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Factors influencing the reuse of reclaimed water as a management option to augment water supplies

May A. Massoud · Arine Kazarian · Ibrahim Alameddine · Mahmoud Al-Hindi

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Abstract The reuse of treated wastewater, whether direct or indirect, can raise public concerns as a result of the overall risk perception. As such, community acceptance plays a significant role in the implementation of alternative water systems. Public attitudes towards water reuse are highly influenced by perceived health risk, religious prohibition, political issues, and the degree of human contact with recycled water. In most of the Mediterranean countries, wastewater is reused to different extents either within planned or unplanned schemes. Unfortunately, there are few in-depth studies of the socio-cultural aspects of reuse projects in developing countries, and Lebanon is no exception. Accordingly, this research will comprehensively tackle the issue of public knowledge, perceptions, and acceptance from different perspectives in an effort to provide national baseline information on wastewater reuse that is needed for future regulatory and developmental projects. As such, a survey was developed, tested, and administered. Results showed an inverse relation between the degree of human contact with the treated wastewater and public acceptance. People were found to be more inclined towards reuse for purposes with minimal human contact such as landscaping and agriculture with opposition when it came to use for personal use. Moreover, the results showed a general lack of trust in governing institutions and authorities, which could explain perceived health risks and perceptions of risk resulting from system failure. Overall, the willingness to use treated wastewater was found to vary as a function of the "disgust factor," religious beliefs, and perceptions of a high risk towards contracting waterborne diseases. The disgust towards reuse of treated wastewater was found to be a strong predictor affecting willingness to reuse whereby those who believed it is disgusting to reuse treated wastewater were found to be on average, three times less likely to reuse treated wastewater as compared to those who did not declare disgust. Similarly, a significant association was found between religious beliefs and respondents' willingness to use treated wastewater. Interviewees who thought treated wastewater reuse is not religiously accepted were, on average, twice less likely to use treated wastewater as compared to those who did not believe that reuse contradicts with their religious beliefs. Additionally, people's perceptions on associating the spread of water-borne diseases with reuse were found to be significant. Those who perceived that reusing treated wastewater would lead to diseases and affect the human health, were on average, twice less likely to accept reuse. Developing a

M. A. Massoud (✉) · A. Kazarian
Department of Environmental Health, Faculty of Health Sciences, American University of Beirut, P.O. Box 11-0236, Riad el Solh, Beirut 1107 2020, Lebanon
e-mail: may.massoud@aub.edu.lb

I. Alameddine
Department of Civil and Environmental Engineering, American University of Beirut, P.O. Box 11-0236, Riad el Solh, Beirut 1107 2020, Lebanon

M. Al-Hindi
Department of Chemical and Petroleum Engineering, American University of Beirut, P.O. Box 11-0236, Riad el Solh, Beirut 1107 2020, Lebanon

comprehensive strategy that integrates increasing awareness and knowledge, setting policies related to water reuse, building public trust and communication channels, increasing public participation/engagement in decision making, and developing a sustainable management framework is thus crucial before any investments are made in reclaimed water-reuse projects.

Keywords Water reuse · Public perception · Acceptance · Lebanon

Introduction

Water scarcity is a global problem that is anticipated to aggravate as a result of population increase, economic growth, technological development, and increased per capita consumption. Currently, more than 700 million people are experiencing water stress (World Bank 2010), and two out of three people are predicted to be living in water stressed areas by 2025 (UNEP 2008). Changes in precipitation, runoff, and evapotranspiration rates as a consequence of climate change are expected to amplify the aforementioned pressures in many parts of the world. Consequently, water management challenges will force water utilities and establishments to increase their reliance on the utilization of non-conventional sources of water. Among these sources is water reuse that can provide alternative water supply and reduce the environmental impacts of discharging untreated wastewater into surface water bodies. Previous studies have shown that planned and unplanned water reuse are on the increase worldwide as a result of water scarcity (Vigneswaran and Sundaravadivel 2004; Lautze et al. 2014; Rice et al. 2016). While there are many, economic, agricultural, and environmental benefits for water reuse, failing to address the potential negative health and environmental risks (Lam et al. 2015) associated with reuse may jeopardize the environment and public health.

Studies conducted in several countries reported that positive public perceptions and acceptance of water reuse are essential for the effective implementation of reuse projects (Sims and Baumann 1974; Po et al. 2003; Baggett et al. 2006; Friedler et al. 2006; Nancarrow et al. 2008; Dolnicar et al. 2011; Garcia-Cuerva et al. 2016; Hurlimann and Dolnicar 2016). Globally, several reuse schemes have failed due to strong opposition from the local community (Okun 2002; Po et al. 2003). Public acceptance plays a significant role in the uptake and implementation of alternative water systems (Buyukkamcia and Alkan 2013; Chen et al. 2015). Community opposition of water reuse schemes can be attributed to a combination of factors including prejudiced beliefs, perceived health risks, religious prohibition, fear, attitudes, lack of knowledge, general distrust (Friedler et al. 2006; Wester et al. 2015), quality satisfaction, and sociodemographic factors (Dolnicar and Schafer 2009; Fielding and Roiko 2014; Ross et al. 2014). While previous research findings concur with regard to the role of certain factors (knowledge, trust in authorities, risk perception, health concern, and water quality) and their association with water reuse, the impact of other factors are less clear, especially those associated with demography. The success of any reuse project is directly related to the public's general knowledge and awareness which in turn are highly correlated with the level of education (Buyukkamcia and Alkan 2013). People's trust in authorities who are responsible for managing the treated wastewater has also been shown to influence attitudes. Most often, there is a general distrust in local municipalities or governmental institutions and in their ability to handle and operate wastewater treatment correctly and supervise the application process adequately (Fielding and Roiko 2014). The lack of skilled labor and efficient management has also been identified as a major concern among people (Nijhawan et al. 2013).

Risk perception is normally related to public health issues as associated with the water quality and safety of using recycled water, perceived dirtiness or filthiness, and the fear of contamination from using the water (Po et al. 2003). As such, several projects avoided using terms related to treated or recycled wastewater and used more preferred terms such as "re-purified water" (Leovy 1997). Risk perception is also associated with the targeted community norms, traditions, and religious beliefs (Madany et al. 1992; Wilson and Pfaff 2008; Drechsel et al. 2015). The issue of water availability is also a major factor affecting the public's acceptance of water reuse. In places with water shortage, people tend to more readily accept reuse primarily for non-potable purposes (Dishman et al. 1989; Hurlimann et al. 2008; Bakopoulou and Kungolos 2009; Bakopoulou et al. 2010; Dolnicar et al. 2011; Pham et al. 2011; Gu et al. 2015).

Given appropriate treatment, wastewater can be used for all purposes for which freshwater is used; nevertheless, several challenges including but are not limited to technological, economic, regulatory, and social as well as risk factors ultimately dictate the decision to reclaim and the ultimate reuse of the water. While reuse projects in the USA and Europe typically have very high standards for wastewater treatment, unregulated wastewater reuse has been in practice in several developing countries as a means to compensate for shortfalls in water supply. In most of Mediterranean countries, wastewater is reused to different extents within planned or unplanned schemes (Kamizoulis et al. 2003). Few in-depth studies have looked at the sociocultural aspects affecting communities' perceptions with regard to reuse schemes. Consequently, this research study aims to estimate the level of support for various water reuse options, investigate the key factors influencing people's decision making process with regard to the acceptance/rejection of water reuse, and assess the willingness to use recycled water in a water stressed urban area in a developing country.

Methodology

Instruments

A pre-tested survey questionnaire, in English and Arabic, was developed and used for the acquisition and collection of primary data. It comprised of a set of structured, standardized, closed-ended, and coded set of questions. The questionnaire was structured and developed so as to address the following:

1. Identify potable and non-potable water use patterns including source, availability, cost, problems encountered in water supply, and perceived water-related risks.
2. Gauge the level of opposition to and support for various treated wastewater-reuse options. Participants were asked to mark each of the reuse options on a scale from 1 to 5 (1: strongly opposed; 2: opposed; 3: indifferent; 4: supportive, 5: strongly supportive).
3. Assess the participants' perception/knowledge regarding the proposed water-reuse options. Participants were asked for their opinion regarding a list of statements that identifies their perceptions towards reuse.
4. Evaluate the respondents' trust in authorities.
5. Assess participants' willingness to use for treated wastewater.
6. Evaluate the impact of sociodemographic variables including gender, education, marital status, and income level on the willingness to use and participate in a reuse plan.

Study area and targeted population

The study area of the public survey encompassed the Administrative Beirut Area (ABA), which extends over an area of 19.6 km^2. This area is divided into 13 different zones (Fig. 1). Three zones were excluded since they are non-residential. Therefore, the study included the remaining ten zones.

The unit of analysis (study subject) of the study was the household member (interviewee). The sampling units that made up the study sample were the residential households in ABA. The ABA houses a population of approximately 400,000 inhabitants. In order to estimate the representative number of surveys needed to describe the study area, Eq. 1 was used (Krejcie and Morgan 1970). As such, the study sample size was estimated to be equal to 287, which was rounded up to 300 households. Household questionnaires were conducted between February and March 2016. Random samples of digitized and geo-referenced residential buildings were taken from each zone to choose the buildings to be targeted. Household units, within each randomly chosen residential building, were then randomly selected. In the event of a non-response, rejection, and inaccessibility, an adjacent left-side building or household unit was selected.

$$\boldsymbol{n} = \frac{\boldsymbol{Z}_{0.95}^{2}{}^{*}\ \boldsymbol{p}\ (1-\boldsymbol{p})^{*}\ \boldsymbol{N}}{(\boldsymbol{N}-1)^{*}\boldsymbol{m}^{2} + \boldsymbol{Z}_{0.95}^{2}{}^{*}\ \boldsymbol{p}\ (1-\boldsymbol{p})} \tag{1}$$

Where, $\boldsymbol{n}$ = required sample size; $\boldsymbol{Z}$ = confidence level set to 95% (standard value of 1.96); $\boldsymbol{p}$ = estimated prevalence of the outcome variable of interest set to 0.25; $\boldsymbol{N}$ = the total number of the population; and $\boldsymbol{m}$ = margin of error set to 5% (standard value of 0.05).

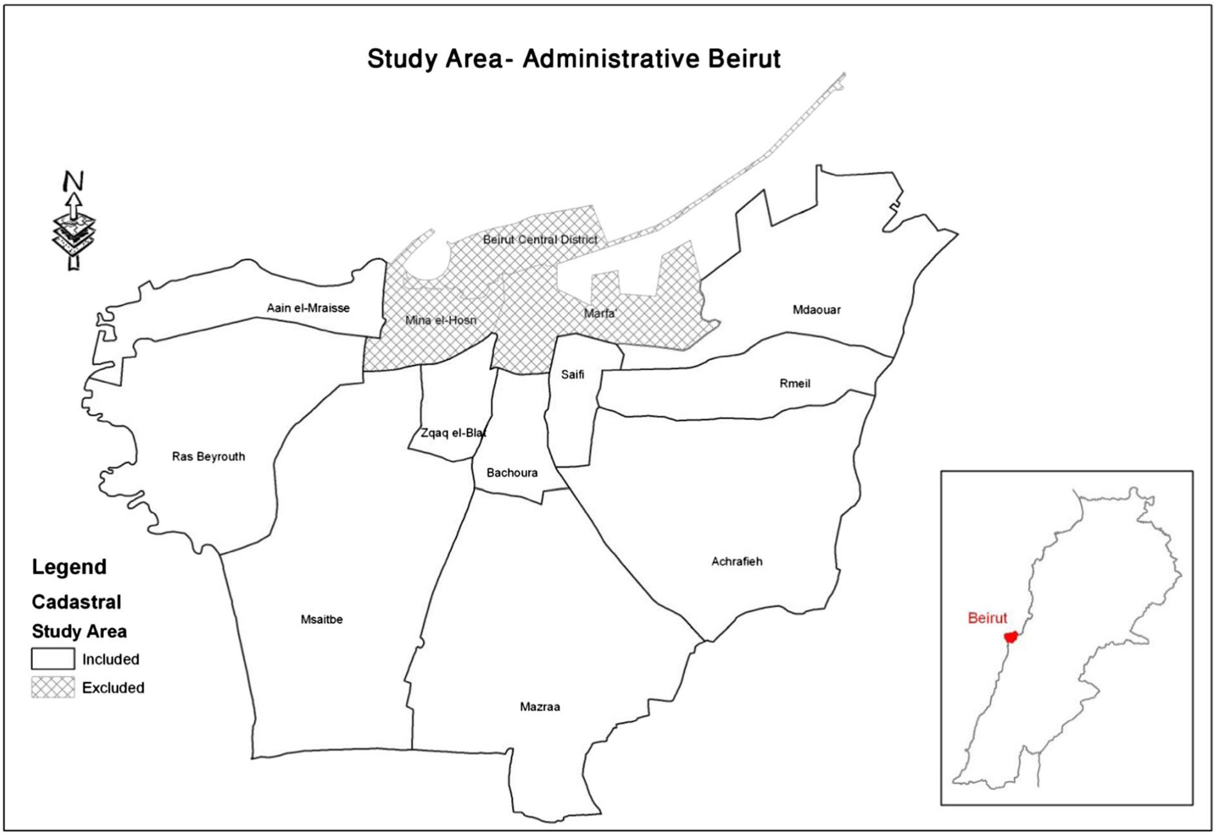

Fig. 1 A geographic information system (GIS) map of the study area

Data management and statistical modeling

Collected data was cleaned, coded, and entered for subsequent analysis. Data processing and analysis was carried out with the use of two software environments for statistical computing: SPSS® (Venables and Ripley 2002) and R® (R Core Team 2013). Descriptive statistics were carried out to present the frequency distribution of different variables. Continuous variables were reported in terms of their mean and standard deviation. In an attempt to document all the causes that may lead to the opposition of water reuse schemes, the fishbone analysis tool (Ishikawa 1968) was used. Following the analysis and characterization of the main patterns in the data, logistic regression was conducted to find the predictors expected to be associated with the "willingness to use treated wastewater"

A cutoff point for statistical significance was taken at $\alpha = 0.1$, where a p value less than 0.1 indicates a statistically significant association at the 95% level. Final model was selected based on conducting a stepwise backward model selection technique on the full model that was initially constructed by including all predictors that were identified as significant from a univariate model development process. Model pruning was based on finding the most parsimonious model, with the lowest Akaike Information Criterion (AIC) score.

$$\ln\left(\frac{\boldsymbol{P}}{1-\boldsymbol{P}}\right) = \log\left(\mathbf{odds}\right) = \boldsymbol{\alpha} + \boldsymbol{\beta}_1\mathbf{x}_1 + \boldsymbol{\beta}_2\mathbf{x}_2 + \boldsymbol{\beta}_3\mathbf{x}_3 + \ldots + \boldsymbol{\beta}_{\boldsymbol{n}}\mathbf{x}_{\boldsymbol{n}} + \boldsymbol{\varepsilon} \quad (2)$$

where: $\boldsymbol{P}$ is the probability of the acceptance, $\boldsymbol{\alpha}$ is the intercept parameter, $\boldsymbol{\beta_i}$ are the slope parameters, $\boldsymbol{x}_i$ are the predictor independent variables, and ε is the error term that was assumed to be normally distributed around zero. Additionally, we tested if the willingness of the respondents to use treated wastewater affected their willingness to pay for its use. This was assessed through the construction of a contingency table and the use of the Pearson's chi-squared test of independence.

Results and discussion

Respondents demographic and socioeconomic characteristics

Results revealed a gender bias in the survey, with 58.6% females ($N = 174$) and 41.1% males ($N = 122$). Mean age of the interviewees was around 46 years (minimum = 18; maximum = 85) with the majority of the respondents falling in the range of 35–49 years old (30%). About 70% of the interviewees were married. The average number of persons per household was around 4 (mean = 3.64). About 54% of the respondents had attained university degrees, 27.8% have reached intermediate education, 9.2% elementary, and 7.8% held technical degrees (Table 1). It is worth mentioning that the high educational level is not reflective of Lebanon as a whole, but only in the ABA. Nearly 60% of the interviewees were employed at the time when this survey was conducted. The majority of those who were unemployed were either housemakers or retirees (people aged 64 and more). A quarter of the respondents reported that they had a monthly income between 1000 and 3000 USD and almost a quarter did not report their monthly income. A possible explanation for the high percentage of non-response rate regarding the monthly household income could be fear of using the collected data for taxation.

Table 1 Demographic and socio economic background of respondents

Characteristics	Actual number (frequency as %)
Gender ($N = 297$)	
Male	122 (41.1)
Female	174 (58.6)
Age, mean (± SD) ($N = 272$)	46.14 (± 16.272)
Education ($N = 295$)	
Elementary	27 (9.2)
Intermediate	82 (27.8)
University	160 (54.2)
Technical	23 (7.8)
Household Size, (± SD) ($N = 292$)	3.64 (± 1.594)
Currently employed ($N = 284$)	
No	116 (40.6)
Yes	168 (58.7)
Monthly household income (in USD) ($N = 294$)	
Less than 500	14 (4.8)
Between 500 and 1000	55 (18.7)
Between 1000 and 3000	86 (29.3)
Between 3000 and 5000	32 (10.9)
Between 5000 and 10,000	23 (7.8)
Greater than 10,000	2 (0.7)
No answer	82 (27.9)

Most commonly used sources of water

The majority (70%; $N = 207$) of the respondents reported that they suffer from water scarcity problems (Table 2). Around 30% of the surveyed households who use network water for domestic purposes reported to have their water supply limited to four times per week, while 25% mentioned that they received water three times a week. Moreover, more than half (nearly 64%) of the network water users stated that they were unsatisfied by its quality. To meet their domestic potable and non-potable needs, households in ABA rely on a range of supplementary sources of water such as wells, tankers, and bottled water. Well water is basically used for all types of domestic purposes except drinking. Nearly 87% of the interviewees who use well water declared that their wells were shared by all apartments in the building. Similarly, water delivered by tankers is used for non-potable domestic purposes. The majority reported that they do not know the source of

Table 2 Most commonly used sources of water

Characteristics	Percentage
Suffering from water scarcity problems ($N = 295$)	
Yes	70
Other[1]	30
Sources of household water ($N = 300$)	
Network water	93
Well water	20
Water tanker	29
Bottled water	71
Satisfied by the quality of	
Network water	33
Well water	11
Water tanker	11
Bottled water	75

[1] Other includes No (not personally suffering from water shortage problems = 27.8%) and No clue (2.0%)

the water tankers and are generally dissatisfied with its quality. About 77% of the households use bottled water for drinking, which may be attributed to the lack of trust in the public water supply.

Respondents perception and knowledge of water reuse

Around half of the interviewees reported that they were aware of the term “wastewater reuse,” 34% had not heard the term before, and approximately 20% had heard the term but did not know how/why wastewater was reused (Table 3). No link was found between the level of education and level of awareness of wastewater reuse. In a similar study conducted in Kuwait, about 38% of the respondents had no knowledge about wastewater reuse, 47% had some knowledge, and only 14% were aware about the reuse of treated wastewater (Alhumoud and Madzikanda 2010). When asked about their willingness to use treated wastewater, about 50% of the interviewees responded positively with the rest being either not willing to reuse or had no opinion on the topic. Expectedly, the most acceptable reuse option for the interviewees was its use in agriculture/landscaping followed by toilet flushing and industrial use (Table 3). The acceptance rates decreased to 55% for clothes washing, 44% for showering/bathing, and 24% for cooking. Almost 15% of the interviewed households showed willingness to use treated wastewater for potable purposes; yet, this relatively high percentage may be attributed to respondents unconsciously seeking to impress the interviewers. Clearly, the level of human contact with the treated wastewater proved to be crucial in determining the acceptance of wastewater reuse; this is in agreement with other studies (Madany et al. 1992; Jefferson et al. 2004; Alhumoud and Madzikanda 2010). More than half of the respondents considered treated wastewater reuse advantageous as it conserves potable water, improves soil productivity, and saves money. Around 20% (strongly agree = 10%; agree = 10%) of the total respondents considered treated wastewater reuse as religiously unacceptable. The majority believed that it is disgusting to reuse water that was once contaminated with human waste and that treated wastewater is of inferior quality to network water. Nearly half of the respondents (51%) showed willingness to participate in programs that support the use of treated wastewater, 33% were not willing to support such programs, while the remaining did not express any opinion. Moreover, about 40% of the respondents were willing to pay

Table 3 Knowledge and perception of wastewater reuse

Characteristics	Percentage
Awareness of the term treated wastewater	
Have not heard about it	34.3
Have heard and know what it means	46.8
Have heard but don’t know what it means	18.9
Do you accept to use treated wastewater for non-potable purposes?	
Yes	50.7
No	38.3
No opinion	11.0
Acceptance to reuse treated wastewater for:	
Agriculture/landscaping	80.8
Industrial use	72.0
Toilet flushing	75.6
Clothes washing	55.3
Showering/bathing	43.7
Cooking	23.7
Do you accept to use treated wastewater for potable purposes?	
Yes	15.1
No	79.5
No opinion	5.4
Treated wastewater is disgusting	
Strongly agree	35.0
Agree	28.7
Other[1]	36.3
Wastewater reuse is not religiously accepted	
Strongly agree	10.4
Agree	10.4
Other[1]	79.2
Do you think treated wastewater reuse will conserve potable water?	
Strongly agree	23.8
Agree	34.9
Other[1]	41.3
Do you think treated wastewater reuse will improve soil productivity?	
Strongly agree	21.8
Agree	38.9
Do you think treated wastewater reuse will help us save money?	
Strongly agree	26.8
Agree	33.2
Other[1]	39.9
Willingness to participate in programs that support the use of treated wastewater	
Yes	50.5
No	33.9
No opinion	15.6

Table 3 (continued)

Characteristics	Percentage
Willingness to pay extra on current water bills for the cost of building a system	
Yes	40.8
No	44.6
No opinion	14.6

[1] Other includes "neutral," "disagree," and "strongly disagree"

an additional fee on their current water bill in order to build a new system for water reuse while 45% were not willing to incur any additional cost (Table 3).

However, it is worth noting that public acceptance of wastewater reuse for irrigation purposes is by no means universal as is evidenced by the studies of Ahmad (1991) and Kantanoleon et al. (2007) where more than 90% of the surveyed population in Doha-Qatar opposed the reuse of treated wastewater for farming (Ahmad 1991) while more than 70% of the surveyed population in Chalkida-Greece also opposed the use of treated wastewater for animals, crops, and greenhouse vegetables (Kantanoleon et al. 2007).

Lebanon lacks a functional wastewater sector and an effective and implementable national wastewater management strategy to protect public health and environmental quality. This has led the local communities and municipalities to plan and implement their own arrangements for wastewater treatment systems. However, most municipalities still lack the needed (human and financial) resources, management capabilities, and environmental awareness necessary to implement wastewater management in an environmentally sound manner. As such, almost all the respondents had no prior experience with reusing treated wastewater. Thus, questions about the likelihood to use this alternative source of water are hypothetical. Around 60% of the participants perceived the reuse of treated wastewater as risky and unsafe. Generally, people were found to trust their own impressions of water quality (often based on the turbidity of the water) more than they trust scientific evidence. This may be attributed to their lack of confidence in local government and the public utilities and/or the lack of environmental and public health awareness programs. Moreover, most respondents (about 60%) considered treated wastewater of inferior quality that might pose health risks and they stated that they found it hard to believe that water being previously in contact with contaminants can be purified and treated (Fig. 2). Nearly half of the interviewees stated that they believed that there was plenty of freshwater to use, as such using treated wastewater is not needed. A large percentage of the interviewed household members (42%) believed that the incidence of disease outbreaks would increase with the reuse of treated wastewater. Figure 2 depicts the general perceptions that the residents in the ABA had about the reuse of wastewater.

The success of water-reuse projects often depends on the credibility of the information provider and the communication process. The results revealed low levels of public trust in the government and media. About 90% of respondents did not trust that the current governmental authorities were able to properly operate a wastewater treatment plant and to deliver safe and high quality water or even oversee the process. Furthermore, about 80% of the surveyed ABA residents had no trust in the information

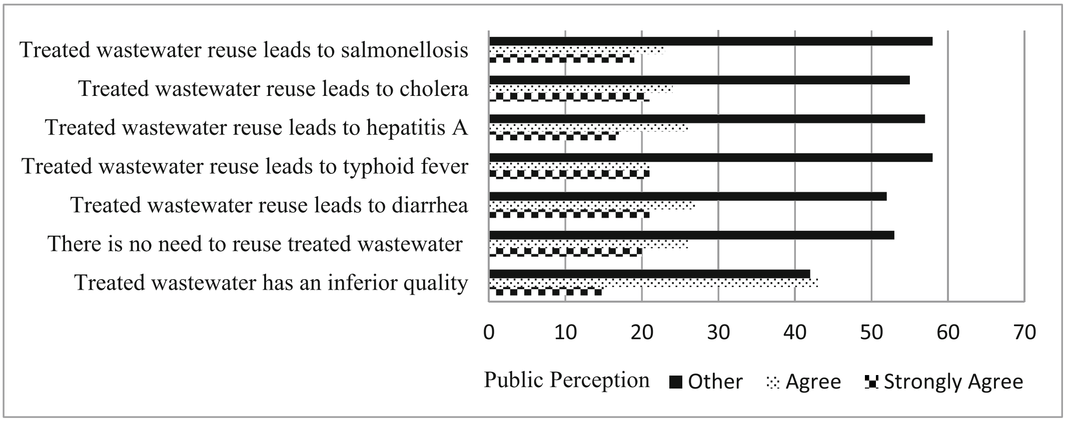

Fig. 2 General perception about the reuse of wastewater

communicated through social media (newspapers, TV stations, and radios), which may be attributed to the fact that the majority of Lebanese media institutions are operated by subjective porters for a political or sectarian faction. Respondents had a higher tendency to trust academicians and non-governmental organizations (NGOs), particularly with respect to environmental and public health issues. The potential root causes that may lead to the opposition of wastewater reuse projects are summarized in the fishbone diagram (Fig. 3).

Factors influencing willingness to use treated wastewater

Logistic regression was adopted in an effort to find the predictors affecting people's willingness to use treated wastewater. Significant variables at the 95% CI included the disgust factor, religion, and the perceived risk of water-borne diseases (Table 4). The disgust towards reuse of treated wastewater was found to be a strong predictor affecting willingness to reuse with an odds ratio (OR) of 2.848 (p value < 0.05); whereby those who believed it is disgusting to reuse treated wastewater were found to be on average, three times less likely to reuse treated wastewater as compared to those who did not declare disgust. This is in agreement with other studies (Nancarrow et al. 2008; Po et al. 2005; Wester et al. 2016) that have identified the disgust factor as a significant contributor to the lack of public acceptance and willingness to use. Similarly, a significant association was found between religious beliefs and respondents' willingness to use treated wastewater (OR = 1.88, p value < 0.05). Interviewees who thought treated wastewater reuse is not religiously accepted were, on average, twice less likely to use treated wastewater as compared to those who did not believe that reuse contradicts with their religious beliefs. Additionally, people's perceptions on associating the spread of water-borne diseases such as "Diarrhea" (OR = 2.525, p value $<$ 0.05), "Typhoid Ascariasis" (OR = 2.86, p value $<$ 0.05), "Hepatitis A" (OR = 2.586, p value < 0.05), "Cholera" (OR = 2.277, p value < 0.05), and "Salmonella" (OR = 2.092, p value < 0.05) with reuse were found to be significant. Those who perceived that reusing treated wastewater would lead to diseases and affect the human health, were on average, twice less likely to accept reuse (average of ORs for all types of diseases). Given the high correlation between the perceptions of contracting the different water borne diseases, only one typhoid ascariasis was included in the model. Not surprisingly, when asked about their willingness to pay for the treated wastewater, it was found that respondents

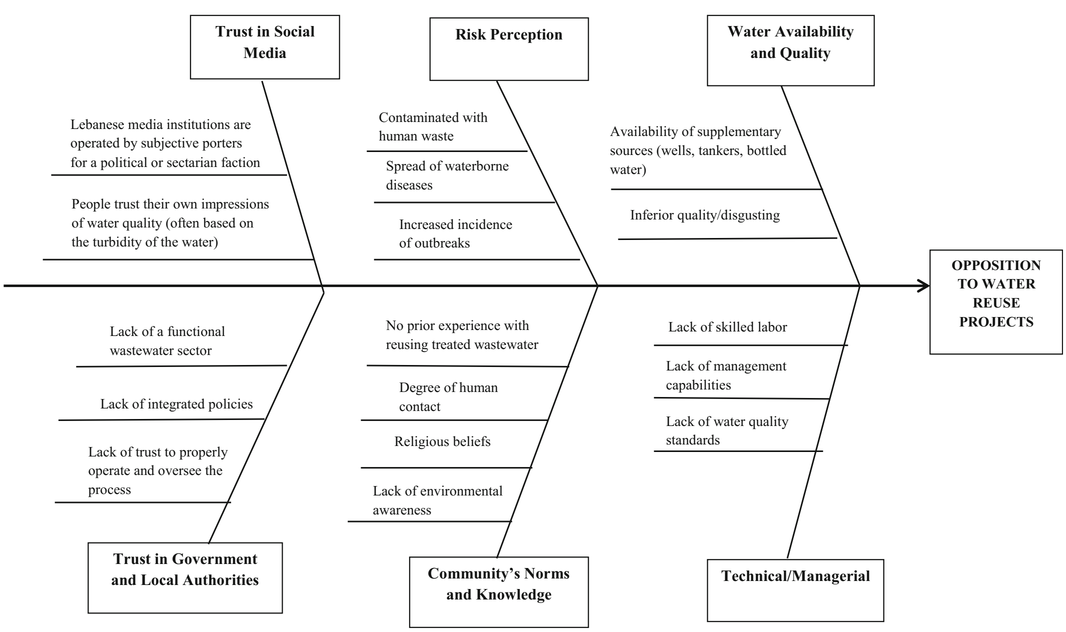

Fig. 3 Fishbone diagram for the opposition of water reuse projects

Table 4 The significant predictor variables tested for their association with willingness to usetreated wastewater at multivariate logistic regression

Variables in the equation	B	Exp (B)	S.E.	*t* value	*p* value
Typhoid ascariasis	− 0.257	0.773	0.060	− 4.273	2.78e-05
Disgusting to reuse treated wastewater	− 0.298	0.742	0.062	− 4.793	2.86e-06
Treated wastewater reuse not religiously accepted	− 0.133	0.876	0.071	− 1.857	0.0646
Constant	0.927	2.528	0.045	20.582	< 2e-16

B regression coefficient, *Exp* (*B*) odds ratio for each variable category

who indicated that they were willing to use treated wastewater were significantly more willing to pay for it as compared to those who refused use ($\chi2 = 64.129$; df = 1; p value < 0.05).

Conclusions and recommendations

This study revealed that public perception for the reuse of treated wastewater in the study area is primarily influenced by the disgust factor, religious beliefs, and perceived health risks associated with the reuse. Although the majority of respondents reported suffering from water scarcity problems, the use of supplementary sources of water such as wells, tankers, and bottled water to meet their domestic potable and non-potable needs may have been inadvertently affected their stated willingness to use treated wastewater. The degree of human contact was noted to influence the acceptance of water reuse, with a greater inclination towards the reuse for purposes with minimal human contact such as agriculture and landscaping. Although the public generally supports most wastewater reuse options, acceptance drops when the reuse option involves bodily contact with the greatest opposition for drinking water consumption.

The study highlighted a general lack of trust in governing institutions and authorities, which could be responsible for the high perceived health risks and high perceptions of risk resulting from system failure. Correspondingly, it is essential to involve the public in all phases of wastewater reuse schemes rather than to inform them of final decisions. Although the disgust towards reuse of treated wastewater was found to be a strong predictor for the willingness to use, alone it does not explain the negative public response of the community members. The study showed that the perceived risks of contracting waterborne diseases in general were highly correlated with willingness to use treated wastewater. A possible explanation can be that the level of knowledge about water reuse in ABA is relatively low. In the event people had previous experience or had heard about successful implementation of projects/examples, they might have been more likely to acknowledge the benefits of reusing water and less reluctant towards utilizing it as a supplementary source of water.

In order to ensure the maximum social acceptability of water reuse, awareness campaigns should be designed to promote water reuse projects at the country level. These campaigns should highlight potential health risks and benefits of using treated wastewater through training workshops, media, and educational institutions. Furthermore, the government of Lebanon should develop relevant policies and abide by WHO standards to minimize the hazards of wastewater reuse and to ensure safe and good quality treated water in Lebanon. Ultimately, the involvement of all stakeholders in improving the social acceptability towards wastewater reuse is mandatory. Given the lack of trust in the governing authorities and the fact that residents reported low trust in information communicated through the government, local media sources, and social media, public awareness campaigns should be conducted by trusted international and/or local non-governmental organization in association with scientific experts. Yet, actions based merely on awareness will not guarantee public acceptance of reuse projects. A comprehensive strategy of increasing awareness and knowledge, setting policies related to wastewater reuse, building public trust and communication channels, increasing public participation/engagement in decision making, and developing a sustainable management framework are all crucial elements.

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