Rights (ICESCR) - signed by Israel in 1966 and ratified in 1991 - (Beshtawi, 2020). As Israel is a signatory to these conventions, it is obliged to uphold this right in all the territories it controls. Since 1967, Israel has occupied and militarily administered the West Bank through the Israeli Military Governorate and then the Israeli Civil Administration (ICA), including direct control over water infrastructure. Since the Six-Day War, water has remained a symbol of the Israel–Palestine conflict. Even though inhabited Palestine is historically rich in fresh groundwater, all water resources in the newly captured regions were taken over by Israel in 1967 (Awad, 2020). With the exception of a small stretch of the coastal aquifer that runs under the Gaza Strip, Israel holds exclusive control over all water resources between the Jordan River and the Mediterranean Sea resulting in a lack of water provision to the residents in the West Bank and in water unsafe for consumption in the Gaza Strip.

Water scarcity in the Palestinian territory, in addition to land confiscation and armed attacks against farmers, leaves Palestinians at risk of having to abandon their lands and lose their inherited culture, which is mainly related to agriculture. Surviving farmers, in fact, confront unfair

market competition from Israeli products, which are cheaper and more marketable also due to the recruitment of low cost migrants and Palestinian labour (Salem *et al.*, 2021).
The 1993 Oslo Agreement, which was designed only to last for a short period of time, restricted the amount of water used by the Palestinians West Bank population in 1995[5] (Boatman, Martin, 2019).
A recent Oxfam report, published in 2019, stresses that although the population in the West Bank has nearly doubled, the amount of water provided by the Israeli side remains the same as that agreed on in 1995, as the agreement did not include any provisions for amendments to reflect new realities.
The water regime established by the Oslo Agreement (Trottier, 2019) reveals the strategic advantage gained by Israel by maintaining its hegemony over the mountain aquifer (UN, 1980).
"Water domination", "water hegemony", "water deprivation", "water politics", "hydro-politics", "water militarization", "water strategies", "water pollution", and other terms have been used to describe Israeli absolute control of Palestinian legal water resources (UN, 1980; Isaac, Salem, 2007; Zeitoun, 2011; Zeitoun *et al.*, 2013; WCC, 2016; EJA, 2019; Salem, 2019). As a result, Palestinians only have access to a small portion of their legitimate water resources.
International law and human rights treaties set out that the Israeli occupation is responsible for providing Palestinians with enough water for domestic, agricultural, and industrial consumption (Salem *et al.*, 2021). According to a report issued by UNHRC in March 2017 (Jaramillo and Restrepo, 2017) the agricultural sector has been affected by the denial of access for farmers to agricultural areas, water resources, and domestic and external markets. As such, our case study can be read within the framework of environmental (in)justice, intended as «the right to remain in one's place and environment and be protected from uncontrolled investment and growth, pollution, land grabbing, speculation, disinvestment, and decay and abandonment» (Anguelovski, 2014, p. 33). Exploring the (re)uses and distribution of water resources in the West Bank and the Gaza Strip inevitably draws attention to «the ethical and political questions of 'who gets what, why, and how much'» (Bullard, 2001, p. 153), unveiling some of the processes that have contributed to produce unequal protection from environmental degradation or deprivation, and calling for remedies.
Given the above, the objective of this paper is to investigate perceptions and attitudes on the use of treated wastewater for agricultural purposes in Beit Dajan. We use these two terms respectively to mean the way in which treated wastewater use is regarded, understood, or interpreted, and the emotional or behavioral disposition of local people with regard to it, within a given family or social environment.
The article commences by contextualizing the use of TWW in agriculture in the West Bank. It then delves into local stakeholders' perceptions and attitudes to the use of treated wastewater for agricultural purposes by reporting the results of a qualitative research based on six semi-structured interviews with farmers, traders, and policy-makers and two focus groups with a total of 30 end-buyers of products and farmers using TWW. We conclude by evidencing how the fieldwork results point to the need for research teams, international NGOs, local institutions and technical units to plan actions aimed at increasing local people's understanding about the use of treated wastewater in agriculture whilst also providing them professional assistance and training.

1. The Use of Treated Wastewater in Agriculture: Focus on Beit Dajan

Water can be considered a "total social fact" as it connects multiple domains of social life (economic, political, religious, etc.) to each other rendering them interdependent (Orlove, Caton, 2010). Water concerns thus cannot be divorced from territorial disputes or the pursuit of agricultural livelihoods (McKee, 2021). Water is both a common component of daily life and a

5 The Gaza Strip and the Jordan River, as well as the 60 percent of the West Bank (Area C) that remained under Israel's direct security control, were not included in the deal.

precious resource in the communities of Beit Dajan and the surrounding areas, where its ebbs and flows follow socioeconomic and political lines. The occupation of the West Bank and control of basic resources as a result of settlement development has left Palestinians with a wastewater crisis, with many areas unable to connect to the main sewage system (Jaramillo, Restrepo, 2017). Between 2012 and 2015, the cost of wastewater treatment in the West Bank topped USD 90 million for clean water that was not reused by Palestinians (ARIJ, 2015). To a certain extent, then, wastewater treatment in the West Bank is needed so as to prevent exorbitant expenditures for the already impoverished Palestinians.

In addition, the use of treated wastewater in agriculture could benefit human health, the environment and the economy. The most well-known benefit is the decrease of pressure on freshwater because treated wastewater can be used as an alternative irrigation source since agriculture consumes 60-70% of available water. Secondly, the reuse of treated wastewater can reduce the cost of groundwater extraction. Thirdly, treating wastewater can reduce water pollution when disposed of in seas and rivers and landfills. Fourthly, agricultural wastewater reuse can contribute to the justification of suitable investment policies and financing mechanisms for pollution control and prevention. Finally, it also reduces the use of artificial fertilizers in agriculture (Jaramillo, Restrepo, 2017).

Indeed, the use of TWW in agriculture reduces the use of fertilizers in water including organic content that can replace chemical fertilizers, and can reduce costs. In 2017, Barghouthi led experimental work in the West Bank and Gaza to study the effect of TWW on olive trees (Barghouthi *et al.*, 2017). that the study concluded that TWW has an added-value for the soil when compared to soil irrigated with fresh water for the presence of carbon-based content and cation-exchange capacity the measure of the soil's ability to hold positively charged ions - a very important soil property influencing soil structure stability, nutrient availability, soil pH and the soil's reaction to fertilizers and other ameliorants (Hazelton, Murphy, 2007).

However, improper agricultural irrigation with TWW has the potential to harm public health, the environment, crop quality, and soil conditions (Ashraf *et al.*, 2017). Some severe consequences of the improper use of treated sewage water range from soil salinization and chemical and biological contamination of crops to poisonous materials that may enter the food chain, damaging the food consumed by humans and animals (Faryal *et al.*, 2007). However, salt and wastewater tolerant crops, such as trees, shrubs, and fodders, can be irrigated with TWW. Management measures that can lower hazards to human health and the environment are thus fundamental in order to decide which crops may be irrigated with treated wastewater, and to establish the criteria to check its quality (i.e., periodic laboratory testing) (Salem *et al.*, 2021).

In the West Bank the importance and efficiency of TWW for reuse in integrated water resource management, as well as its role in water cycle management, water shortages, climate change adaptation, and water in future cities, are enormous. To boost water availability and reliability, treated wastewater reuse is a cost-effective and energy-saving option. It is a tried-and-trusted water scarcity solution that increases water availability and thereby mitigates climate change.

Currently, along with small-scale treatment units, the main and larger treatment facilities are those of Jenin, Nablus, and Al-Bireh. This is in addition to a facility that is about to start up in Tayaseer (Tubas Governorate) and two more plants planned for the east Nablus (northern West Bank) and Hebron regions (southern West Bank). It is estimated that the West Bank could potentially produce over 50,000 m3/d of treated wastewater, which could be reused to irrigate over 20,000 dunums (20 km^2) of high-value crops and animal feed. To date, treated wastewater reuse has been limited to the Jenin area, as well as a few demonstration uses in Nablus.

Beit Dajan is a Palestinian village in the Nablus Governorate in the north-central West Bank [Fig.1], located 10 kilometers (6.2 miles) east of Nablus, and after the 1995 accords, 38% of the village land is defined as being in Area B, while the remaining 62% is Area C.

Fig.1: Map of the West Bank, with Nablus Governorate highlighted.
Source: ANERA: https://www.anera.org/stories/nablus-palestine-history-helping-palestinian-villages/

Beit Dajan and its environs have long been one of the most important agricultural zones in the Levant, shipping the best of its produce to cities throughout the region and beyond. In an industrialized world, the development of borders, the expropriation of agricultural areas, as well as water shortage issues and market competitions have generated major food security issues in the Palestinian territory. Initiatives to address the problem of water shortage and the neglect of agriculture in the designated region have run into financial difficulties and have lacked a long-term strategy. In Beit Dajan, a wastewater treatment unit was created as a solution to the collected grey and blackwater. While greywater is the water leaving sinks, bathtubs, washing machines, and floor drains, which doesn't contain organic substances, blackwater refers to wastewater containing faeces, urine, latrine water, and toilet paper. Blackwater is distinguished from greywater, as the result of human domestic activity from washing utensils and clothes and from showering. In developed contexts, blackwater is usually separated from greywater in private residences, for example, in order to facilitate later treatment and then use the appropriate method for water purification. This is not common in many areas, including in Beit Dajan in Nablus Governorate. 70 percent of the Beit Dajan village was connected to the sewage system. According to the interviews conducted with the local council, the sewage connection project was funded by the EU, for political and geographical reasons. The idea was the reuse of sewage water after its treatment in agriculture, especially for agricultural lands being located in the lowest area. Some parts and constructions, especially regarding the secondary filtration, were missing or not implemented fully for the treatment unit to fully function. Nonetheless, treated wastewater has been in use for agricultural purposes since 2012. Several follow-on projects were instigated to inform and train farmers and support them with a piping system to help them plant and benefit from the system.

In the village, the historical shift in land use from wheat fields to trees could have an impact on the ecosystem and bird migration. Lands have been abandoned due to a lack of water and the risk of wild animal damage to agricultural fields. Planting wheat and conventional crops is no longer economically viable due to the elevated risk of agricultural pest infestations and competition with Israeli occupation products. A complete shift in agricultural culture with no plantation diversification available would affect the soil and increase the risk of infectious disease spread. Traditionally, in the Palestinian culture, crops are irrigated mainly with rainfall. To avert future environmental, human, and agricultural land disasters, the methods must be thoroughly tested. Moreover, global warming is having a significant impact on the region of Beit Dajan, which is predicted to experience greater drought in future decades. Research in the area includes examining which trees can thrive in the location and what diversification planting plan should be implemented.

Agriculture in Beit Dajan, and in the OTP, is not heavily industrialized, but rather still carried out with the use of rudimentary tools and the cooperation of all family members. Palestinians have a strong relationship with the land, and it is a family activity in which all members of the family participate in planting, irrigation, and harvesting.

During long days of work and harvest season, meals are prepared and shared on agricultural property or sent by Palestinian families living elsewhere. The olive harvest is a national holiday celebrated by family members. The *Ouneh* method is linked to agriculture in historic Palestine, a source of pride for Palestinians as part of their rich legacy. In times of construction or harvest, *Ouneh* refers to humanitarian assistance and support. The *Ouneh* concept in the West Bank holds social and cultural activities and perspectives that are difficult to change as they are rooted in the culture. In the case of Beit Dajan, heritage proved to be more powerful than new restrictions for working on agricultural lands, taking into account health precautions. It is then important to explore the perceptions and attitudes that local people have towards treated wastewater in agriculture before proposing or evaluating any policy in this area.

2. Methodology

This research aimed at exploring local stakeholders' perceptions and attitudes towards treated wastewater in Beit Dajan, West Bank, in order to provide multi-layer recommendations (from policy to community practices) for improving local agricultural production and food security. Given the exploratory nature of the research, which aimed at stimulating the exchange of opinions and facilitating the elucidation of the perceptions of the local population and policymakers towards the issues mentioned above, a qualitative methodology was chosen.

Initially structured around in-person fieldwork trips to Palestine, the research had to be significantly redesigned due to the COVID-19 pandemic, forcing the European-based research team to outsource the conducting of interviews and focus groups to a local team on the ground. The initial team, composed of researchers in the Sociological field, then welcomed three professionals with backgrounds in Water and Environmental Studies, Agricultural Heritage, and Development Studies, already working on comparable funded projects in the West Bank. One of the added values of this collaboration was that it allowed us to collect data directly in the local languages and only subsequently translate them into English for analysis.

Different methodologies have been adopted in order to capture a broader range of people's perceptions and attitudes toward TWW.

As a first step, a literature review was conducted on the impact of the reuse of treated wastewater on agricultural production and food security, and on existing scholarship on environmental justice and water management in the West Bank.

Secondly, 6 semi-structured interviews with key informants - 2 farmers, 1 lemon trader, 1 representative of the Village Council, 1 representative of the Ministry of Agriculture (MoA), 1 represen-

tative of Palestinian Water Authority (PWA) - were conducted. Semi-structured questions were adopted in order to allow participants to explain in greater detail their opinions and perceptions of treated wastewater and to better explore the other factors that influenced their attitudes towards it.
In addition to interviews, two focus groups were conducted: the first with 10 members of the village (end-buyer of fruits produced with treated wastewater), all women; the second with 20 members of the Farmers' User Association, all men. The Farmers' User Association is formed by a group of farmers in Beit Dajan that intend to benefit from the treated wastewater in their village and reuse it in irrigating suitable crops. The association is responsible for managing the water irrigation network connected to the wastewater treatment plant in collaboration with Beit Dajan Village Council and by an *ad hoc* treated water tariff system that will financially complement the operation and maintenance of the wastewater treatment facilities by the Village Council.
Focus groups questions revolved around participants' general and technical knowledge about TWW, TWW user's acceptance, local agricultural production methods, food processing and consumption practices.
Interview' questions revolved around local irrigation methods and their impacts, management and water governance, food quality control, concerns, experiences and opinions towards TWW use.
Both focus groups and interviews were conducted between November 2021 and January 2022. Participants were recruited through a convenience sample, following the interest and willingness expressed by members of the local community in response to a call circulated to the Farmers User's Association. Interviews and focus groups were then transcribed, translated and thematically analyzed following an inductive process that allowed us to identify the core issues to be discussed.

3. Research results

Focus groups and interviews enabled us to identify three main factors that, according to local stakeholders, have so far prevented and sometimes continue to prevent TWW use from being adopted successfully: mismanagement of the treatment unit; misleading (or lack of) information; and socio-cultural and religious aspects.

3.1 Mismanagement of Treatment Unit

The Palestinian Water Authority (PWA) and non-governmental organizations (NGOs) are the main supporters of the West Bank's water and sanitation sector, with projects mostly supported by international funding. Al-Bireh, Ramallah, Jenin, Tulkarm, East and West Nablus, and Jericho are among the West Bank's seven centralized urban wastewater treatment facilities. The creation of a treatment unit and the support to use TWW in agriculture, as well as its sustainability and quality, is fully dependent on funded projects implemented by different stakeholders over a short period of time. Our interviewees identify limited funding and no long-term plans as the main factors that prevent TWW use from reaching a satisfactory level of functionality. A representative of the Ministry of Agriculture explained:

> «Currently there are many treatment unit projects implemented in the West Bank each funded by a different NGO and with various objectives. Mostly TWW is reused for agricultural purposes, while TWW treatment level in occupied Palestinian territory does not allow many options» (Interview 3, December 2021).

A representative of the Village Council, farmer and financial officer, observed:

> «The treatment unit was first established with a project funded by the EU, but the initial design was not completed and the tertiary filtration was absent. Poor maintenance of the sections of TWW installed caused further problems. Different NGOs and INGOs provided support through small projects targeting different components and providing awareness on different topics. Overall, little continuity, sustainability and ownership was ensured leading to lack of general awareness in the community and technical problems with TWW units» (Interview 2, November 2021).

The Beit Dajan Village Council is responsible for the management of the unit, hiring qualified employees to manage the unit. The Village Council tends to collect money from the users so they can pay salaries and cover small maintenance issues. Each house pays up to 12 shekels (3,42 euros) per month. The economic situation in Beit Dajan does not allow an increase in fees payment. Therefore, the Village Council together with the PWA water office expected to plan a different strategy to ensure greater sustainability of the system and budget availability for its running and maintenance.
Many interviewees underlined the importance of periodical tests to measure the quality and efficiency of the wastewater treatment facilities as well as data and better communication and coordination between farmers and the Village Council for increasing awareness both among the farmers and the local community. Other studies conducted in the West Bank showed that TWW users feel local monitoring and oversight are insufficient (Dare and Mohtar, 2018).
The interviewees claim that a system is to be adopted for the work at the treatment unit. A small shop owner, farmer and land owner, and TWW user said:

> «I always had concerns about TWW quality where I don›t think there is good management at the treatment unit. [...] I visited the units at different times and found out that tests are not regular and are not even sent to laboratories to be checked so I decided to install another filter on the main pipe coming from the treatment unit as I have a significant need for water to use for irrigation» (Interview 1, November 2021).

Underlining the importance of not mixing rainwater with black water at the treatment unit, a member of the Village Council observed:

> «We have a major issue of flooding during wintertime and rainy days. Sewage water mixes with rainwater and the treatment unit pools cannot handle this huge amount of water which causes flooding into nearby agricultural lands» (Interview 2, November 2021).

Many interviewees stress the ambivalent value of depending on international organizations (European, American, United Nations, and so on) for funding TWW units. The reliance on external international funding has contributed to the work of Palestinian governmental institutions (such as the Palestinian Water Authority, the Environmental Quality Authority) as well as Palestinian academic institutions (universities and research centers) which has helped tackle various elements relating to the use of TWW (geopolitics, technicality, finance, socioeconomics, climate change, public health, culture, etc.). Nonetheless, different donors with divergent aims and strategies are perceived as setting up plans that are not sustainable in the long run.

3.2 Misleading and inadequate information

During focus groups and interviews, most of the participants expressed satisfaction with the wastewater treatment unit's functioning as a solution to a key difficulty the hamlet faced with sewage water. However, they underlined that the local community, especially farmers, have a

lack of awareness and inadequate information regarding the use of TWW in agriculture. Farmers are not well-informed about plantation, irrigation, fertilizers, and economic feasibility in investing in agriculture and most importantly the consideration of health precaution in the use of TWW. This lack, as noted by a representative of the PWA, is made even more complicated by employee turnover and the hiring of unqualified personnel, both of which can lead to the treatment units being damaged.
The Water Council highlights how important it is to train employees who work in treatment units, and that it is their responsibility to do so through study tours to local treatment units in Jordan and Spain. A member of the Village Council explains:

> «Each of the field programs featured a milestone for raising awareness. We posted posters on the Village Council walls for everyone to read, and we held lectures on many topics» (Interview 2, November 2021).

In relation to daily practices, participants reported that there was an outright rejection to utilize TWW for agriculture at first, particularly from individuals who lived on or near agricultural grounds. Elderly participants, particularly, during focus groups, refused to accept that TWW can be used and is used in irrigation. As a housewife said:

> «Despite the fact that our land is so near to the treatment unit, my mother refused to use TWW to irrigate trees on our land, and this costs us a lot of money to bring fresh water trucks and irrigate olive trees» (Focus Group 1, November 2021).

However, following the success of a few farmers with their plantations and new companies, the majority of the farmers petitioned the Village Council to have access to TWW for agriculture.
During focus groups' discussion, we observed that the users' organization had no technical grasp of the wastewater treatment process or the health precautions that need to be followed while utilizing TWW for agricultural uses. Farmers and the surrounding community have been asking for additional information on how to assess water treatment levels, if it is safe to use treated water, what kind of trees may be irrigated with TWW, and whether it is safe to eat fruits from TWW-irrigated trees.
Farmers who took part in tours and talks on the topic of TWW usage for irrigation expressed a strong desire to engage in agriculture in the use of TWW because of the foreseen advantages and lower costs envisaged. Some farmers are very interested in using TWW in agriculture whereas others are quite opposed, and the different attitudes between the two appear to be related to the amount of knowledge they have been able to acquire on this topic and the experience they have already had in the use of TWW.
Farmers do not take health and safety precautions into account when utilizing TWW on agricultural grounds. Rumors have been circulating in the hamlet and during interviews about how people water their vegetables with black, untreated water, which is illegal under Palestinian law:

> «There is no full understanding of the risk of TWW to irrigate veggies or even water grass surrounding the house on which children play» (Focus group 2, December 2021), explained a farmer.

The spokesperson from the Ministry of Agriculture emphasizes how harmful this might be in the long run. The Ministry of Agriculture has been sending alerts to the Beit Dajan Village Council to take action against persons watering vegetables using black water. Participants do not have the knowledge on how dangerous TWW may be if precautions are not taken. The first projects on TWW have been focused on the importance and encouragement of TWW consumption without emphasizing its proper use and hazards.
Resistance arose as a result of new changes in the area, such as the adoption of new agricultural techniques that differed from what was previously practiced. The more they learn about TWW,

the more confident they are that it can be used in agriculture. Nonetheless, work must be done to improve trust in the current system, such as how many of the required tests are performed on the plant's TWW, what methods are safe to apply, and so on.

«Usually, I have a hard time finding labourers to cultivate the land since trees are irrigated with TWW, or so they think» (Focus group 2, December 2021), farmer of the users' association.
Another farmer interviewed answered:

> «It is not because of TWW they refuse to work at your place but because the rates for working in agriculture are very low in addition to the hard work that is required in comparison to working in the city» (Focus group 2, December 2021).

All of the aforementioned variables contributed to spreading inaccurate information about the safe use of TWW to consumers and the local community. One of the farmers interviewed declared:

> «He was the one who persuaded me not to use TWW, but now I'm thinking about using it exclusively to irrigate olive trees» (Focus group 2, December 2021).

3.3 Religious, social and cultural aspects

It is an integral part of Palestinian culture and inherited customs to reuse water till the last drop due to water shortages. Water from the kitchen sink or bathroom sink/shower, as well as water from the laundry, is collected and utilized to clean the outside spaces and water the trees in the garden. A woman in the focus group declared:

> «Up until today, my husband linked the kitchen sink and bathroom shower and sink to a particular conduit with water used to irrigate garden plantation» (Focus group 1, November 2021).

Despite the sensitivity of the issue, little attention has been paid to the study of socio-cultural (religious) viewpoints. Several *Fatwā*[6] have been expressed by Saudi Arabia and local *Sheikh*[7] allowing the use of TWW in agriculture in the West Bank, according to the representative of the Ministry of Agriculture, as well as farmers interviewed. The Sheikh's invaluable contribution made it easier for TWW project partners to work in the field, providing much-needed infrastructure and public awareness campaigns. According to the representative of the Ministry of Agriculture, the problem was fixed from the start through *fatwas* given by Muslim holy men in Nablus and Saudi Arabia:

> «I don›t see why TWW shouldn›t be used in agriculture. Farmers and landowners are also pleased with the price reductions, as they have received TWW for free up until now and have reduced fertilizer payments» (Interview 3, December 2021).

Since 2012, one of the Beit Dajan farmers has been using TWW to water almond and lemon trees and has petitioned the Nablus Sheik for *ifta*[8] on the use of TWW to irrigate olive trees. When questioned why he chose olive trees in particular, he explained that they are sacred plants referenced in the *Quran*, thus he had concerns prior to obtaining religious approval.
A farmer confirmed the concern:

6 *Fatwā* is a nonbinding legal opinion on a point of Islamic law given by a qualified jurist in response to a question posed by a private individual, judge, or government.
7 *Sheikh* is a man authorized to teach, initiate, and guide aspiring dervishes in the Islamic faith.
8 *ifta'* means elucidating an unknown legal ruling on a certain issue with the aim of conveying its legal ruling.

«I planted and irrigated grape and lemon plants with TWW directly after being convinced and even given trees to grow by one of the programs. Nonetheless, I did not use TWW to irrigate my olive trees until I received a *fatwa* from a *mufti* in Nablus, as olive trees are considered sacred trees and are referenced in the Holy Quran» (Focus group 2, December 2021).

In the focus group, several women expressed concerns about consuming TWW-watered items: they referred to TWW-watered products with the word "*Betsed AlNafs*", a cultural expression meaning you no longer have the appetite to eat something.
There also seemed to be a difference in attitude towards TWW-watered products depending on whether they are bought or offered.

«Relatives and neighbors never purchase from me» declares a farmer «but they don›t mind eating the fruits I give them as a present». He added: «Because I utilize TWW in my land, which I visit regularly, I have never had any social difficulties with the people in my community. People desire products as gifts, therefore my wife constantly gives out lemons and grapes to her neighbors, who are aware that it is irrigated with TWW» (Focus group 2, December 2021).

The fact that fruits are irrigated with TWW is not indicated in the market. Nevertheless, more than 93 percent of Israeli agriculture water is treated, thus the Palestinian population in the West Bank should be aware that they have been eating fruits and vegetables grown on trees and plants watered with treated wastewater. Instead, they attempt to dismiss the idea. Farmers and dealers tend to avoid disclosing that the fruits were grown with TWW, and women avoid asking questions: «I'd rather not know that the crops are irrigated with treated water» (Focus group 1, November 2021), one woman in the focus groups remarked, adding that she buys fruits and vegetables considering shape and price evaluations. On the contrary, other women from Beit Dajan expressed being proud to have a treatment unit in the community and to be more inventive in this regard compared with women from neighboring villages.
Working with and travelling to agricultural fields in Israel irrigated with treated wastewater, as well as introductory visits from farmers and traders, helped to garner an understanding of the system and make significant advances in (welcoming) the business. According to a senior and former teacher:

«I was involved in several initiatives related to TWW and agriculture since I am highly educated and had the time after I finished teaching. I went to observe other treatment centers in the West Bank and Israel with the Ministry of Agriculture and learned a lot. The program combined lectures and field trips in one visit to Nazareth to better grasp the idea and how treatment works in one location, and the engineer swam in the treatment pool to demonstrate how pure the water was» (Focus group 2, December 2021).

4. Concluding remarks

As a result of the peasant majority in the West Bank and the Levant, local populations place a high value on land protection, seeing it as a need and duty, especially after the loss of land and ongoing occupation by Israel. This value was passed on despite the neglect of agriculture owing to water scarcity and globalization, which drove more people out of their villages in search of work in cities. As a woman denounced during a focus group:

«Agriculture in the village has diminished in recent years owing to a lack of water. Not every household has the financial means to purchase freshwater to irrigate their plants» (Focus group 1, November 2021).

Nonetheless, the connection to the land and the process of agriculture using traditional methods are still present and expressed through songs and sayings such as "أكضرع كضرأ", meaning

«your land is your honor». The research project we conducted in this area was invested by unexpected issues and obstacles that led us to have to modify original assumptions and research strategy. Firstly, as the research was conducted during the global COVID-19 pandemic, the research team was forced to conduct research remotely in the case-study country instead of via in-person fieldwork trips. This situation precluded a first-hand exploration of the environmental and social context of analysis and the investigation of spontaneous issues that arose during interviews. Secondly, while in-depth interviews helped to achieve important results, the sample size is still somewhat small to be considered representative and insufficient for results to be generalisable. Thirdly, there may have been "lost in translation" issues, especially related to the linguistic equivalence of original words with their cross-cultural translation, as the interviews were carried out in Arabic and we analyzed them in English. For the same reason, we preferred not to over-interpret the perceptions that emerged with reference to the socio-cultural and religious aspects that mediate the use of treated wastewater. We are aware, for example, of the deeply cultural aspects that exist with respect to the conception of purity or pollution of objects such as wastewater (Douglas, 1966), but we have not been able to explore these dimensions within this research. These aspects would be interesting to explore in future research.
Participants in focus groups reported some religious, cultural, or social concerns in the application of TWW in agriculture. However, these barriers do not seem to be an obstacle to the use of wastewater or the purchase of products treated with it. The Palestinian population is not fully aware that they have been ingesting fruits and vegetables irrigated with TWW of various treatment levels for some time, and this is a common claim made in interviews and focus groups:

> «I buy veggies and fruits based on the quality of the product and never think about how they were produced, not even irrigation with TWW» (Focus group 1, November 2021), one woman remarked in the focus group.

Most of the interviews, focus groups and workshops revealed a lack of awareness and understanding about the use of treated wastewater in agriculture among the local population, particularly among farmers. Farmers are not guided in terms of planting, irrigation, fertilizers, economic feasibility in investing in agriculture, and, most significantly, health precautions while using TWW. More awareness is needed on methods on how to maintain and sustain the treatment plant. Lack of accurate information is one of the three major factors that appear to prevent TWW use from being adopted successfully. A second factor is the mismanagement of the treatment unit, as the establishment of a treatment facility and support for the application of TWW in agriculture is entirely reliant on well-funded projects completed in a short period of time. The research emphasizes the necessity of professional assistance in developing knowledge on the use of TWW in agriculture as well as in an effective wastewater treatment plant management system. Interviews with farmers of the user association underlined the need for learning from the success of other farmers' organizations recently created in the West Bank and training in order to organize and administer themselves.
Finally, focus groups stress the importance of taking into consideration perceptions, attitudes, and other cultural aspects of the end buyers: the local community.
The usage of TWW encouraged landowners to return to their grounds and grow trees instead of relying on rain for crops, increasing the value of the lands and deterring urbanization of agricultural regions. Few landowners began fruit-growing enterprises and found them to be lucrative. The research emphasizes the necessity of learning more about how TWW may be used to irrigate agricultural areas and develop small companies in relation to the planted area. As we have seen throughout the words of the interviewees of this study, it is essential to raise awareness of safety and health precautions for TWWs, as well as to provide guidance measures regarding agriculture. International NGOs and local institutions may be able to work to establish new treatment units, but for the cultivation of fruits and vegetables, it is essential to cultivate awareness of the field.

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