Is The Water OK?

Factors Influencing Treated Wastewater Acceptability

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ABSTRACT

As climate change depletes our water availability, finding methods for water conservation becomes increasingly crucial. As a result, water-governing agencies spanning local, state, and federal levels are conserving their potable water through recycling wastewater. Although water reclamation through this method is feasible, public acceptance is scarce due to lack of awareness, anxiety about health risks, and preconceived notions of disgust. For example, in the early 2000s, the Toilet-to-Tap campaign began in California in an effort to combat water scarcity as a result of a persistent drought. Because of public opposition, this campaign was shut down, along with its efforts to build new wastewater treatment plants. While existing research has studied the nature of this opposition in terms of stewardship, my study aims to find factors directly related to one's willingness to drink recycled water. Additionally, this study attempts to find ways to change perceptions about treated wastewater. My study analyzed 130 survey responses and an interview with Michael Tovar, a retired Senior Project Manager for wastewater treatment plants. Results from the survey conclude that no matter a person's religion, political affiliation, education, and income, 66.2% of people say that water can be treated highly enough that they would drink it. A person's identity may serve as a justification for one's willingness, but do not directly influence acceptability. I intersect the aforementioned variables with trends of willingness, to demonstrate how raising awareness among the public and improving leadership would enhance the feasibility of drinking recycled water.

KEYWORDS

Direct potable water, recycled water, water reclamation, water conservation, public opposition

INTRODUCTION

Water is an essential resource that all societies and cultures need access to. People need to drink water to maintain proper bodily function (CDC 2018). Water symbolizes cleansing in religions like Christianity through baptism (Nelson 2021) and Islam through wudu (Burton 1988). Most of our freshwater withdrawals are used for irrigation needed for our food sources (US Geological Survey). Water is also an important source of renewable energy that comes in the form of hydropower (Office of Energy Efficiency and Renewable Energy). Whether it be for health, identity, or infrastructure, water plays an important role in maintaining daily life. Although water is an essential renewable resource, climate change (United Nations 2022) and unchecked use of water (Kummu et al. 2016) puts this resource at risk. To ensure water availability and combat water scarcity, many water-governing agencies are turning to wastewater treatment plants as a solution. For example, in countries like Singapore and Israel, authorities invested heavily in water reclamation infrastructure to meet their water demands, including drinking water (Evans 2021, Simpson 2018).

However, there is resistance even where potable water is scarce. Because Australia was experiencing severe water scarcity, Australian authorities made plans to turn wastewater into potable water (Saad et al. 2017). Despite these plans to enhance public health, the general public opposed this plan out of disgust and would rather rely on a more costly water resource option, Brisbane's Wivenhoe Dam (Saad et al. 2017). Other barriers such as the non-use of technology by the Amish occurred in Minnesota regarding the Minnesota County's requirement to install septic systems to reduce health risks (Fritze 2021). Lack of trust in government authorities can also deter a person from supporting the drinking of recycled water (Ormerod and Scott 2013). Water is a resource necessary for survival, but recycling wastewater, even when faced with water scarcity, appears to be an unthinkable option for some more than others. Forms of resistance can be motivated by religious, political, economical, or scientific factors. In my paper, I aim to uncover the reasons behind the inconsistencies in the success of recycling wastewater as a water conservation method.

In order to remedy water scarcity, I investigate the viability and barriers of using recycled water for drinking water. I seek to answer the central question, "Is drinking treated wastewater a feasible solution for environmental sustainability?" Through surveys and interviews, I aim to answer: (1) What factors (e.g. religious, "yuck", political, and education) have an influence on

people's perception of drinking treated wastewater? (2) Can people's perceptions about recycled water change? And (3) What actions effectively change public perception of recycled water? I expect to find that religion will have a relationship to a person's choice to drink treated wastewater. I also expect to find that informing people of the wastewater treatment process will affect their willingness. Ultimately, I want to see if certain identities and practices will deter people from drinking treated wastewater and will therefore fall short from being a practicable, sustainable solution.

RECYCLED WATER IN CALIFORNIA

Potable water, also known as drinking water, can come from several sources depending on the location. This paper's research took place in California. Most of California relies on the rain and snow from the mountains that falls into its watersheds to supply residents with potable water (Fitzgerald and Klausmeyer 2012). Unfortunately, in 2021, California experienced its driest winter months in the last century (California Drought Action). This drought would exacerbate water scarcity in California. In recent years, water recycling is becoming increasingly important in California as the state faces these persistent drought conditions. There are several ways that recycled water is used in California, including: Direct Potable Reuse, Indirect Potable Reuse, and Non-Potable Reuse (California State Water Resources Control Board). Recycled water is regulated by the State Water Board's DDW who ensure California's quality of water is up to their drinking standards (California State Water Resources Control Board).

TOILET-TO-TAP CAMPAIGN EVOLUTION

The "toilet-to-tap" campaign involved plans to treat wastewater to produce high-quality drinking water. Public acceptance and political support have been problematic even for Orange County which has been recycling water for nearly 50 years (Mackie 2021). The term "toilet-to-tap" was first mentioned and most extensively used in social media to highlight the fact that recycled water comes from "dirty" water sources (Mackie 2021). This negative connotation is what ultimately led the campaign to fail. This framing contributed to the negative perception of recycled water as unsafe. Once the campaign was completely canceled, it was mocked by comedians on late night shows (Mackie 2021). This response to drinking recycled water not

only illustrates the power of disgust but also the public's inability to understand the severity of their water scarcity problems.

Since then, there have been many efforts to reframe the conversation around water reuse and illustrate its benefits for water sustainability and resilience. Many communities around the world, as seen in Singapore (France-Presse 2021) and Israel (Simpson 2018), have successfully implemented water reuse projects, using recycled water for purposes such as irrigation, industrial uses, and even indirect potable reuse. Now, the conversation around water reuse emphasizes water as a valuable resource. In fact, if things go according to the DWP (Department of Water and Power) and L.A. Bureau of Sanitation's plans, the city of Los Angeles will rely on recycled water from wastewater plants to meet their drinking water needs in the next decade (Pannett 2022).

However, the adoption of water reuse still varies widely depending on geography, culture, and regulatory frameworks. While some regions, such as California and Singapore, have embraced water reuse as a critical tool for water management in the face of drought and climate change, others are still struggling to overcome the "yuck" factor and gain public acceptance.

WATER RECLAMATION PROCESS

The treatment processes used in California's water recycling projects generally involve multiple stages of filtration and disinfection to remove contaminants and ensure the water is safe for its intended use. This process typically involves advanced treatment technologies such as reverse osmosis or ultraviolet disinfection to further remove impurities from the treated wastewater (Lakeside Equipment Corporation 2019). Water reclamation is a complex process that requires careful monitoring and testing to ensure that the treated water meets all requirements for safe drinking water.

The Process

Preliminary Treatment	Screening of large objects
Primary Treatment	Wastewater is sent to settling tanks where sludge is removed
Secondary Treatment	Partially treated water is sent to aeration tanks, removing bacteria and microorganisms
Tertiary Treatment	Water is disinfected with chemicals (chlorine) or ultraviolet rays to remove viruses

Table 1. From Nickles, C., and S. McClurg. 2013. Wastewater Treatment Process in California. https://www.watereducation.org/aquapedia/wastewater-treatment-process-california

Once the wastewater has been fully treated through this process, it is typically discharged back into the environment, either into the ocean, rivers/lakes, or groundwater recharge systems (U.S. Geological Survey).

POSSIBLE FACTORS FOR WILLINGNESS

As water scarcity becomes an increasingly pressing issue, the importance of water recycling is likely to continue to grow in California and other water-stressed regions; however, public acceptance is still a significant barrier to implementation. Some factors that might influence someone's willingness to drink recycled water include: religion, politics, education, and disgust.

Religion

According to available studies, there is a relationship between religion and environmental stewardship. These studies investigate the relationship between belief systems, like dominion beliefs (Shin et al. 2021) and controlling beliefs (Eom et al. 2021), and their influence on a person's environmental attitudes and behaviors. Depending on what type of "god" you believe in, a person may think the world's resources are theirs for the taking or theirs for the protecting. Those who believe in "dominion" oriented religions uphold the belief that god created the world and its resources for people to use for their advantage (Shin et al. 2021). Those

who believe in a "controlling" god believe any events or decisions are up to the will of their god (Eom et al. 2021). These beliefs can either influence a person to protect their resources because it is their responsibility, or it can influence a person to neglect the sustainability of their resources because their "god" will handle the recovery of these resources. As a result of these different foundational religious beliefs, a person may endorse stewardship but may not necessarily engage in environmental practices. In the case of treated wastewater acceptability, a religious person may support the idea because, for example, water is a gift from their god. However, the same person may not necessarily drink the water themselves because of disgust. These studies were limited to stewardship, which means that religion does not necessarily influence willingness to drink recycled water. However, religion does have an opinion on recycled water. For example, from an Islamic perspective, the reuse of treated wastewater is considered legitimate (Farooq and Ansari 1981). Instead, Muslims appear to be more concerned over health risks, costs, and public opposition (Farooq and Ansari 1981).

Religion also influences water management. In 2013, Fillmore County began requiring that the Amish install septic systems to treat wastewater to reduce health risks (Fritze 2021). The Supreme Court sided with the Amish who wanted to reuse water for irrigation or treat it through older systems because they do not believe in using technology (Fritze 2021). The Amish maintain a religious belief that encourages them to separate themselves from the world, which includes most technology, in order to enter heaven (Brady 2013). In this scenario, religion played a role in deciding that wastewater treatment plants would be unaccepted in a religious community.

Conversely, one study confirms that it is common, especially in developed countries, for policymakers to ignore religious voices in their policy decisions (Maliva and Missimer 2012). This study gave an example using the Ganges River: cleaning up the Ganges River has great religious significance, but political authorities prioritized food production (Maliva and Missimer 2012). Installing wastewater treatment plants and using its products for potable purposes is a major policy decision for authorities to make. When making decisions, it is important to take into account all voices, including religious ones. In this case, religious concerns were overshadowed by health concerns, much opposite of the Amish community example.

Although previous studies have demonstrated religion's role in stewardship (Eom et al. 2021 and Shin et al. 2021), water management (Fritze 2021), and water policy (Maliva and Missimer 2012) it is unclear whether religion will also play a role in water conservation in the form of recycled water acceptability.

Politics

The water crisis along the Gaza Strip is fundamentally a religious and political issue. The crisis is not because of water, but water is nested in it. Currently, Israeli authorities are weaponizing water. Water weaponization in the Gaza Strip refers to using water as a tool to take political advantage of the Palestinian territory of Gaza byIsraeli authorities (Baroud 2016). The Gaza Strip is an important example that illustrates a limitation on water availability due to politics (Haas 2022). Israeli policies have contributed to the depletion of Gaza's water resources by destroying infrastructure needed to maintain wastewater treatment plants (Haas 2022). As a result, residents of the Gaza Strip face severe water shortages. Efforts are underway to address the water crisis in the Gaza Strip, including through the installation of new water treatment plants and pipelines (KFW 2021). However, the root causes of the crisis, including the ongoing religious conflict and political instability in the region, continue to pose significant challenges to achieving sustainable water access in Gaza. Recycled water acceptability based on these events are inconclusive, but this information provides motivation for this research. The war between the Israelis and the Palestinian illustrates how important water is while also portraying the political challenges that come with water conservation.

Politics also shapes public perception which can be convoluted by knowledge, values, and authority. Several studies have shown that willingness to drink recycled water can be influenced by one's trust in their governing bodies (Massoud et al. 2018). In Arizona, public acceptance of potable reuse depended on people's trust in the wastewater management authorities (Ormerod and Scott 2013). However, trusting an authority does not mean a person is educated on the process. Unfortunately, promoting awareness will not guarantee public acceptance of reuse projects either (Massoud et al. 2018). Inherently, it may seem that developing an awareness of water conservation methods would be conducive to recycled water acceptance. However, studies have also shown that public acceptability of drinking treated wastewater was low even for literate or educated people (Mu'azu et al. 2020).

YUCK Factor

Ultimately, disgust and survivability may determine acceptability. Studies by Rozin and Nawab suggest that the "yuck" factor controls one's willingness to drink treated wastewater. Previous research highlights that recycled water is mostly associated with disgust and

contamination (Etale et al. 2020). Similar studies have investigated the use of framing recycled water in a way that promotes recycled water as safe (Menegaki et al., 2009). The more general literature focused on disgust sees the emotion of disgust as a mechanism that alerts people of potentially dangerous substances that can cause harm or disease (Mankad 2012). For example, molding food or feces can be harmful if consumed, so feeling disgusted by them helps us avoid them. However, people need to learn that wastewater is treated properly enough to be safe to drink. What was once waste is no longer harmful for consumption.

METHODS

Data Collection

I conducted my research by building upon two distinct data collection methods: a survey and a semi-structured interview. First, in order to examine which factors influence acceptability and changing perceptions, I designed a survey that consisted of 22 questions pertaining to one's willingness. I also asked 7 demographic questions about age, gender, education, political affiliation, eating preferences, cultural preferences, religion, and income. This survey was written using Google Forms, and I shared the link to the survey to UC Berkeley Students and Professors who also had the option of sharing the survey link with others. Most of the students and professors I initially reached out to had some knowledge about the environment.

In order to investigate possible actions to advocate for recycled water, I interviewed Michael Tovar, a retired CH2M HILL Senior Project Manager with over 30 years of experience. His work included operations line management of design and construction organizations as well as project design management and construction management responsibilities for water and wastewater projects up to $300 million in value.

Data Analysis

To determine whether there was an association between religion, political affiliation, education, and income, I performed a statistical analysis on R Commander. I used chi-squared tests comparing my demographic variables to the responses I received from my survey. More specifically, I performed this statistical analysis on the responses for question #8 on my survey, which asked for the respondent's willingness to drink wastewater subject to tertiary treatment.

To explore any changes in willingness, I compared response averages between different excerpts I presented in my survey. The control variable for this comparison were the responses from willingness to drink water subjected to tertiary treatment.

Interview Coding

To code the responses of the interview, I used a ground-up approach. Inductive coding allowed me to derive codes from the survey data. In order to discover possible actions to support recycled water acceptability, I aimed to find themes among Tovar's quotes.

RESULTS

Demographics

Table 2: Demographics from survey.

Age	**Percentage of Responses**
12-17	6.2%
18-24	50%
25-34	18.5%
35-54	16.9%
55-74	8.4%
Gender	
Female	62.3%
Male	34.6%
Non-Binary	1.5%
Prefer Not Say	1.5%
Education	
Some High School	2.3%
High School	42.3%
Bachelor's Degree	40.8%
Master's Degree	6.2%
Ph. D. or higher	6.9%

Political Affiliations	
Democrat	46.2%
Republican	6.9%
Independent	26.9%
Prefer not to say	20%
Religion	
Christianity	50%
Islam	3.1%
Buddhism	3.1%
Hinduism	0.8%
Atheism	10.8%
Agnostic	16.9%
Income	
Less than $25,000	42.6%
$25,000 - $50,000	6.2%
$50,000 - $100,000	8.5%
$100,000- $200,000	10.9%
More than $200,000	9.3%

I found that a majority of my respondents were 18-24 years old, female, have some high school education, democrat, omnivore, Christian, and made less than $25,000 a year (Table 2). In other words, most respondents were young, educated, and religious.

Part 1: Trust in treatment process

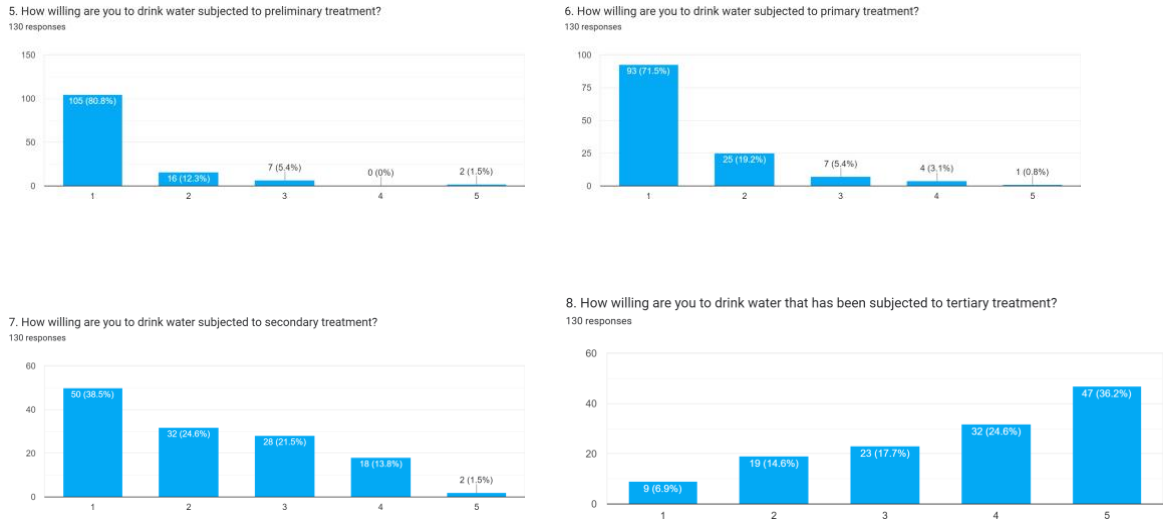

Figure 3. Willingness to drink recycled water based on the different stages of treatment.

For the first 3 steps of the treatment process, people tend to be unwilling to drink the water (Figure 3). By the 3rd step, we see a 116% increase in people becoming more willing (more 2/3/4s and less 1s). And by the tertiary step of the treatment, the trend reverses and now more people are willing than not to drink recycled water: 79 people are now more willing to drink the wastewater compared to the 20 people who said they were willing to drink water subject to secondary treatment. I observed a 295% increase.

Demographic	**P-Value**
Religion	0.1588
Political	0.7718
Age	0.5112
Eating Preference	0.8269
Education	0.6497
Income	0.9205

Table 3: P-Values testing association between willingness and demographic

I used chi-squared tests and compared religious affiliation, political affiliation, economical status, and education to the responses from their willingness to drink wastewater subject to tertiary treatment. I found no p-value less than 0.05 that would reject the null hypothesis that there is no association between the two variables.

Part 2: Excerpts

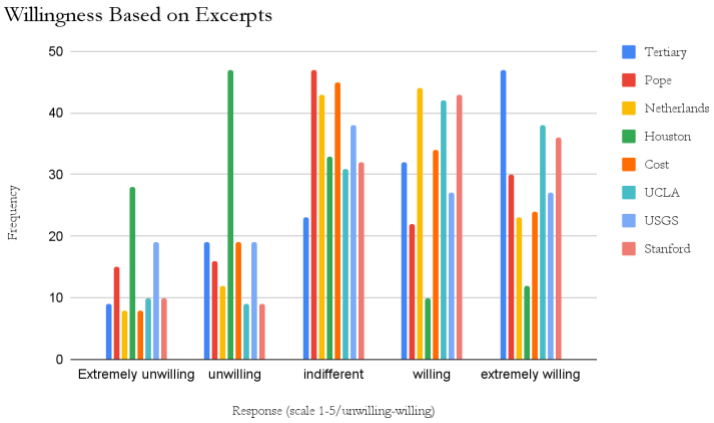

Figure 4: Count of willingness based on excerpts.

I compared the responses from the respondents' willingness to drink wastewater subject to tertiary treatment to the responses from their willingness to drink recycled water based on excerpts I provided under the categories of Religion, Politics, Economics, and Health. I found that most counts of willingness were similar no matter what excerpt I presented to the respondents. I found exceptions to this trend when I presented the excerpt from Houston.

	Extremely Unwilling	Unwilling	Indifferent	Willing	Extremely Willing
Tertiary (Control)	9	19	23	32	47
Pope	15	16	47	22	30
Netherlands	8	12	43	44	23
Houston	28	47	33	10	12
Cost	8	19	45	34	24
UCLA	10	9	31	42	38
USGS	19	19	38	27	27
Stanford	10	9	32	43	36
Average	14	18.71428571	38.42857143	31.71428571	27.14285714

Table 4: Average willingness based on excerpts

For the responses related to the excerpts, respondents answered on average extremely unwilling 14 times, unwilling 18.71 times, indifferent 38.42 times, willing 31.71 times, and extremely willing 27.14 times (Table 4). Compared to the responses from their willingness to drink wastewater subject to tertiary treatment, on average, people were more indifferent (23 < 38.42) and unwilling (47 > 27.14) when I presented the excerpts. This difference I observed indicates some form of change in perception based on the excerpts. By the end of my survey, 66.2% of people say that water can be treated highly enough that they would drink it (Figure 5).

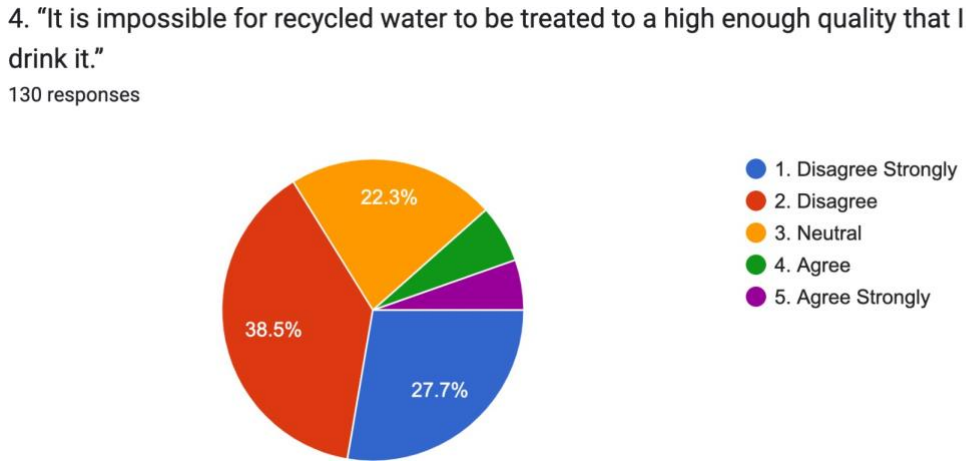

Figure 5: Possibility of treating water to be potable

Part 3: Actions to move forward

From the quotes I derived from Michael Tovar's interview, I found the following themes: survival, disgust, culture, education, and leadership (Table 4).

Issues to Address	Quote
Survival	"Because human waste is associated with odor, usually odor, anything that is odor rotten, like rotten carcasses, things like that means danger means it's not healthy, it's diseased ridden, you could die from this, stay away from it. So there may be some of that built in, you know, from eons ago, the survival instincts of you stay away from that." "And people will come up to me and just say, I am so glad you are here. When are you going to be done? You know, please hurry, you know, we're really, really afraid that we're going to be running out of water."
Disgust	"So they gave me a dozen bottles. Brought it to them, to a family thanksgiving after everybody had eaten because I want to make sure to eat first. And then I said okay, I wanted to give you guys a little bit something to think about and I gave them a bottle of water. I said, 'This right here is from Orange County and it is treated wastewater that is now drinkable.' And so then we all opened it up and said okay, what do you think? So it was a fascinating discussion. And people were a little nervous, but at the same time curious. And so yeah, it's fine. Tasted-like water."
Culture	"They refused to operate it. When they said that this is beneath us, and it's some cultural thing. They said, You know, we're going to have the Filipinos operate, or we're gonna have the Indians up, we are not going to touch it."
Education and Ignorance	"It's very foreign to them. And most people don't like even talking about them. Or I don't want it in my backyard. It just flushes and goes down the toilet, and I just really don't want to think about it." "The city of LA has stopped calling their wastewater treatment plants, scorching plants, they're now called water recycling plants."
Leadership	"I've seen [frustration] in many places, in both publicly operated facilities and in privately run facilities, when the team does not feel like they have the backing of the leadership, the political leadership, whoever provides the funds for maintenance." "And then you see, the workers, the operators, the maintenance, guys, just like, if my boss doesn't care, why should I? It's so I think it's a matter of leadership." "I can't believe they're wasting so much money on me trying to make this thing work when you haven't even been paying attention to maintaining your system."

Table 4: Themes from Tovar interview

DISCUSSION

Previous studies have shown that environmental stewardship can be influenced by cultural factors (Eom et al. 2021 and Shin et al. 2021). Cultural factors like religion do play a role in supporting or opposing water policy, but it is unclear how religion plays a role in a person's acceptability to drink recycled water. Stewardship does not necessarily mean that people will choose to drink treated wastewater. Politics, costs, and education also guide methods of water conservation, but little research shows whether personal political affiliation, income, or education status will affect recycled water acceptability. Instead, most studies on willingness to drink recycled water conclude that disgust is the most influential factor (Powell et al. 2019, Rozin et al. 2015, Wester et al. 2016). While disgust is an important factor to consider, it would be unproductive to assume that no other factors play a role.

Factors Influencing Treated Water Acceptability

There is a trend in increasing willingness as wastewater treatment increases. However, my statistical analysis, as indicated by the p-values greater than than 0.05, illustrates that religion, political affiliation, education, income, and age did not play a role in deciding whether a person will be willing to drink recycled water or not. These results are similar to another study done in Nigeria (Akpan et al. 2020). In this study, religion did not play a role in one's willingness to drink recycled water (Akpan et al. 2020). In this same study, researchers found that more than half of the respondents were more concerned about the water quality, health risks, plant management, and the legitimacy of the treatment process (Akpan et al. 2020). Ultimately, it is a factor of disgust and health concern when it comes to a person's willingness. In another study done in Durban, researchers concluded with comparable results: key concerns were related to the "yuck" factor and religion did not pose an opposition to wastewater reuse (Wilson and Pfaff 2008). In general, people are not comfortable with the idea of potable water recycling and deem it a last resort (Wilson and Pfaff 2008). Although people are not completely open to drinking recycled water, my results, like those found in Rozin's study in 2015, found that more than 60% of people believe that water can be treated enough to be drinkable. It is simply a matter of getting over the disgust factor. My final analyses of my factors support the idea that religion is not an influential factor in acceptability and imply that disgust could be a determining factor.

Although religion, political affiliation, education, income, and age did not play a decisive role in willingness, I would argue that these variables are a means of justifying one's disgust. For example, a person justifies their stewardship based on the type of "god" they believe in (Eom et al. 2021 and Shin et al. 2021). The way religion frames stewardship can be reflected in recycled water acceptability. If a person's "god" says to drink water because the person has a duty to protect the sustainability of their resources, then a person would be more willing. Researchers can apply the same logic for opposition: if their "god" says not to, they would not drink it. Using a belief as a means of justification can also apply to other cultural or political identities.

Changing Perceptions

To evaluate changing perceptions, I presented a series of excerpts containing a mixture of articles that supported and opposed the use of wastewater treatment plants and recycled water. In general there is a lack of both unwillingness and willingness when a person was presented with excerpts about wastewater treatment plants and recycled water. More than half my respondent population had a Bachelor's Degree or higher, but most people responded with an indifference to their willingness when given an excerpt from the US Geological Survey saying recycled water is safe to drink. These results are supported by the results from the study done in Saudi Arabia that also found low acceptability of reusing treated wastewater among students and academics (Mu'azu et al. 2020). My findings also support another study that concluded that a lack of trust in governing bodies deters people from drinking recycled water (Massoud et al. 2018). Surprisingly, when presented with an excerpt from Stanford Engineering that supported the use of recycled water for drinking, respondents were quick to change their willingness. Similarly, one outstanding result involved how the respondents reacted to my excerpt on Houston. The excerpt I chose came from an article exposing the fact that a privately owned wastewater treatment plant was allegedly falsifying their reports, causing a bad smell to overwhelm the neighboring city. In both these cases (Stanford Engineering and Houston excerpts), there is a visible change in willingness to drink water depending on the information provided. This would imply that people's perceptions can change.

Addressing challenges

Michael Tovar mentions issues he has encountered during his time as a wastewater treatment plant project manager. Among the issues, he addresses educating people as a very effective way of increasing acceptability. Early in the interview, Tovar says that the wastewater treatment process is "very foreign" to people and "most people don't like even thinking about it" let alone talking about it. However, when Tovar made the effort to educate his family and offer to drink recycled water with them, people were more open to talking about how it tastes "just like normal water." This is a reasonable result as there is a study done in the UK that found that disgust influences a person's willingness to pay for sustainable product alternatives (Powell et al. 2019). This study found that a slow and repeated exposure to recycled water can be used to change one's perception of disgust (Powell et al. 2019). My results indicate that changing perceptions are possible and can be altered to encourage more environmentally sustainable behaviors.

Tovar's interview also discusses another key feature: lack of leadership and management. If people can uphold higher standards of leadership and management when maintaining wastewater plant facilities, people would probably be more inclined to drink recycled water. This response is supported by a study done by Ormerod and Scott who found similar results.

Limitations and Future Directions

A limitation of my study involves a need for further statistical analysis. I only performed chi-squared tests on one of the many questions I presented in my survey. With more time, it would have been interesting to assess whether my demographic data had a relationship with the willingness presented in my excerpts. My study also lacked diversity. My study only sampled responses from 130 people. It would have been beneficial to have asked other institutions to respond to my survey. For example, with more time I could have surveyed Mormons, more Catholics, elementary or middle schools, or public officials.

The one factor I touched on but did not go into depth was eating preference. There was a lack of research on the health benefits surrounding the consumption of recycled water, so I was unable to develop theories around eating preferences. It would also be beneficial for the feasibility of wastewater treatment plants to research specific framings or words to reduce a person's preconceived notion of disgust. Moving forward, future research should focus on ways

of overcoming disgust to make recycling water a feasible option for water conservation.

CONCLUSION

Reclaiming water is an option. Treating wastewater enough to be potable is possible today, and it is used in California. While not currently normalized or used worldwide, drinking treated water is a solution for water conservation. Oppositions to wastewater treatment plants do come in many forms (religious, political, and economical). Through my research, results indicate that people are capable of changing their perceptions. Opposition is reversible and people are willing to drink recycled water. Although my findings illustrate that certain factors do not influence willingness to drink recycled water, I found a trend in how these factors pose as a justification for the preconceived notion of disgust when it comes to treating wastewater. With the help of these results, future public officials and researchers will be able to consider the influence of different factors on water conservation.

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REFERENCES

Akpan, V. E., D. O. Omole, and D. E. Bassey. 2020. Assessing the public perceptions of treated wastewater reuse: opportunities and implications for urban communities in developing countries. Heliyon 6:e05246.

Baroud, R. 2016, July. In the West Bank and Gaza, Israel is using water as a weapon of war. https://theecologist.org/2016/jul/04/west-bank-and-gaza-israel-using-water-weapon-war.

Brady, J. 2013, September 2. Amish Community Not Anti-Technology, Just More Thoughtful. NPR.

Burton, J. 1988. The Qur'ān and the Islamic Practice of wuḍū'. Bulletin of the School of Oriental and African Studies, University of London 51:21–58.

California Department of Water Resources. (n.d.). The California Water System. https://water.ca.gov/Water-Basics/The-California-Water-System.

California Drought Action. (n.d.). Current drought conditions. https://drought.ca.gov/current-drought-conditions/.

California State Water Resources Control Board. (n.d.). Regulating Direct Potable Reuse in California. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/direct_potable_reuse.html.

CDC. 2018, October 26. Agricultural Water. https://www.cdc.gov/healthywater/other/agricultural/index.html.

CDC. 2022, June 6. Water and Healthier Drinks. https://www.cdc.gov/healthyweight/healthy_eating/water-and-healthier-drinks.html.

Eom, K., T. Q. H. Tok, C. S. Saad, and H. S. Kim. 2021. Religion, environmental guilt, and pro-environmental support: The opposing pathways of stewardship belief and belief in a controlling god. Journal of Environmental Psychology 78:101717.

EPA. (n.d.). Where Does All the Dirty Water Go?

Etale, A., K. Fielding, A. I. Schäfer, and M. Siegrist. 2020. Recycled and desalinated water: Consumers' associations, and the influence of affect and disgust on willingness to use. Journal of Environmental Management 261:110217.

Evans, J. 2021, August 14. Singapore Turns Wastewater into Drinking Water. https://learningenglish.voanews.com/a/singapore-turns-wastewater-into-drinking-water/5997771.html.

Farooq, S., and Z. I. Ansari. 1981. Philosophy of water reuse in Islamic perspective. Desalination 39:273–281.

Fitzgerald, K., and K. Klausmeyer. 2012. Where Does California's Water Come From?

France-Presse, A. 2021, August 10. Singapore Turns Sewage into Clean, Drinkable Water, Meeting 40% of Demand. https://www.voanews.com/a/east-asia-pacific_singapore-turns-sewage-clean-drinkable-w ater-meeting-40-demand/6209374.html.

Fritze, J. 2021, July 2. Supreme Court sides with Amish who argued septic systems violate their religious beliefs. https://www.usatoday.com/story/news/politics/2021/07/02/supreme-court-backs-amish-religious-opposition-septic-systems/5368117001/.

Haas, A. 2022, January. Israel Holds Up Vital Spare Parts for Gaza's Water and Sewage Systems. Haaretz.

KFW. 2021, March 23. Long breath required - wastewater treatment plant in Gaza put into operation - occupied Palestinian territory | ReliefWeb. https://reliefweb.int/report/occupied-palestinian-territory/long-breath-required-wastewater-treatment-plant-gaza-put.

Kummu, M., J. H. A. Guillaume, H. de Moel, S. Eisner, M. Flörke, M. Porkka, S. Siebert, T. I. E. Veldkamp, and P. J. Ward. 2016. The world's road to water scarcity: shortage and stress in the 20th century and pathways towards sustainability. Scientific Reports 6:38495.

Lakeside Equipment Corporation. 2019, October 7. Does Wastewater Become Drinking Water?

Leong, C., and L. Lebel. 2020. Can conformity overcome the yuck factor? Explaining the choice for recycled drinking water. Journal of Cleaner Production 242:118196.

Mackie, A. 2021, January 14. California's Water History: The Origin of 'Toilet-to-Tap.'

Maliva, R., and T. Missimer. 2012. Religious and Cultural Influences on Water Management. Pages 871–879 *in* R. Maliva and T. Missimer, editors. Arid Lands Water Evaluation and Management. Springer, Berlin, Heidelberg.

Mankad, A. 2012. Decentralised water systems: Emotional influences on resource decision making. Environment International 44:128–140.

Massoud, M. A., A. Kazarian, I. Alameddine, and M. Al-Hindi. 2018. Factors influencing the reuse of reclaimed water as a management option to augment water supplies. Environmental Monitoring and Assessment 190:531.

Menegaki, A. N., R. C. Mellon, A. Vrentzou, G. Koumakis, and K. P. Tsagarakis. 2009. What's in a name: Framing treated wastewater as recycled water increases willingness to use and willingness to pay. Journal of Economic Psychology 30:285–292.

Mu'azu, N. D., I. R. Abubakar, and N. I. Blaisi. 2020. Public acceptability of treated wastewater reuse in Saudi Arabia: Implications for water management policy. Science of The Total Environment 721:137659.

Monks, K. 2014, May 1. From toilet to tap: Getting a taste for drinking recycled waste water. https://www.cnn.com/2014/05/01/world/from-toilet-to-tap-water/index.html.

Nawab, B., I. L. P. Nyborg, K. B. Esser, and P. D. Jenssen. 2006. Cultural preferences in designing ecological sanitation systems in North West Frontier Province, Pakistan. Journal of Environmental Psychology 26:236–246.

Nelson, S. 2021, August 16. The Fascinating Symbolism Of Water In The Bible: 9 Attributes.

Nickles, C., and S. McClurg. 2013. Wastewater Treatment Process in California.

https://www.watereducation.org/aquapedia/wastewater-treatment-process-california.

Office of Energy Efficiency and Renewable Energy. (n.d.). Hydropower Basics. https://www.energy.gov/eere/water/hydropower-basics.

Ormerod, K. J., and C. A. Scott. 2013. Drinking Wastewater: Public Trust in Potable Reuse.

Science, Technology, & Human Values 38:351–373.

Pannett, R. 2022, September 1. Don't be 'squeamish' about drinking reused wastewater, U.K. official says. Washington Post.

Powell, P. A., C. R. Jones, and N. S. Consedine. 2019. It's not queasy being green: The role of disgust in willingness-to-pay for more sustainable product alternatives. Food Quality and Preference 78:103737.

Rozin, P., B. Haddad, C. Nemeroff, and P. Slovic. 2015. Psychological aspects of the rejection of recycled water: Contamination, purification and disgust. Judgment and Decision Making 10:50–63.

Saad, D., D. Byrne, P. Drechsel, D. Saad, D. Byrne, and P. Drechsel. 2017. Social Perspectives on the Effective Management of Wastewater. Page Physico-Chemical Wastewater Treatment and Resource Recovery. IntechOpen.

Simpson, K. 2018, October 18. What the world can learn from Israel's water reuse programs.

Shin, F., J. L. Preston, and this link will open in a new window Link to external site. 2021. Green as the gospel: The power of stewardship messages to improve climate change attitudes. Psychology of Religion and Spirituality 13:437–447.

United Nations. 2022, May 20. Climate change threatening access to water and sanitation. https://news.un.org/en/story/2022/05/1118722.

US EPA, O. 2021a, November 9. California (Treated Municipal Wastewater for Potable Water Reuse). Data and Tools. https://www.epa.gov/waterreuse/california-treated-municipal-wastewater-potable-water-reuse.

US EPA, O. 2021b, December 3. California (Treated Municipal Wastewater for Centralized Non-potable Reuse). Data and Tools. https://www.epa.gov/waterreuse/california-treated-municipal-wastewater-centralized-non-potable-reuse.

U.S. Geological Survey. (n.d.). A Visit to a Wastewater Treatment Plant. https://www.usgs.gov/special-topics/water-science-school/science/a-visit-a-wastewater-treatment-plant.

Wester, J., K. R. Timpano, D. Çek, and K. Broad. 2016. The psychology of recycled water: Factors predicting disgust and willingness to use. Water Resources Research 52:3212–3226.

Wilson, Z., and B. Pfaff. 2008. Religious, philosophical and environmentalist perspectives on potable wastewater reuse in Durban, South Africa. Desalination 228:1–9.