
Public knowledge of seawater desalination and its impacts on the environment in Gaza strip, Palestine

Saleh Aldaghma* and
José Luis Sánchez Lizaso

University Institute of Water and Environmental Sciences,

University of Alicante,

San Vicente del Raspeig s/n, Alicante, Spain

Email: salehalda17@gmail.com

Email: jl.sanchez@ua.es

*Corresponding author

Abstract: This research assesses public awareness and knowledge about seawater desalination and its impacts on the environment in the coastal area in the Gaza strip, Palestine. In addition, the study investigates how socio-demographic, motivational factors, and information use shape public knowledge. Data was collected using a survey from a random sample of the residents who live in Dier Al balh City in the Gaza strip. Both People's self-assessed knowledge and factual knowledge indicators about desalination and its impacts on the environment were poor. Furthermore, it was found that people who were more connected with their place showed high awareness. Information resources indicate a low relation with self-assessed knowledge and awareness and lower with factual knowledge.

Keywords: desalination; water crisis; awareness; knowledge; environment; Gaza; Palestine.

Reference to this paper should be made as follows: Aldaghma, S. and Lizaso, J.L.S. (2021) 'Public knowledge of seawater desalination and its impacts on the environment in Gaza strip, Palestine', *Int. J. Global Environmental Issues*, Vol. 20, No. 1, pp.18–41.

Biographical notes: Saleh Aldaghma is a PhD Researcher in water and sustainable development at Alicante University. His main research focuses on the history of water and how society can achieve sustainable water resources.

José Luis Sánchez Lizaso is a Professor and President of the Scientific Forum for Spanish Fisheries in the Mediterranean, and member of the Scientific Council of the Spanish Committee of the MaB Program. He is also the Scientific Director of the Master in Sustainable Fisheries Management. His lines of research have focused on the study of marine ecosystems, the impacts of human activities on them, and the management of living marine resources. José has also advised numerous entities and companies on reducing the effects of human activities on marine ecosystems and the sustainable management of resources.

1 Introduction

Many people participate in activities and behaviours that may have contrary natures and adverse effects on the environment and coastal areas. Thus, Public knowledge and environmental awareness are important issues for both society and the environment. In particular, public knowledge about the environment and its resources is necessary since it represents the quality of activities and behaviours that increase or decrease negative and positive impacts on the environment. Furthermore, the importance of environmental awareness and knowledge initiates from the fact that it is a political pressure tool for decisions and legislation related to environment protection, especially the coastal areas where many different projects may lead to harmful consequences.

Therefore, coastal populations can influence decision-makers and decision-making processes if they have the right tools. Thus, people should be aware of environmental issues if they want to participate in discussions about their territory and environment in an informed manner. Recently, the Palestinian water authority (PWA) emphasised the importance of public environmental awareness to citizens to become a helpful assistant in developing and managing areas at risk of environmental degradation. Assessing public knowledge and identifying factors that increase knowledge and awareness is critical to identifying misconceptions, knowledge gaps, and less-known societal categories. This assessment necessarily leads to improved ways of communicating information to people, making them more aware of the problems that threaten their regions and increasing their participation in changing environmental policies.

Research on public knowledge about the environment, desalination, and coastal areas is quite limited globally and in Palestine. Various studies have investigated environmental knowledge among students and the influence of attitudes towards the environment (Aminrad et al., 2013; Cruz and De La Vega 2004). In general, studies on public knowledge have investigated awareness of coastal and marine environmental issues and the influence of the nearness of residence to the sea, the use of information sources, environmental values, and socio-demographic variables on knowledge about the ocean. (Snider et al., 2010) (Duda et al., 2007)

A study by (Heck et al., 2016) examines coastal residents' awareness and knowledge about the impacts of seawater desalination on marine ecosystems in Carlsbad, California. The study explored to what extent socio-demographics, motivational factors, and information can shape people's literacy about seawater desalination and its impacts on marine life. Other studies investigated people's literacy about the ocean and how it could influence their behaviour. The most comprehensive study of public awareness of coastal area issues was conducted by (Fletcher et al., 2009), where the study examined the levels of people's knowledge about ocean issues. The study included a questionnaire for 1,233 people from the American public of different regions. The study found that people living in coastal states have higher self-knowledge of ocean issues and coastal policies and excellent knowledge of the ocean and coastal management terms, which also showed that their performance was better in ocean investigation issues. In addition, the study found a clear relationship between the location of residence and the extent of awareness and knowledge of ocean issues.

In Palestine, there were limited case studies investigating the environmental role of media and sources of information. Besides, there were some studies on general environmental problems with different causes. Although many studies investigated desalination, none of them have investigated the public knowledge on desalination's

impacts on the environment (Aish, 2011; Al-Agha and Mortaja, 2005; Alazaiza, 2013; Bashitialshaer et al., 2012; “Desalination in the Gaza strip: drinking water supply and environmental impact,” 2005; EIB, 2016; Chakli, 2013; Ismail, 2003; et al., 2017).

1.1 Public knowledge and awareness

Although awareness and knowledge are two different words that might be used interchangeably in closely connected contexts, there is a definite distinction between them. Awareness could be considered perceiving, knowing, feeling, or attentive to events, objects, thoughts, emotions, or sensory patterns. While knowledge refers to facts, data, and skills, none heritable through expertise or education (Clayton Littlejohn, 2014). The critical distinction between awareness and knowledge is that knowledge is related to deep understanding and familiarity with an issue, whereas awareness does not imply a deep understanding.

The Oxford dictionary defines awareness as ‘knowledge or perception of a state of affairs or truth.’ Merriam-Webster defines awareness as knowing, feeling, experiencing, or noticing a state of affairs, condition, problem, sound, sensation, or emotion. Awareness can also be a standard knowledge or understanding of a couple of social, scientific, or political issues. Other scholars define awareness as the individual perception of what surrounds him comprehensively, or it is the status when the individual reaches the level to judge the forms of events that affect his/her life, either external or internal events. Furthermore, psychologists say that awareness is the individual’s consciousness, whether abstract or concrete. According to these definitions, awareness can focus on an internal state, such as feelings, emotions, or external events by sensory perception or the state or condition of knowing consciousness. As a result, humans can understand and assimilate the surrounding situations, making them realise their role in behaving towards circumstances. However, awareness is not the same as knowledge. Awareness merely refers to an understanding of general information facts.

The philosopher Plato has defined *knowledge* as justified true belief, though; this definition is problematic by many analytical philosophers (Boghossian, 2010). According to their interpretation, the individual gets knowledge about subjects through direct experience with objects by questioning or absorbing interest and information about the specific event from others through dialogue, discussion, listening, or through the media (Druckman, 2005). Thus, knowledge refers to familiarity and understanding of somebody or something like info, facts, and skills acquired through expertise or education. It can be each practical and theoretical understanding of a subject matter (Hrachovec and Pichler, 2008).

The acquisition of knowledge about the environment varies among people, as explained by Lovrich and Pierce (1984). It depends on many factors; this variation is called the *knowledge gap*. There are many theories stated to explain the *knowledge gap*. Two of the most spread theories that explain the difference between people’s literacy about the environment are *trans-situational variables* and the theory of situation-specific variables.

The first theory hypothesizes that racial and economic characteristics, education degree, and income impact knowledge. These elements have been found strongly related to environmental knowledge in developed countries such as Canada and the USA. Other studies also found that sex and age were significant influencing factors (Soden and Steel, 1999; Delli Carpini and Keeter, 1996; Thai et al., 2017).

The other theory hypothesizes environmental literacy; the knowledge acquisition and the degree of awareness diversity can be increased irrespective of a person's socioeconomic status due to context- specific variables such as having a stake in a policy outcome, living near the coast; and place attachment (which is the central concept in environmental psychology that describe the emotional bond between person and place). Place attachment is highly influenced by individual and personal experiences (Scannell and Gifford, 2010). Hence, people become more aware of the place's environmental aspects representing their personality, identity, and social connectedness (Delli Carpini and Keeter, 1996; Ettema and Kline, 1977).

Assume that, if there is a low level of knowledge within these cells, it is easy to identify the required niche for making campaigns to increase awareness and knowledge (Steel et al., 2005).

In addition to the factors above, information sources, especially media, play an essential role in increasing knowledge about the environment or reducing the knowledge gap. The media should diversify its mechanisms to protect the environment, preserve the quality of life, alert against potential hazards, protect biodiversity, stop interfering in its balance, and expose those who pollute the environment and destroy it in various ways. It should also motivate the public to actively participate in environmental care by encouraging people to work and engage in dialogue, sending their opinions with a strong message to the government, leading people to be a helpful decision- making tool. Likewise, we should consider the importance of social media, which carries more influence since it does not wait for editorial policy or censorship of the content, and it is the right tool from people to people.

1.2 The purpose of the study

This paper depends on the existing literature and presents the results of a survey of public knowledge that strives to investigate knowledge and awareness of Gazans coast residents about seawater desalination and its impacts on the environment. The study investigates the socio- demographic variables that affect public knowledge, to what extent motivational variables affect knowledge, and how information resources, including government agencies, affect people's knowledge about desalination and the environment. Finally, the article motivates people to increase their environmental knowledge, leading to positive behaviour towards the environment. This study is essential since it is the first study in the Gaza strip that investigates public knowledge about the harmful side of desalination.

1.3 Desalination and its impacts on environment

Desalination is extracting salts and other minerals from water (Lattemann et al., 2010). Desalination may include different sources such as brackish water, wells, surface water (rivers and streams), industrial water, and seawater.

Seawater desalination is a reliable resource to produce enough potable water to support the significant population growth globally; it is also an acceptable solution to overcome the water crisis, especially in drier areas like Palestine. Currently, approximately 1% of the world's population is dependent on desalination water to meet daily needs (Pinto and Marques, 2017). Many reports from the United Nations expect that 14% of the world population will use desalination as the leading water resource.

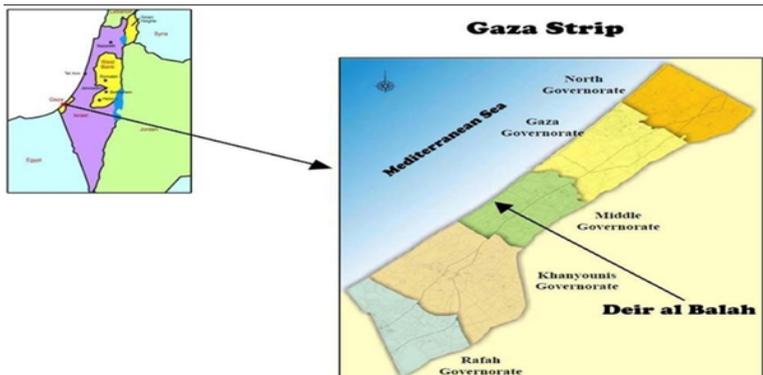
Equally crucial to seawater desalination advantages is that it is more costly than fresh water from rivers or groundwater due to its high-energy consumption production process. Also, the desalination process poses undesirable environmental impacts in energy consumption, land use, and seawater intake, but particularly the most significant impacts are related to effluent disposal and discharge (Fernandez Torquemada et al. 2019). The effluent characteristics depend on the feed water and desalination technology used. Potential impacts may be monitored and mitigated (Sola et al. 2020).

1.4 Study area

Gaza Strip is located on the eastern coast of the Mediterranean Sea at (31 25 N, 34 20 E). The Strip borders are 'Israel' on the south, east, and north and Egypt on the southwest. It is about 41 kilometres long and between 6 and 12 kilometres wide, with a total area of 360 Km². The Strip comprises five governorates: North Gaza, Gaza, Deir El-Balah, Khanyounis, and Rafah.

The study area is Deir El-Balah City, where the Deir El-Balah Seawater Desalination Plant is located; in 2016, the PCBS estimated the population of Deir El-Balah to be 72,409 inhabitants (Palestinian Central Bureau of Statistics (PCBS), 2009; Agha, 2006).

Figure 1 Deir Al-Balah in the Gaza strip (see online version for colours)

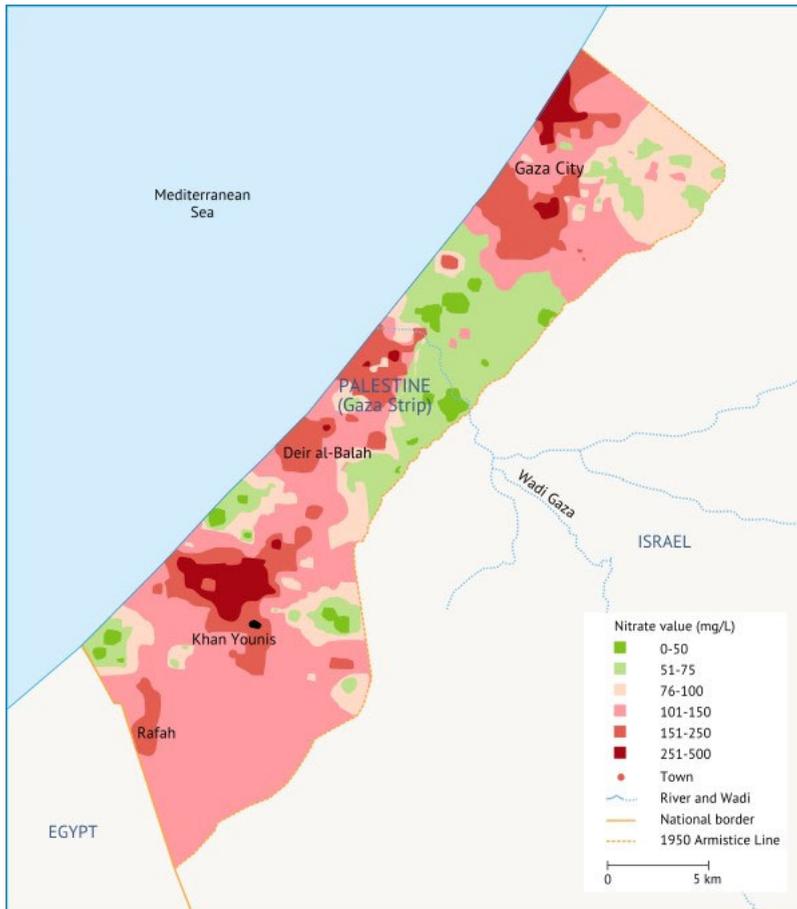


There is little access to safe drinking water in Gaza. In 2014, less than 11 percent of Gaza residents had access to safe drinking water through the public network, compared to 97 percent in the West Bank. Water access in Gaza may have worsened since then. According to a 2016 report by the Palestinian Water Authority, the total water supply in Gaza for domestic use, including drinking, cooking, and bathing, was 95.3 million cubic meters in 2015, compared to 119.6 million cubic meters in the West Bank. Almost half of Gaza's population receives water for domestic use for only 8 hours every four days; another third receives water for 8 hours every other day (Al-Shalalfeh et al., 2018). As a result, 90 percent of the population relies on water tanks and containers. Water limitations have led to a decrease in water consumption and hygiene standards.

According to United Nations reports, unsustainable water use poses a severe threat to the source's long-term availability. In the Gaza coast, groundwater levels decrease, water infiltrates from the near Mediterranean Sea, and nitrates from sewage and fertilisers from farmlands irrigation combine with the pollution of the aquifer. The Palestinian Water

Authority states that about 98% of the total groundwater in the aquifer of the Gaza Strip is of poor quality and unfit to drink according to the World Health Organisation standards. As pumping increases, the aquifer becomes more degraded, and the saltwater encroaches into the aquifer (PWA, 2015).

Figure 2 Nitrate concentrations in the Gaza strip in 2009¹ (see online version for colours)



Note: The internationally accepted guideline for nitrate in drinking water is 50 mg/L.

Source: Palestinian water authority (2013)

To overcome the water crisis in Gaza, UNICEF, with support from the Arab Gulf and the European Community, led a project to develop Gaza's largest seawater desalination plant. The plant was formally inaugurated on 19 Jan 2017; however, it was running solely on a partial basis powered by emergency fuel funded by the Humanitarian Fund by the end of February. In the beginning, it produced 6,000 cubic meters of desalinated water daily, with a projected target of more than three times this volume (approximately 20,000 cubic meters a day), serving 275,000 individuals in Rafah and KhanYounis with ninety liters of safe potable per capita per day (Jāmi'ah al-Islāmiyah (Gaza) and Ghabayen, 2017).

2. Methodology

2.1 Introduction

The research assessed three indicators to examine people's knowledge and awareness. These indicators are:

- 1 'Public awareness' of the desalination plant and the impacts on the environment
- 2 'People Self assessed-knowledge' of desalination impacts on the environment
- 3 'Factual knowledge' of desalination and the impacts on the environment

The variation between people's *Self-assessed-knowledge* and factual knowledge is vital since there is a big difference between what people believe they know and the fact. *Self-assessed knowledge*, which refers to what the individual believes and knows about the object, is measured by evaluating what a person believes he or she knows about desalination and the environment. On the other hand, *factual knowledge* refers to the real facts about the object, is measured by evaluating if a person knows the correct answers to specific knowledge questions regarding desalination (Boghossian, 2010; Heck et al., 2016; Steel et al., 2005; Needham et al., 2016).

2.2 Survey

The questionnaire is one of the widely used tools that have been usually used in order to collect quantitative information. There are two simple classified rules for success in designing questionnaires and conducting surveys: firstly, choosing the right people, and secondly, having the right questions to ask them. The excellent design of the questionnaire is the key to obtaining good results and achieving a high return rate. Further, the most critical factor of a successful questionnaire is selecting the right people (McNeill, 1990).

The study questions were selected to support the subjects of the main study objectives. Therefore, the questionnaire was designed in Arabic so that the target population could easily understand it. Similar to public awareness research, the questions within the questionnaire were obtained from different articles and similar studies, especially those investigating public knowledge about marine life (Needham, Cramer, Johnston, et al., 2016; Steel et al., 2005; Heck et al., 2016).

The questionnaire was distributed between November 2017 and February 2018 in two stages: *the pilot study evaluated the clarity of the questionnaire and optimised the techniques*. During the pilot study 50 questionnaires, were distributed randomly. It was used to get feedback on the reading level, understanding of each question, and the completeness of the instrument. At the end of the pilot study, a revision and necessary modifications were done on the questionnaire. *The second stage* was the distribution of the questionnaire, considering that response distribution is 30%. Questionnaires were sent manually for the random sample of 900 households randomly selected from the *Deir al-Balah* Municipality records. The total respondents were 289, then achieving a 32.1% respondent's rate. This response rate is consistent with surveys asking the public about natural resource issues (Needham et al., 2016; Vaske, 2008).

2.3 Questionnaire contained

- 1 Closed question on people's 'awareness' with a yes/no choice asking about awareness of desalination plants and their impacts.
- 2 Rating questions on the level of 'Self-assessed-knowledge,' which were measured on a '5-point scale' from 0 'Do not know' 5 'Very high level of knowledge.'
- 3 'Factual knowledge' was tested based on a list of 13 knowledge items. The items were listed as statements, and people were asked to reply with 'Agree,' 'Disagree,' or 'Do not know' for each item.
- 4 Independent variables include 1. Socio-demographic information on gender, 2. Level of education, 3. Income, and 4. Age. Table 1
- 5 Motivational variables include 1. The frequency of undertaking five beach activities (fishing, swimming, meditation, viewing, beach walk) in the area, which were measured on a '5-point scale' from 0 'Never' to 5 'Almost every day.' (Table 2) 2. Place attachment variables were measured based on five items. These variables were measured on a '5-point scale' from 0 'Strongly disagree' to 5 'Strongly Agree.' Table 3
- 6 Information source: Based on 14 different sources of information, people were asked how frequently they use these sources to know about desalination and its impacts on the environment. '3-point scale' from 0 = Low to 3 = High was used to measure this part.

The SPSS program was used to analyse the data. The results are presented in tables and figures, depending on the mathematical analysis needed. Besides, a written description outlines the three leading indicators and how they are affected by different factors.

Table 1 Socio-demographic profile of people in our study (N = 289).

<i>Variable</i>	<i>Coding</i>	<i>Sample percent</i>
Income (monthly\$)	< 100 (1)	15.2%
	100–200 (2)	47.4%
	>200 (3)	37.4%
Age	18–35 (1)	51.9%
	36–65 (2)	32.1%
	> 65 (3)	15.0%
Level of education	Less than high school (1)	9.5%
	High school (2)	29.2%
	Undergraduate (3)	43.9%
	Postgraduate (4)	17.4%
Gender	Male (1)	59.9%
	Female (2)	40.1%

Table 2 Description and reliability analysis of sea use (N=289)

Variable	Average	SD
Swimming	2.26	0.828
Fishing	1.52	0.812
Beach sport	2.01	0.888
Meditation	2.81	1.024
Beach walking	2.53	0.841
Sea use	2.228	0.546

Note: Measured on a 4-point scale from 1= Never to 4= Almost every day.

Table 3 Description and reliability analysis of place attachment (N=289)

Variable	Average	SD
This is the ideal place for me	2.96	0.758
This place is part of me	2.61	0.762
It would be tough for me to leave this place	2.56	0.836
I have nothing in common with this place	2.62	0.886
I do not feel integrated into this place	2.96	0.989
Place attachment	2.7412	0.48762

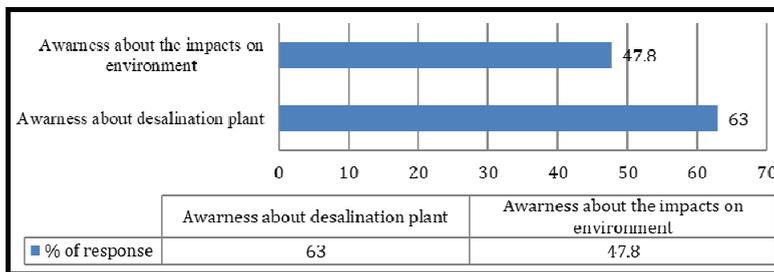
Note: Measured on a 4-point scale from 1=Strongly disagree to 4=Strongly agree.

3 Results

3.1 People awareness and knowledge about desalination and its impacts on the environment

For the first indicator (awareness about desalination plant and its impacts): Figure 3 shows a high percentage of the study respondents (63.0%) were aware of the desalination plant. In contrast, less than half of the respondents (47.8%) reported that they were aware of the impacts on the environment.

Figure 3 Awareness (% of respondents, n=289) (see online version for colours)

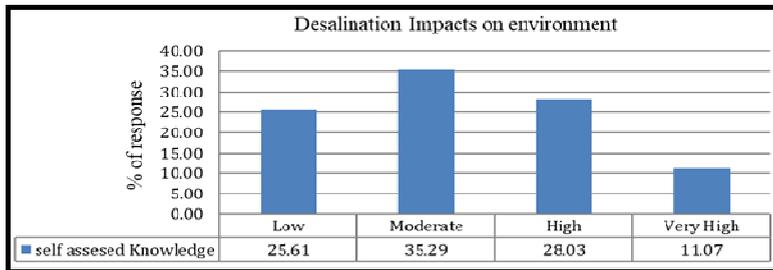


Note: measured on a 4-point scale from, 1=low, 2=moderate, 3=high, 4=very high.

For the second indicator (Self assessed-knowledge), respondents indicate moderate and low knowledge with 60.9%, and there was a percentage of 39.1% who have high and

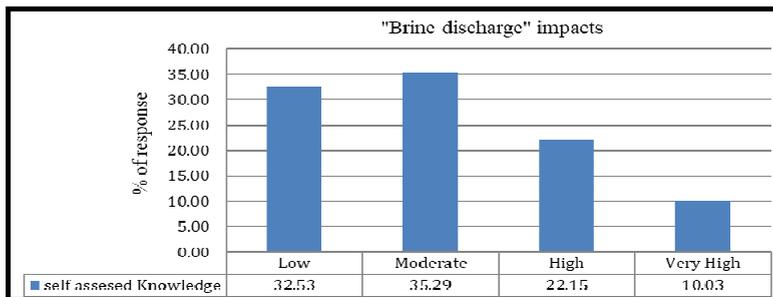
very high knowledge about desalination impacts on the environment (Figure 4). Also, Figure 5 shows *Self- assessed- knowledge* about the impact of desalination caused by *brine discharge*¹; respondents indicate moderate and low knowledge with 67.82%, and there was a percentage of 32.18% who have high and very high knowledge. From Figure 6, it is clear that there is a (moderate to high) *Self - assessed-knowledge* about water price, a moderate level of knowledge about desalination impacts on sea and environment and brine discharge, and a low level of knowledge about the energy required for desalination and desalination process.

Figure 4 Self assessed-knowledge about the seawater desalination impacts (see online version for colours)



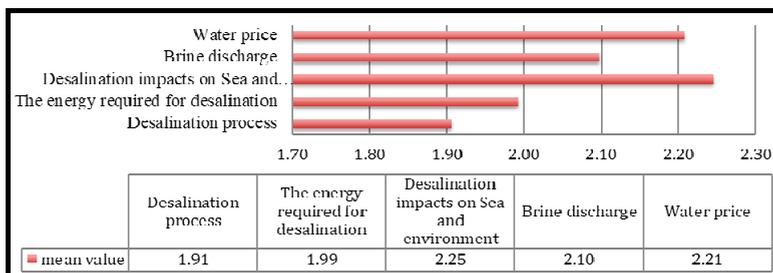
Note: Measured on a 4-point scale from 1=low, 2=moderate, 3=high, 4=very high level.

Figure 5 Self assessed-knowledge about 'brine discharge (see online version for colours)



Note: measured on a 4-point scale from, 1=low, 2=Moderate, 3=High, 4=Very high level.

Figure 6 Self assessed-knowledge about desalination elements (see online version for colours)



Note: Measured on a 4-point scale from 1=low, 2=moderate, 3=high, 4=very high level.

For the third indicator (Factual knowledge), Table 4 shows a low level of respondent's factual knowledge about desalination and its impacts on the environment. For most statements, the percentage of the correct answers was much lower than half (it varies between 20-30%).

For all 13 statements, the percentage of respondents who answered correctly was 31.88%. 47.4% of respondents answered correctly that seawater desalination is an expensive source of water, 44.6% that brine contains chemical additives, 43.9% that brine discharge can kill marine organisms and causes damage to the marine population. Besides, no one of the 13 statements had more than 50% 'correct answer' responses. Furthermore, respondents who answered 'Do not know' were higher for all statements than the number of incorrect answers. Therefore, respondents have preferred to answer 'Do not know' instead of giving a precise answer.

Table 4 Factual knowledge about seawater desalination and the environmental effects

<i>Variable</i>	<i>The right answer</i>	<i>% Answer corrects</i>	<i>% Answer wrong</i>	<i>% I do not know</i>
1 Desalination technologies are classified into three main categories	Yes	24.6	25.6	49.8
2 RO technology uses heat as the primary resource of energy	No	28.4	24.2	47.4
3 The main classification of desalination technology is dependent on the separation process	Yes	34.9	23.2	41.9
4 Desalinated seawater could be distributed directly to non-coastal customers using existing or new pipelines.	Yes	27.7	22.8	49.5
5 Seawater desalination is an expensive source of water	Yes	47.4	19.7	32.9
6 The brine contains chemical additives	Yes	44.6	15.9	39.4
7 The brine contains heavy metals (copper, zinc, and nickel)	Yes	31.5	26.6	41.9
8 The brine contains dead marine organisms	Yes	28.0	29.1	42.9
9 Brine has less salt than seawater	No	33.2	29.4	37.4
10 Brine is discharged directly to the sea	No	21.1	35.3	43.6
11 Brine is cooler than the receiving waters	No	26.6	20.1	53.3
12 Desalination process would lead to greenhouse gas emissions into the atmosphere	No	22.5	30.4	47.1
13 Brine discharge has the potential to kill marine organisms and cause damage to the marine population	Yes	43.9	19.7	36.3
Total (% average score)		31.88	24.77	43.34

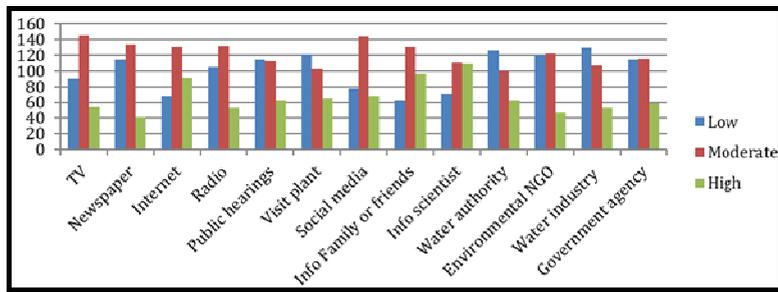
3.2 The information resources

Figure 7 shows the frequency of the information tools, which people use or trust to acquire knowledge about desalination. The majority of these resources were used moderately except for the water industry, water authority, government agency, and visit the plants were low.

3.3 Factors that affect people's awareness and knowledge

To indicate the relation between the different variables and people's awareness and knowledge and understand how much these factors affect people's knowledge, a correlation table (Table 5) was made between the different factors and the three indicators of knowledge.

Figure 7 Frequency of using information sources for learning about desalination



Note: The frequency of use is measured on a 3-point scale from 0 = never, 1 = low, 2 = moderate, 3 = high.

3.3.1 Socio-demographic factors:

Socio-demographic variables did not correlate with all the indicators except education, which correlated positively only with awareness indicator ($r = 0.216$, $p < 0.001$), suggesting that higher educational achievement increase awareness about the desalination plant and its environmental impacts.

3.3.2 Motivational variables and informational resources variables:

- For the first indicator (Awareness about desalination plant and its impacts), there is a high relation between awareness and the people bond with their place and frequency of use. Sea use and Place attachment correlated with awareness where ($r = 0.185$, $p < 0.001$), ($r = 0.195$, $p < 0.001$), respectively. Suggesting that people who have more ties with their area, their awareness about its problems increased. In contrast, information resources results have not shown a relation for all items, except public hearings ($r = 0.117$, $p < 0.05$). People who listen to others speaking about desalination indicated more awareness about desalination and environmental impacts than others who use different sources.
- For the second indicator (Self assessed-knowledge), there is a high relation with the frequency of use where ($r = 0.335$, $p < 0.001$), but there is no relation with the place

attachment. Therefore, people who do special activities at the seaside have shown a high Self assessed-knowledge than others about desalination and environmental impacts. In contrast, information resources did not record a high correlation with Self assessed-knowledge, except for the fact of visiting the plant ($r = 0.123$, $p < 0.05$) as people who visited the plant indicated a higher knowledge, as well as people who get information from friends ($r = 0.203$, $p < 0.001$). Public hearings ($r = .136$, $p < 0.05$) and social media resources ($r = 0.200$, $p < 0.001$) also indicate correlation with Self assessed-knowledge. Hence, these ways of getting information seem related to each other, especially in the Gaza culture, where people are socialized more.

- For the third indicator (Factual knowledge), none of the variables have a relationship with people's factual knowledge except people who read newspapers ($r = 0.133$, $p < 0.001$) who showed high factual knowledge.

Table 5 Non-parametric correlation coefficients among the 19 different factors and three knowledge indicators.

<i>Variables</i>	<i>Awareness A</i>	<i>Self-assessed knowledge B</i>	<i>Factual knowledge (# of correct answers) C</i>
Socio-demographic factors			
Gender	0.102	-0.091	0.003
Education	0.216**	0.001	0.060
Income	-0.109	-0.025	0.053
Age	0.043	-0.063	-0.008
Motivation factors			
Frequency sea use	-0.185**	0.335**	-0.024
Place attachment	-0.195**	0.041	0.025
Information source factor			
TV	0.029	0.052	0.078
Newspaper	-0.055	0.092	.133*
Internet	-0.028	0.098	0.112
Radio	-0.073	0.076	0.039
Public hearings	-0.117*	0.123*	0.022
Visit plant	-0.051	0.203**	0.019
Social media	-0.023	0.136*	0.071
Info from family or friends	0.038	0.200**	0.109
Scientists' info	0.011	0.070	0.071
Water authority	-0.032	0.172	-0.068
Environmental NGO	-0.060	0.071	0.007
Water industry	-0.081	0.094	-0.033
Government agency	-0.004	0.113	-0.008

Note: a combined awareness of desalination and impacts. (Figure 2), b self-assessed knowledge of the impact on sea 'environment.' (Figure 5) c number of correct answers in Table 4, ** Spearman's rho significance $p < 0.001$, * Spearman's rho significance $p < 0.05$.

4 Discussion

Knowledge is a reliable tool. On the first hand, it transfers individual consciousness to behavioural abilities, facilitating many tasks. Thus, raising knowledge calls for dialogue through which people will reach the policymakers, and the official parties will convey to the people what the government is doing to protect the environment. It also urges the public to exert pressure and engage in the planning process. Public engagement in environmental dialogue leads to the maturity of public awareness to preserve the resources of nature. Moreover, media and information sources are also an engine of creating public opinion to build practical trends and formulate legislation, proposals, and solutions.

On the other hand, knowledge, substantiality behaviours, and attitudes need more than ability alone; they also require high motivation levels. People should be motivated and have a passion for learning more about environmental issues. The role of motivations leads to push, influence, instigate and direct the actions that build environment-sustainable goals. Without the preferred motivation, even high knowledgeability or information sources will have little impact on behaviour. So, people who are motivated to engage in environmental learning and motivated to be positive members of society will significantly affect environmental behaviour.

The study examined Gaza's awareness and knowledge about a critical environmental issue, a desalination impact on the ecosystem. One of the main aims of the study was to shed light on the public knowledge of environmental problems and raise questions about how people could protect the environment in Gaza, which has already been degraded.

The main goal was to investigate which factors influence public awareness and knowledge. Those factors were based on: Personal and demographic factors, motivational factors, and learning and information sources.

Due to the lack of specialised studies in environmental awareness and environmental knowledge about seawater desalination impacts in Palestine, the comparison with similar indicators cannot be precisely determined. Nevertheless, using similar studies close to the study scope, it was acceptable to give sufficient interpretations of its results.

The results of the study were consistent with results in similar studies about public awareness of environmental problems that had been done in different countries in the world, taking into account the geographical, temporal, and conditional nature of Gaza, Palestine (Needham et al., 2016; Steel et al., 2005). The results, in general, showed a lack of respondents' awareness, a decline in the personal knowledge upon desalination, and the problems resulting from its process. Furthermore, the absence of factual knowledge of the elements of desalination and its impacts has been found. The study also showed the weak role of information sources in providing education to people about environmental problems. Furthermore, the result indicates a poor connection between people and information sources.

Moreover, foreign studies related to the subject give results almost identical to the different levels of awareness and knowledge, as mentioned above, but the causes of awareness and desire for it differ. In the case of the United States, desalination is considered an auxiliary solution for ordinary reality. In contrast, in the Palestinian case, desalination is necessary to provide unique products in the current Palestinian case in this high degree of pollution and shortage of water. Therefore, knowledge of the possibilities, dangers, and benefits of desalination should be made clear to the public, and the public

should have a good awareness of this technology, which is considered the leading water provider for the Gaza strip.

The study results were consistent and nearby to the results of (Al-Khatib et al., 2009) in both aspects of self-assessed knowledge and the degree of initial awareness of the risks. In which (Al-Khatib et al., 2009) confirm that the degree of people's awareness of solid waste problems increases with increasing religious consciousness. This degree of knowledge captures its basic concepts from primary religious learning. This corresponds to the study results in the indicator of public awareness and self-assessed knowledge, where the results showed a high level of these indicators and their link to primary education that the individual gets. Thus, an individual who receives an education, even a simple one, has a responsibility sense above the direction of his surroundings, and this feeling increases if he is linked to a spiritual and doctrinal bond that urges him to care. This goes with the nature of the Palestinian society and its social structure, which derives its knowledge from mostly unofficial means because it is more reliable than conventional. On the other hand, this awareness does not generate sufficient expertise that inherits factual knowledge of the problem and its implications.

This is understood in the social context in such studies. When factual knowledge is absent, it is replaced by a simple initial degree of awareness that the individual obtains from his social environment, whose degrees and tools vary from one society to another. In the Palestinian case, it is the primary education, chatting of friends, and religious preaching. Moreover, this situation is almost a specific feature in countries that suffer from weak structural or poverty or under occupation and the control of foreign powers, where people resort to the knowledge of the simple means that they trust and provide them with a margin of self-safety in light of the flow of information that makes it difficult for them to trust its content.

Factual knowledge requires an individual to obtain primary or official sources, such as government agencies, official publications, or civil society organisations. In the Palestinian case, these institutions suffer from difficulty in communication and interacting with people. They lack many resources, programs, and campaigns that can send their message and clarify it to people, in addition to the degree of political polarisation that affects their work. It is also noted the weakness of the official and local media, which is charged with disseminating knowledge and raising awareness, due to the nature of the Palestinian situation in particular and which is full of political events that affect editing policies. It is also affected by scathed from the state of political polarisation that touches it and its priorities.

4.1 The demographic factors

Even though there was a relationship between 'education' and public awareness of environmental problems, the results did not show a strong correlation or relation between demographic factors and public awareness for the first indicator. That could explain the results; public awareness is the lowest level of knowledge individuals have received through school or university. A minimum level of environmental education may be sufficient for a minimum level of awareness but not for factual knowledge. Thus, even a low degree of education can lead people to achieve awareness about desalination and the environment in Gaza. (Bennett and Dean, 1984).

For the second indicator, self-assessed knowledge, the results did not show a relation, correlation, or difference, based on demographic factors, and likewise, the third indicator, Factual knowledge, did not show a relation.

Furthermore, these results indicated a general cognitive imbalance of knowledge between society's different segments for several reasons. Those reasons can be explained by determining the problems that affect different parts of society. For example, the main components of the society of Gaza can be identified as individuals themselves, society as a whole, and government or political parties. Individual differences can refer to the lack of desire or interest in the environmental problem, inability to access the information, and interest for another subject more urgent, such as political topics. The social reasons can refer to the difference between age groups. Besides the nature of society that is not economically or socially motivated to diversify knowledge because of the economic and political problems that burden individuals. The government has inhibited the society more than the other circumstances as the political division that attracts individuals within the scope of the struggle between the party's led society to a low interest in the environment and water problems.

4.2 The motivations factors

The motivational factors in both categories: place attachment and the rate of place used for hobbies and activities, showed a high degree of correlation with two indicators: public awareness and self- assessed knowledge. Like similar studies (Needham et al., 2016; DelliCarpini and Keeter, 1996), these findings show that people are more aware of the problems about the hazards that threaten the places they love or where they spend a relaxing time. Therefore, individuals have an increased attention knowledge and awareness of a place they love, and their awareness increases when they realise some dangers could affect the places they like. In contrast, the results of factual knowledge were not favourable; the analysis did not show a correlation between this indicator and the motivational factors. The scientific fact assumes that people aware of a specific case do not necessarily have factual knowledge of its dimensions or details. The actual knowledge depends on the scientific and real information available for people, how people behave towards it, and how motivated they are to learn more. Understandably, this indicator was negative in Gaza since information resources are not widely available in Gaza, where there is not enough information for the public about desalination or environmental problems in general.

4.3 Information sources

In general, the results showed there was no correlation between the majority of information sources and the three indicators of knowledge, except for the public hearings, plant visit, social media, and friends' and relatives' information, which showed a correlation with the awareness indicator and the self-assessed knowledge indicator. This situation refers to the nature of society where people get their primary knowledge about urgent news and information from friends, what other people said, or sometimes try to go to the actual place of the event. In reality, those sources do not build strong real factual knowledge about the subject or the case under consideration. Consequently, it was evident in the factual knowledge indicator that the correlation was almost entirely negative with information resources—nevertheless, one source, 'newspaper,' correlated

with factual knowledge. So, people who read newspapers as a resource of information showed higher factual knowledge about the environment and desalination. This case may refer to the rise of current environmental issues covered in newspapers, connected with the political issues that use water problems to advertise its agenda. Moreover, the results indicate that the information resources, especially media, are weak and do not include in their priorities environmental subjects, even those whose responsibilities are to educate people such as the environmental authority, government agencies, or specialised scientists. Therefore, they have a lower impact on increasing people's knowledge and awareness about desalination and environmental problems.

To sum up, Environmental awareness is a crucial factor in improving the marine ecosystem. Many scholars explained environmental awareness as the first degree of creating an environmental trend, which determines individual behaviour towards the environment. It aims to establish a base of knowledge regarding environmental problems, relations between them, and their effects on different sides, so people could improve their reaction to these challenges and increase the possibility of solving them.

Individuals should have the necessary education to achieve the limits of awareness to be effective in the environment. Many studies have found that increasing community awareness, especially among the emerging generation of ecological risks, improves society's ability to make sound decisions that reduce this risk and diminish it to a minimum in the long run. In Palestine, evidence has been found that involving students in water-related projects significantly impacts their awareness of water issues. Visits to water infrastructure facilities can increase awareness. Furthermore, teacher training plays a vital role in the education of children. With the help of water managers, teachers, principals, and others can develop new ways to use local learning resources for schools and arrange workshops and seminars on water issues (Nazer et al., 2010).

Many scholars believe that environmental education is the incubator, improving environmental culture and civilised behaviour towards nature. Moreover, they have introduced environmentalism as the process that aims to promote environmentally responsible citizenship by bringing sustainable change and protecting natural resources. Furthermore, increasing public awareness and the necessary knowledge of environmental problems can solve these problems (Bell and Carolan, 2009). On the contrary, creating knowledge on environmental issues has a high 'mental and economical' cost, increasing when people have little environmental knowledge.

Prior knowledge of any subject improves an individual ability to acquire new knowledge and helps to deduce the main elements of the issues and understand its dangers. Additionally, prior knowledge about a specific subject also raises the individual's ability to store new information or increase their ability to be more educated about it in the future. Hence, the less environmental information people have in their mental records, the more challenging to assign new information or obtain information on similar topics (Eckhardt et al., 1991). As a result, that situation leads people to be easily controlled by governments or policymakers. This also may drive to establish projects that may harm people, the environment or destroy the individual's benefit. Many scholars point out that the lack of knowledge is a significant cause of non-environmental activities. Some naturalists and sociologists agree that knowledge stimulates the ability of individuals to behave politely on environmental issues (McKenzie-Mohr et al., 1995).

However, it is not a condition that environmental awareness implies a good behaviour towards the environment; an individual or an entity may be aware of the damage of pollution, but even though he does not hesitate to pollute (Bennett and Dean, 1984).

Therefore, awareness-raising and education programs ‘only’ are not enough to impose rational water use on the population. Preferably, specific laws must be activated in Palestinian law, or at least pictorially under Palestinian control, that obliges citizens to rationalise water use and combat pollution and equitable access to water.

5 Water crisis and desalination in Palestine: the path to sustainability!

Many matters may cause concern about desalination technology in the marine and urban environment in which environmental problems include all stages of construction and operation. The state of these menaces is more significant in environments that are already threatened by pollution or possess short coasts that are not sufficient for their natural population growth and people’s needs. One of the most dangerous threats to the coastal environment is brine discharge, which relates to the influx of high salt solutions and various processes to the marine environment. Besides, the threat includes greenhouse gas emissions and air pollutants due to the energy demand in the desalination process (Ibraheem et al., 2007). Additionally, other issues and problems related to desalination and its environmental impacts raise widespread concern among specialists, such as the devastation of marine life.

In Palestine and Gaza in particular, all international and domestic plans focused on finding new water sources, snubbing the reality on the ground, and the available opportunities for the water already possible, which, if controlled with complete guidance and sovereignty, could fulfil the essential needs of the Palestinian people (Quagliarotti, 2015). Also, by following international law and the articles stipulated for shared water, Palestine can attain its fair share to build and establish sustainable development and effective management.

Remarkably, one who observes the history of water in Palestine believes that the foreign aid to the Palestinian people in the water development sector has not resulted in a tangible impact on the development or water improvement side, as the Palestinian lands still suffer from a complex water reality that affects all aspects of life and exposes the Palestinian people to all kinds of suffering. Where this aid aimed to improve the level of Palestinian irrigation through the establishment of technical projects that use the resources available to the Palestinian people, this good goal implied a big problem within it, which is the normalisation of the Palestinian with his reality and the conditions of the occupation, and the confession in the mindset of the Palestinian citizen that his water problem is primarily a problem of scarcity, not the occupation. Consequently, it leads to the understanding of the ordinary Palestinian searching for a drop of water that his main water problem is a subjective problem stemming from the scarcity of nature and geography. Thus, the Palestinian mind is distracted from the actual origin of the problem, the occupation, the means of control, and might in West Bank and Gaza.

The Israeli occupation is practicing the most horrific methods of hidden ethnic cleansing against the Palestinians by stealing their water and transferring it to the illegal settlements. The occupation resells that water again to the Palestinians through the Mekorot Company. Constantly, Israel creates a severe water development reality and forms deliberate successive crises, the results of which continue to form other compound and more complex crises than its predecessor, producing a social and economic reality with which sustainability and development are impossible. The occupation policies vary in controlling water between the West Bank and Gaza, whether utilising confiscation,

prevention, or agreed-upon control. Israel has always resorted to extending its strengths in the agreements signed with the Palestinian self-rule authority, especially those emanating from the joint committee that gives Israeli members the right to veto every Palestinian project they do not like (al- Shalalfeh et al., 2018). The committee requires the Palestinian members to approve and barter illegal Israeli settlement projects in the West Bank so that the Palestinians can obtain approval from the Israeli side for vital Palestinian water projects.

While the Israeli occupation imposes military laws on the ability to access and control primary resources such as water, and the noose stresses primary imports of fuel and energy sources, the Palestinian Authority has not for decades developed any major infrastructure in the water sector, especially in Area C, which constitutes 60% of the area of the West Bank. The Civil Administration of the occupation has the right to object to all infrastructure projects in Area C until its approval rate for projects reached only 1.5% between 2010 and 2014. Moreover, most major water projects have been frozen because of Israel's requirement to link settlements to those funded by donor agencies for the Palestinian people. Thus, Area C is still the scene of declining development, and the international community classifies it as an area of humanitarian intervention only.

Israel resorts to offering technical solutions from which it seeks to improve its image in front of international opinion, from the image of a racist occupier to a good occupier aiming to advance the people against whom the occupation is practiced! Israel is covering up behind the mask of technology to impose solutions on the Palestinians, shrinking their water rights in their lands. Accordingly, Israel always calls for the establishment of advanced desalination plants in Gaza and strives to market that desalination is the 'only solution' to Palestinian water problems, ignoring Palestinian water rights in international law! Israel aims that the Palestinian citizen reaches the surrender stage and leave his land. Consequently, it is easier for Israel to annex these strategic parts of the territories.

This does not mean rejecting technical solutions to increase the water share of the Palestinian people to fit with the steady increase in population growth, but instead refusing to be the 'only solution' to the water problem without which the Palestinians do not have the right to object against the painful reality. This suggestion pushes the Palestinian people to surrender and accept life under military rules away from freedom and independence. Indeed, this proposition (technological one) mistreats itself and suffers for a long time to find a convincing answer to a simple question to the international community that calling for the technical solution to be the ideal solution to the crisis of water in Palestine. How can this solution be the first solution in light of the occupation and its control? The international community is trying hard to prove the economic feasibility of improving the Palestinian water situation by pumping projects in the Gaza Strip and the West Bank, ranging from desalination and wastewater treatment. However, the international community ignores the fact that in this way, it creates facts on the ground that make the occupation a natural entity, which creates an unsustainable solution. The concept of aid is that it is temporary and capable of producing a reality capable of sustaining itself and its efforts in the long run. Not that the subsidy is a permanent and durable solution to longevity. This assures us that tackling the actual reality requires addressing the main problem and not its symptoms. Besides, most of these projects are implemented according to the Oslo agreement. Then, one of the pillars of those agreements is the joint committee concerned with the full planning of the projects. It is ironic to mention that Israel, in the occupied Palestinian land investing the aid funds in illegally building its settlements.

The water situation in the Gaza Strip is still catastrophic to the extreme. Furthermore, Gazans complicated health situation, economic and social consequences are hardly enough for a single article to mention and detail. Only knowing that more than 98% of the groundwater is polluted and not suitable for drinking is a catastrophe in itself that requires urgent solutions like desalination, whether Sea water, groundwater, or recycled wastewater. Nevertheless, these solutions alone in isolation from the inherent water right of the Palestinians to their water in Palestine as a whole and isolating the Gaza Strip as a separate entity that is neither associated nor annexed to the West Bank and which benefits or cooperates with should be a rejected solution.

This approach reinforces the narrative of the geographical and political separation of the Gaza Strip from the West Bank, where it treats Gaza as a self-standing entity that needs its facility in order to supply water. These allegations ignore that water in the West Bank – almost entirely under Israeli control - can help Gaza. In this regard, Clemens Messerschmid, the German hydrologist working in the Palestinian water sector, stresses (Messerschmid, 2012)

‘The Gaza Strip is entitled to receive a fair share of the coastal groundwater basin under international water law. Gaza cannot be separated from the rest of Palestine. Gaza must be supplied with water from abroad, just like New York, London, Paris, or Munich. The water-rich West Bank is buying increasing quantities of water from Mekorot (Israel), while Gaza has to take care of itself? This is pure and ancient Israeli logic and Israel’s hydro-political doctrine. Under this new paradigm, the historic Palestinian struggle for water rights is abandoned in exchange for a ‘fair and reasonable share of transboundary water resources, a right stipulated by international water law. The Israeli Negev has a water surplus because the entire Upper Jordan River is converted at the Sea of Galilee into the national water carrier close to Gaza. There is a massive amount of excess water flowing through Gaza, while the sector continues to dry.’

The study carried out by Mimi and Alawi in the West Bank, who presented a methodology for distributing groundwater in the West Bank, could rationalise water needs in Gaza and the west bank. According to this method, the Palestinians can obtain 60% of the available groundwater, equivalent to 400 million cubic meters of water. Based on that study, the Palestinian water shares of the Jordan River and groundwater become equal to 600 million cubic meters, and this suffices for the various Palestinian needs, provided that they are used rationally and the geographical communication between the West Bank and Gaza and the improvement of supplies between them in one sovereign entity and control of its resources. Besides, it is possible to resort to complementary solutions, such as rain-harvesting devices and wastewater recycling technologies, especially in agriculture, and standardisation and irrigation techniques for agricultural and industrial irrigation (Nazer et al., 2010).

Regarding desalination and sustainability, an integrated methodology must be adopted to make desalination a sustainable solution, whether in inputs or outputs. This requires the government to ensure that the designing companies follow sound procedures to reduce the harmful impacts on the marine and urban environment. It could be achieved by using environmentally friendly building methods that integrate all different aspects of construction and operation. Starting from the project design stage through all construction phases and, finally, the operating, maintenance, and disposal of harmful brine phases. It can also take advantage of mining technology and station exhaust recycling, whether salts or minerals. All of this brings us that the project must be sustainable in all respects. It is desirable to follow a circular economics approach, requiring specialists in different

disciplines and interlocking sciences to participate in all its stages, especially in sustainable development.

Therefore, what is required is an integrated management approach that efficiently manages available resources and seeks to find complementary ones. That includes the various types of desalination provided that they are sustainable and do not affect the environment negatively, or the impact is minimal.

All of the aforementioned takes us to a higher level of integration in which the citizen becomes a part of decision-making and implementation, significantly when awareness and education about water, development, sustainability, and proper management issues increase.

6 Conclusions

The research has investigated to what extent socio-demographics, motivational factors, and information use shape public awareness and knowledge about desalination and its impacts on the environment in Gaza, Palestine. The study indicates that the public lacks an understanding of fundamental ideas concerning desalination and its effect on the environment. Furthermore, the results show a significant lack of knowledge, including all the layers of society. Also, the study ensures that current ways of raising awareness and knowledge among the public about environmental issues are weak and include significant problems in building connections and bonds with society. Moreover, the research foretells that increasing desalination plants aiming to supply fresh water in Gaza probably leads to more pollution in the environment. So, there is a significant demand for plenty of public education, media campaigns, improvement of government policies to raise people's knowledge about the new technologies, and the ability to comprehend how this affects the environment.

Finally, targeted education and additional reaching efforts are going to be essential for addressing the knowledge gap. Moreover, the study recommends more analysis for public awareness to identify the influence of extra variables that increase policy-relevant knowledge of water sectors, like desalination and water treatment.

Acknowledgements

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

- Al-Khatib, I.A., Arafat, H.A., Daoud, R. and Shwahneh, H. (2009) 'Enhanced solid waste management and understanding the effects of gender, income marital status and religious convictions on attitudes and practices related to street littering in Nablus-Palestinian territory', *Waste Management*, Vol. 29, pp.499–455, <http://dx.doi.org/10.1016/j.wasman.2008.02.004>.
- Agha, S.R. (2006) 'Optimizing routing of municipal solid waste collection vehicles in Deir El- Balah – Gaza strip', *The Islamic University Journal (Series of Natural Studies and Engineering)*, Vol. 14, No. 2, pp.75–89 [online] <http://www.iugaza.edu.ps/ara/research/> (accessed 14 May 2018).

- Aish, A.M. (2011) 'Water quality evaluation of small-scale desalination plants in the Gaza Strip, Palestine', *Desalination and Water Treatment*, Vol. 29, Nos. 1–3, pp.164–173, <https://DOI.org/10.5004/dwt.2011.1765>.
- Al-Agha, M.R. and Mortaja, R.S. (2005) 'Desalination in the Gaza strip: drinking water supply and environmental impact', *Desalination*, Vol. 173, No. 2, pp.157–171, <https://DOI.org/10.1016/j.desal.2004.06.212>.
- Alazaiza, M.Y. (2013) *Development of Safety Plan for Desalinated Water Use in Gaza Strip Middle Governorate Case Study*, The Islamic University of Gaza [online] <http://library.iugaza.edu.ps/thesis/109784.pdf> (accessed 14 May 2018).
- al-Shalalfeh, Z., Napier, F. and Scandrett, E. (2018) 'Water nakba in Palestine: sustainable development goal 6 versus Israeli hydro-hegemony', *Local Environment*, Vol. 23, No. 1, pp.117–124, <https://DOI.org/10.1080/13549839.2017.1363728>.
- Aminrad, Z., Zarina, S., Sayed Zakariya, B., Hadi, A. S. and Sakari, M. (2013) 'Relationship between awareness, knowledge, and attitudes towards environmental education among secondary school students in Malaysia', *World Applied Sciences Journal*, Vol. 22, No. 9, pp.1326–1333, <https://DOI.org/10.5829/idosi.wasj.2013.22.09.275>.
- Awad, I.M. and Al Karaki, M.S. (2019) 'The impact of bank lending on Palestine economic growth: an econometric analysis of time series data', *Financial Innovation*, Vol. 5, No. 1, pp.1–21, <https://DOI.org/10.1186/s40854-019-0130-8>.
- Balfaqih, H., Al-Nory, M.T., Nopiah, Z.M. and Saibani, N. (2017) 'Environmental and economic performance assessment of desalination supply chain', *Desalination*, Vol. 406, pp.2–9, <https://DOI.org/10.1016/j.desal.2016.08.004>.
- Bashitialshaaer, R., Persson, K.M. and Aljaradin, M. (2012) *Desalination and Power Plants Together for Water and Peace A Case study of the Gaza-Strip*, Palestine [online] <http://www.tvrl.se/ma/Documents/Desalination and Power Plants Together for Water and Peace.pdf> (accessed 14 May 2018).
- Bell, M. and Carolan, M.S. (2009) *An Invitation to Environmental Sociology*, 3rd ed., Pine Forge Press, Los Angeles.
- Bennett and Dean B. (1984) *Evaluating Environmental Education in Schools a Practical Guide for Teachers* [online] <http://unesdoc.unesco.org/images/0006/000661/066120eo.pdf> (accessed 15 May 2018).
- Boghossian, P. (2010) *Fear of Knowledge: Against Relativism and Constructivism*, Vol. 9780199287, 'Oxford publisher, <https://DOI.org/10.1093/acprof:oso/9780199287185.001.0001>.
- Clayton Littlejohn. (2014) *How and Why Knowledge is First. King's College London* [online] <https://philarchive.org/archive/LITHAWv1> (accessed 15 May 2018).
- Chakli, F. (2013) *Water Desalination Projects in the Gaza Strip a Geographic Study*, The Islamic University of Gaza.
- Cruz, R.M. and De La Vega, L. (2004) *Awareness, Knowledge, And Attitude About Environmental Education: Resp* [online] <http://stars.library.ucf.edu/etd/178>.
- Delli Carpini, M.X. and Keeter, S. (1996) *What Americans Know About Politics and Why It Matters*, Yale University Press [online] <https://yalebooks.yale.edu/book/9780300072754/what-americans-know-about-politics-and-why-it-matters>.
- Desalination in the Gaza strip: drinking water supply and environmental impact. (2005) *Desalination*, Vol. 173, No. 2, pp.157–171, <https://DOI.org/10.1016/J.DESAL.2004.06.212>.
- Druckman, J.N. (2005) *Media Matter: How Newspapers and Television News Cover Campaigns and Influence Voters*, Taylor & Francis Inc., Vol. 22, pp.463–481, <https://DOI.org/10.1080/10584600500311394>.
- Duda, M.D., Jones, M., Criscione, A., Craun, C., Beppler, T., Winegard, T. and Herrick, J.B. (2007) 'California Residents' Opinions on And Attitudes Toward Coastal Fisheries and Their Management [online] www.responsivemanagement.com (accessed 10 May 2018).

- Eckhardt, B.B., Wood, M.R. and Jacobvitz, R.S. (1991) 'Verbal ability and prior knowledge', *Communication Research*, Vol. 18, No. 5, pp.636–649, <https://DOI.org/10.1177/009365091018005004>.
- EIB (2016) *Gaza Central Desalination Plant Project' The Impact on Water Security in Gaza World Water Week*, August [online] http://programme.worldwaterweek.org/sites/default/files/4_eib_stockholm_meeting_gaza_desalination_project.pdf.
- Ettema, J.S. and Kline, F.G. (1977) 'Contingent conditions for understanding the knowledge gap', *Communication Research*, Vol. 4, No. 2 [online] https://deepblue.lib.umich.edu/bitstream/handle/2027.42/67566/10.1177_009365027700400204.pdf;sequence=2 (accessed 9 May 2018).
- Fernández Torquemada, Y Carratalá, A., Sánchez-Lizaso, J. L. (2019) 'Impact of brine on the marine environment and how it can be reduced', *Desalination and Water Treatment*, Vol. 167, pp.27-37, DOI:10.5004/dwt.2019.24615.
- Fletcher, S., Potts, J.S., Heeps, C. and Pike, K. (2009) 'Public awareness of marine environmental issues in the UK', *Marine Policy*, Vol. 33, No. 2, pp.370–375, <https://DOI.org/10.1016/J.MARPOL.2008.08.004>.
- Heck, N., Paytan, A., Potts, D.C. and Haddad, B. (2016) 'Coastal residents' literacy about seawater desalination and its impacts on marine ecosystems in California', *Marine Policy*, Vol. 68, pp.178–186, <https://DOI.org/10.1016/j.marpol.2016.03.004>.
- Hrachovec, H. and Pichler, A. (2008) *Philosophy of the Information Society*, Vol. 2 [online] <https://lirias.kuleuven.be/bitstream/123456789/485001/4/2007.08.10-Druckvorlage+Hrachovec+ALWS+Bd.+7-StefanGradmann-275-286.pdf> (accessed 11 May 2018).
- Ibraheem, A. and Saleh, A. (2007) *Impact of Pumping on Saltwater Intrusion in Gaza Coastal Aquifer, Palestine*, An-Najah National University.
- Ismail, M. (2003) *Prospects of Water Desalination in the Gaza Strip* Mahmoud Ismail, KTH Land and Water Resources Engineering.
- Jāmi'ah al-Islāmīyah, H.A. and Ghabayen, S.M. (2017) 'Solar energy to optimize the cost of RO desalination plant case study: Deir Elbalah SWRO plant in the Gaza strip', *Journal of Engineering Research and Technology*, Vol. 4, No. 4 [online] <http://journal.iugaza.edu.ps/index.php/JERT/article/view/3337> (accessed 13 May 2018).
- Lattemann, S. and Bleninger, T. (2010) *Seawater Desalination and the Environment Course Description*, p.6200.
- Lovrich, N.P. and Pierce, J.C. (1984) 'Knowledge gap' phenomena', *Communication Research*, Vol. 11, No. 3, pp.415–434, <https://DOI.org/10.1177/009365084011003005>.
- Mayla, Y.A., Amr, S.A. and Shatat, O. (2009) *Evaluation of Common and Small Scale Brackish Water Desalination Plant for Drinking Purposes in Gaza Striat*, Gaza [online] <http://site.iugaza.edu.ps/rkhatib/files/2016/05/evaluation-common-and-small-scale-brackish-water-desalination-plant-drinking-purposes-gaza-strip-200.pdf> (accessed 11 May 2018).
- McKenzie-Mohr, D., Nemiroff, L.S., Beers, L. and Desmarais, S. (1995) 'Determinants of responsible environmental behavior', *Journal of Social Issues*, Vol. 51, No. 4, pp.139–156, <https://DOI.org/10.1111/j.1540-4560.1995.tb01352.x>.
- McNeill, P. (1990) *Research Methods*, Routledge [online] https://books.google.es/books/about/Research_Methods.html?id=BVRuUzoqpmQC&redir_esc=y (accessed 16 May 2018).
- Messerschmid, C. (2012) 'Water in Gaza: problems and prospects', *SSRN Electronic Journal*, October, <https://DOI.org/10.2139/ssrn.1764252>.
- Monterey Bay National Marine Sanctuary (2012) *Monterey Bay National Marine Sanctuary Impacts of Desalination on Coastal Ecosystems*.
- Nazer, D.W., Tilmant, A., Mimi, Z., Siebel, M.A., Van der Zaag, P. and Gijzen, H.J. (2010) 'Optimizing irrigation water use in the west bank', *Palestine. Agricultural Water Management*, Vol. 97, No. 2, pp.339–345.

- Needham, M.D., Cramer, L.A. and Johnston, J.R. (2016) *Resident Perceptions of the Oregon Marine Reserve System Final Report* [online] <http://oregonmarinereserves.com/content/uploads/2016/12/Needham2016.pdf> (accessed 19 May 2018).
- Norris I. Erhabora, and J.U.D. (2016) 'Impact of environmental education on the knowledge and attitude of students towards the environment', *International Journal of Environmental & Science Education*, Vol. 11.
- Palestinian Central Bureau of Statistics (PCBS) '(2009) *Palestine in Figures* [online] <https://web.archive.org/web/20101114002607/>, http://www.pcbs.gov.ps/Portals/_pcbs/census2007/ind_loca_09.pdf.
- Palestinian Water Authority. (2013) *Gaza Water Resources Status Report* [online] [http://www.pwa.ps/userfiles/file/1/تصنيف/تقارير/Gaza water Resources status report 2013-2014.pdf](http://www.pwa.ps/userfiles/file/1/تصنيف/تقارير/Gaza%20water%20Resources%20status%20report%202013-2014.pdf) (accessed 21 May 2018).
- Peiris, M., Von Medeazza, G. and Abuzuhry, Z. (2017) 'Seawater desalination transforming the Gaza strip', in *The 40th WEDC International Conference*, Loughborough, UK [online] <https://wedc-knowledge.lboro.ac.uk/resources/conference/40/Peiris-2671.pdf> (accessed 9 May 2018).
- Pinto, F.S. and Marques, R.C. (2017) 'Desalination projects economic feasibility: a standardization of cost determinants', *Renewable and Sustainable Energy Reviews*, February, 78, pp.904–915, <https://DOI.org/10.1016/j.rser.2017.05.024>.
- Quagliarotti, D.A.L. (2015) 'Technical solutions to avoid water conflicts: the red sea-dead sea canal project', *Global Environment*, Vol. 7, No. 2, pp.405–441.
- Scannell, L. and Gifford, R. (2010) 'Defining place attachment: a tripartite organizing framework', *Journal of Environmental Psychology*, Vol. 30, No. 1, pp.1–10, <https://DOI.org/10.1016/J.JENVP.2009.09.006>.
- Snider, A., Luo, S., Hill, J., Buerger, R., Herstine, J. and Sutton, H. (2010) 'factors affecting knowledge, perceptions, and attitudes regarding North Carolina coastal reserve management', *Coastal Management*, Vol. 38, No. 5, pp.540–558, <https://DOI.org/10.1080/08920753.2010.511696>.
- Soden, D.L. and Steel, B. (1999) *Handbook of Global Environmental Policy and Administration*. Marcel Dekker.
- Sola, I. Zarzo Martínez, D. Carratalá, A. Fernández-Torquemada, Y. de-la-Ossa-Carretero, J.A. Del-Pilar-Ruso, Y. Sánchez-Lizaso, J.L. (2020) 'Review of the management of brine discharges in Spain', *Ocean & Coastal Management*, Vol. 196: p.105301, <https://DOI.org/10.1016/j.ocecoaman.2020.105301>.
- Steel, B.S., Smith, C., Opsommer, L., Curiel, S. and Warner-Steel, R. (2005) 'Public ocean literacy in the United States', *Ocean & Coastal Management*, Vol. 48, pp.97–114, <https://DOI.org/10.1016/j.ocecoaman.2005.01.002>.
- Thai, K.V., Rahm, D. and Coggburn, J.D. (2017) *Handbook of Globalization and the Environment*, Routledge.
- United Nation (2012) *Gaza* [online] [https://www.unrwa.org/userfiles/file/publications/gaza/Gaza in 2020.pdf](https://www.unrwa.org/userfiles/file/publications/gaza/Gaza%20in%202020.pdf) (accessed 7 May 2018).
- Vaske, J.J. (2008) *Survey Research and Analysis: Applications in Parks, Recreation, And Human Dimensions*, 1st ed., Venture Pub.

Notes

- 1 It is the fluid waste from a desalination plant that contains a high percentage of salts and dissolved minerals. It returns back to the sea and spreads according to different aspects. The discharge brine has the ability to change the salinity, alkalinity and the temperature averages of the seawater and can cause change on marine habitat.