

Socio-Technical Relationships between Water Access and Quality in Flint, Michigan and Newark, New Jersey

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On my honor as a University Student, I have neither given nor received
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Introduction

Issues with water quality and access are profound problems which are present all over the United States. A multitude of factors have led to previous scandals which would have been more manageable if they were dealt with in a timely fashion. This issue was selected for this research paper due to the personal connection I have with the problem and the case study in Newark, New Jersey. While I was in high school, there were lots of issues with water quality within my county due to malfunctioning water treatment plants and outdated infrastructure. For a couple of months, our water supply at home and school were deemed unsafe to use or consume due to lead leaching into our water supply. My family boiled our water or used bottle water until the lead levels were brought back to a safe level. It was an inconvenience to have to boil our water before cooking and having to use bottled water for everyday activities. The concern about unsafe drinking water was scary and brought up lots of concerns about water quality within my community. This water issue lasted even longer for my father since he works in the city of Newark which has had an even longer bout with lead in the water that will be explained further later on in the paper. He still only uses bottled water at work to this day and does not trust the water although measures have been put in place to ensure its safety. These prevailing attitudes towards the water crisis have caused the problems to rise above just water quality and access but begins to touch different aspects of life.

Considering the United States is found to be one of the most advanced countries in the world, the profound problem with water access and quality is unbelievable to many citizens of the United States. The United States may have some of the best technology in the world, but this

does not mean that this technology is always used in the best way. Funding is not always distributed correctly among the population and its demands, also legislation is not always being used properly or exists to control the issues with not all citizens having access to clean water. As Pretty Prairie, Kansas and certain areas of Delaware have more issues with getting access to clean drinking water (Langin, 2018). This trend shows that within the United States more rural and lower income areas have problems with receiving clean water due to not getting enough funding leading to more water policy violations (Condon, 2019).

The STS research topic being explored in this paper will focus on water quality and accessibility within two specific case studies within the United States. The case studies will range from Newark, New Jersey to Flint, Michigan. The analysis of these case studies will expand on the socio-technical relationships among the water systems with descriptions and comparisons. All the case studies deal with water quality issues but in different aspects as Newark and Flint are associated with lead poisoning from lead seeping into the water pipes (Corasaniti, 2019). This topic is crucial to be discussed because all people deserve the right to clean water since water is a necessity to survive along with food. If too many deaths occur from people not having clean drinking water, the morality of the current government of the United States would be in question. The STS framework to be used within this analysis is wicked problem framing and SCOT framework. Wicked problem framing is put into consideration when an issue has no immediate solution but needs to be addressed in some capacity using certain methods to help the greater good of the nation. The SCOT framework will analyze the different stakeholders within the case studies and determine each of their roles and their efforts within the communities, also it compares the similarities and difference between them to determine the widespread urgency of water access problems. The research question for the STS topic in

consideration is what are the socio-technical relationships among water quality and access among Flint, Michigan and Newark, New Jersey?

Literature Review

Many kinds of factors affect the water crisis all over the United States. People who do have access to clean drinking water tend to be in poverty-stricken areas or minority dominated communities. This can be taken back to the environmental racism that built our country and mixed with the industrial history of the United States. “At the beginning of the 20th century, zoning ordinances emerged as a way to separate land uses in order to protect people from health hazards” (Solomon & Ross, 2017). This evolved to using the zoning laws to create these so-called perfect communities that did not include undesirables, meaning people of color were not included. People of color in a community were known to be frowned upon by some of the white people in the neighborhood and brought down the property values of the homes in the area. Deeming the city, a title of being an undesirable place to live and encouraging white flight to begin. The reluctance of whites to stay in their cities after the increase of minority populations caused white flight to begin and making the surrounding areas around their previous homes to have increased white populations (Pais et al, 2008). This led to lots of funding being placed towards these new white communities to create prosperous and safe environments for their people in the new areas called the suburbs. Neglecting the people of color that they left behind in the previously flourishing urban communities, deciding to cut through their communities and build businesses or homes for the new suburbs. Also exposing the people to noise, air, sound, and more forms of pollution that proved to be detrimental to their health and quality of life. This poor quality of life affects these people in all aspects of their life and causes water issues to transpire due to negligence from the government, legislation, and more.

Water quality issues tend to be more prevalent in areas with large minority populations, but it also affects communities with high levels of poverty with no emphasis on their demographics. Many areas of poverty do not have access to clean drinking water and the government does nothing to aid them because their cities are not considered high priority. In the film, *The Last Call at the Oasis*, the central valley of California is discussed as a previous area of prosperity with business blooming due to agriculture. This agricultural economy was possible due to the supply of water to the farmers to perform their work and keep the produce growing and flourishing (Yu, 2011). But due to water shortages in this area, these people were already living below their means and had their lives changed overnight when the state decided to turn off the water supply to the farms in the central valley to save the population of minnow fish that are close to extinction. This decision caused the loss of jobs for many people due to inoperable farms and droughts due to less water being supplied to their area. This is hurting the people who already were struggling financially to be in a worse off condition due to the loss of their jobs and less access to water which is a living necessity. Another example of government neglecting to think of the whole picture and how their decisions affect everyone involved, forming betrayal and anger from the American people when they can no longer afford their daily expenses and have no access to clean water. No access to clean water can lead to health complications and eventually prove to be dangerous for the wellbeing of the people. Many cities with high levels of poverty also have increasing water bills that are becoming unaffordable for the impoverished communities (Lakhani & Adolphe, 2020). The raising prices of water utilities can make getting clean water inaccessible for a lot of people in the United States, forcing these people to leave their homes and move to other areas where the cost of living is more affordable.

Although there is already some existing literature about general water issues widespread across the country and some certain case studies that have gained lots of public attention. Not enough literature is presently out there to help understand all the factors that affect water quality and access, thus the best approaches to solve the problems are not known. Many cities go through test periods of solutions to be able to select the best one and help the people in the best way possible, but this process can take years and can put people's lives in danger if left untreated for too long. The comparative analysis between Flint, Michigan and Newark, New Jersey that will be completed in this research paper will help further the research in the field of water quality and access in the United States. Also proving the many socio-technical aspects that surround the topic and influence the outcome of the cases.

Methodology and Theoretical Framework

The methods to be utilized within this STS research paper will be analyzing the research question and applying the topic to the STS and ethical frameworks. The method of documentary research methods will be used to gather information on the two case studies, so the case studies are understood completely by the reader and author. This method will provide evidence for the existing socio-technical relationships of water quality and access. Also provide more information about the SCOT framework and ethical framework, thus the applications of these frameworks can be performed using the gathered sources. Since the two case studies are being studied, historical case studies will be a part of the methods used to gather primary and secondary sources on the places and their impacts. Wicked problem framing will also be used as both a method to organize and answer the research question. This method will be employed to show how the issue has connections in many different aspects, but all these connections help arrive at the root of the issue. Also, the problem will never be solved completely due to the complexity of the issue. The

last method will be policy analysis due to the government involvement in this issue, the current policies in place must be analyzed to ensure the laws are sufficient or need revisions. Wicked problem framing will be looking at the water quality and access problems within the case studies that show the disparities among water access and quality in the United States.

Wicked problem framing leans on problems that are considered unsolvable and has no practical solution in sight (Peters, 2017). They are also called complex problems with many layers and components to think about, making the problem so difficult to solve because there are too many players involved. Water issues can be seen as wicked problems because they deal with lots of different stakeholders and many facets to consider when thinking of ways to mediate and lessen the effects of the problem. The structure of the SCOT framework investigates the four steps of interpretive flexibility, relevant social groups, closure and stabilization, and wider context (Klein & Kleinman, 2002). The four groups are defined in a particular way to show how the water crises in the case studies unfold and how to interpret all the information. “Interpretive flexibility is the product of intergroup negotiations, relevant social groups are the embodiments of particular interpretations or agents, closure and stabilization is a multigroup design process that can experience controversies when different interpretations lead to conflicting images, and wide context is the wider sociocultural and political milieu in which artifact development takes place” as defined by the original creators of the SCOT framework, Pinch and Bijork (Klein, 2002). After defining the actors and explaining how the actors relate to the water crises, the methods of closure and stabilization will express the need for innovation and social change from the cities. “Innovation comes from wanting social change not physical” (Yousefikhah, 2017) and these cases show this desire for innovation but will be further explained in the data analysis section. The ethical framework of political-social-cultural roots in engineering ethics relates to

the research question due to the many political and social implications of the case studies. Also, the involvement of the government, the affected population, outside influence, social media, and more all playing large roles in the relationships among the case studies and how the problem and meditation techniques unfolded.

Data Analysis

The socio-technical relationships among water access are considered a wicked problem due to the many levels involved in the problem and no easy solution. The constraints would be considered the infrastructure, government, and demographics due to the problem's solutions heavily relying on these aspects. The aging infrastructure is one of the main causes of water pollution and the technology to fix this infrastructure either does not exist or is too expensive in the eyes of the government. The government controls laws, funding, and more which has a direct effect on the safety of the people. The regulations in place also affect what is considered legally acceptable for clean water standards and the consequences for violations of these laws. The laws already in place are not always the most effective thus revisions may need to be done as stated by Keiser, "rather than recording actual pollution concentrations, the best long-term national data record violations of standards, which are more complex to interpret" (Keiser, 2019). Water access disparities are also prevalent with less access to clean water in lower income areas, thus demographics must be looked at. The ethical aspect of this problem concerns the well-being of the citizens since if this system does not work to provide clean water to all, this could result in declining health for individuals and even death. Wicked problem framing proved not to be a strong enough framework for this analysis since the issues deal with the stakeholders so closely, thus SCPT framework will be used for a further analysis.

SCOT framework relates to the socio-technical relationships among the two water crisis cases, the case studies will be looked at comparatively for the analysis of this STS framework to make all points clear. But both cases incorporate the same interpretive flexibility due to the similarities between the cases even though the actors and methods of closure are slightly different. The interpretive flexibility can be interpreted as the water crises were both formed by miscommunication between the government, the people living in the cities and the negligence from the government. The situation in the Flint, Michigan, the relevant social groups or agents were the Michigan government officials, the citizens of Flint, and the non-profit and grassroots organizations of National Resource Defense Council, Concerned Pastors for Social Action, and American Civil Liberties Union of Michigan. The specific government officials and organizations were Governor Rick Snyder, US Environmental Protection Agency, Nick Lyon; Director of Michigan's Department of Health and Human Services, Dr. Eden Wells; state's chief medical executive, some state and city officials, Flint emergency managers, and Michigan Department of Environmental Quality employees. The Flint citizens that were most impactful were pediatrician Mona Hanna-Attisha and Flint resident Melissa Mays. These agents were chosen due to the large impact they had on the outcome of the situation and the importance of these decisions on the lives of the affected citizens. The Michigan local and state government officials' decisions impacted how the people would get clean water during the crisis and what steps would be taken in the future to make sure this will not happen again to this severe of a degree. The citizens of Flint worked with the non-profit and grassroots organizations and fought to get their voices heard by the government to get their rightful access to clean water. The non-profit and grassroots organizations fought for the people of Flint to get the state to listen to their complaints and get answers for the problem.

The next step of the SCOT framework is to analyze the steps took by the actors to achieve closure and stabilization. In Flint, the government was stating the water was safe to consume but this was contradicting the statements from the residents of Flint that complained about sediments and discoloration in their water. “The General Motor plant in Flint even refused to use the river water as it was causing car parts to rust” (Shen, 2017). Pediatrician Mona Hanna-Attisha uncovered many Flint children had large amounts of lead present in their bloodstream which can lead to a host of health problems. After 18 months, the city switched the water source back to the Detroit system, but the damage was too far gone. The slow response to the crisis was caused by the weakness of the current government at the time of the incident. “The slow, but significant loss of General Motors jobs, the subsequent economic decline, and two municipal takeovers that suspended the governing authority of local elected officials and restructured local government processes” (Nickels & Clark 2019). This allowed the non-profits with the help of Flint resident Melissa Mays to lead the way with getting a response and actual results for the issue at hand. But the slow response from the government resulted in the people of Flint not trusting their government and many still fearful of using the water. The city sent out a survey about how to restore the trust and the results concluded the need to fire all local government officials and start from scratch (Morckel & Terzano 2019). Many of the city officials have received criminal charges and some others have left voluntarily but there is still some work to complete to get the justice deserved for the people of Flint. Governor Rick Snyder was never charged but some of the charges affect other government officials as Nick Lyon is charged for involuntary manslaughter due to the death of two men linked to Legionnaires’ disease and Dr. Eden Wells threatened to withhold funds for a project after researchers began looking into the Legionnaires’ outbreak. Meanwhile, Governor Snyder has not been charged with any crime.

Large number of people have also expressed interest in moving out of Flint within 2 years or less due to the water crisis and mistrust of the government, this would lead to the quality of services and infrastructure declining for the city due to the declining population.

Another impact of the crisis was the health issues, lead poisoning has greatly affected the children of Flint with an increase in developmental and growth problems, an increase in learning, speech, hearing, and behavioral problems, and can cause damage to the nervous and brain systems (CDC 2020). An outbreak of Legionnaire's disease also hospitalized 91 people and killed 12 people (Schroeck 2020) due to the increase of consumption of lead due to the corrosive pipes and water. Some of the regulations in The Safe Water Drinking Act (SWDA) and Federal Lead and Copper Rule (LCR) have changed since the Flint water crisis to ensure this never happens again. SWDA first imposed a maximum contaminant level (MCL) for contaminants in water and then followed with the state changing the LCR to lower lead action level and force utilities to replace all lead services lines if lead action level is not reached. This caused a lawsuit from the water utility companies but the case was dismissed, resulting in Michigan now having the strictest lead in water regulations in the United States. All the actions have resulted in Michigan changing their water regulations significantly and restoring water infrastructure to ensure the people of Flint can be insured of their safety and stop the decline of the city. The next steps would be to look into altering the EPA regulations and make sure all involved government officials are getting accounted for and taking their rightful punishment. The wider context of this situation is the disorganization among government groups to take action led to policy changes, actions taken against officials who knew of wrongdoings but took no action, and improved infrastructure for the city.

In Newark, New Jersey, the agents for the SCOT framework analysis would be New Jersey government officials, the citizens of Newark, and the non-profit organizations very similar to Flint's agents. The non-profits involved were Newark Education Workers Caucus and Natural Resources Defense Council. The specific government officials were US Environmental Protection Agency, NJ Department of Environmental Protection, Newark's consultant; CDM Smith, Newark Watershed Conservation and Development Corporation (NWCDC), mayor of Newark Ras Baraka, and NJ State Comptroller Philip Degnan. The actors were decided upon due to their importance in the result of the water crisis. The government officials' decisions greatly affect the quality of lives for the people of Newark including their access to clean water and the people of Newark spoke up and supported the non-profit organizations that spoke up to fight for them. The non-profit organizations suing the city gained the attention of the state and finally got the ball rolling and provided the public with some answers.

The methods of closure and stabilization resulted in many changes for the city of Newark. The government ignored the residents' complaints of the water source and continued to state the water was safe to drink but after failing many federal water regulations and getting complaints from the Environmental Protection Agency. The city performed tests mandated by the NJ Department of Environmental Protection and found the lead levels in the water to get outrageous and resulted in city's consultant, CDM Smith, stating the discovery of the water treatment plant not performing as effectively thus this was sending lead infested water to the pipes and caused the pipes to become corrosive. This resulted in water filters being sent out to many homes and bottled water being provided to some but this was only a temporary solution so the city had to find another remedy that would ensure clean water for the city. Considering when the city kept violating the Safe Water Drinking Act and the Federal Lead and Copper Rule, the

non-profit organizations of the Newark Education Workers (NEW) Caucus and Natural Resources Defense Council, Inc. (NRDC) jumped into action. “Reshaping of the government allowed for community based organizations to destabilize the emergent regime” (Nickels, Clark, & Wood, 2019). The government was undergoing a renovation process, and this weakened their role and slowed the response to the water crisis. This resulted in the court case issued by NEW and NRDC against the city of Newark for the violation of the Safe Water Drinking Act and Lead and Copper Rule (Faherty 2020). The court case resulted in Newark replacing over 18,000 lead services lines and still using filters to ensure clean drinking water for residents without replaced pipes yet. The city has also invested 1 billion dollars in water crisis relief, and this will go towards replacing lead service lines and providing filters and bottled water to those that still are in need (Corasaniti 2019). The city is still in the process of trying to make up for neglect and help their citizens, the city has also acted against some government officials that allowed this situation to unfold. The management of Newark’s water safety plan is controlled by the Newark Watershed Conservation and Development Corporation (NWCDC) under the command of the Mayor of Newark, Ras Baraka. The NJ State Comptroller Philip Degnan released a report in 2014 stating there is lots of corruption present within the Newark government and many arrests and charges have been made along the lines of bribery. Furthermore, they began a chemical treatment to prevent lead in the water supply.

Concerns of lead poisoning have also been brought up within the city of Newark since the lead levels were so high, thus similar detrimental health effects can occur for the children of Newark as the ones that occurred in Flint. The wider context for Newark concerns the negligence performed by the government with poor decision making leading to unsafe water conditions to the people and ending with replacing infrastructure, ensuring all residents are safe, and getting

justice against the mistakes made by the government. The SCOT framework analysis of these two case studies shows how both situations could have been avoided if all the actors acted morally, treated each other with respect and decency, and listened to the laws and regulations put in place to ensure the safety of all. The SCOT framework analysis will be utilized to complete a comparative analysis between the case studies and determine how the cases are both critical but show water crises differently. The similarities between Newark and Flint are more evident in the timelines of the case studies as both cities were sued by non-profit organizations for their neglect and non-profits organizations performed forceful acts to get action taken. The cities also had corrupt governments that neglected their people and performed criminal acts to keep the situation under wraps until the non-profits acted. They also had situations that both dealt with lead contamination in their water supply, but this was caused by different errors made by the state. In terms of differences, for Newark, the water quality declined after the malfunction of the water treatment plant due to deflecting valves that should have been noticed during routine maintenance, but proper maintenance was not being done at the treatment plant. For Flint, the poor water quality was due to the switch of the water supply from Detroit river system to Karegnondi Water Authority to accommodate budget cuts within the city. They also switched the water supply as rapidly as possible without treating the water before distribution to the residents, even though the tests of the water source stated the water needed to be treated beforehand to obey the water quality legislation. These situations caused their respective cities to spiral downwards into poor water quality and government neglect. The solutions for both case studies followed different paths but both landed at a solution reasonable for their city and their people. For Newark, all of the lead service lines are in the process of being replaced to ensure the safety of the water for all residents of Newark. The city will also make sure all treatment plants that

provide water to Newark and working properly and maintenance is performed when necessary. Newark will also work with the residents and ensure all people are educated about lead poisoning and how to behave and what equipment you will need at home in case lead levels spike again in the future. The switch of the water source back to the Detroit River System was an immediate solution for the Flint Water Crisis but the city also implemented some measures for the long run. They have increased resources in schools due to the high levels of lead poisoning among the children of Flint causing developmental problems and providing specialized support for children under 6 years of age with elevated lead levels in their systems. Flint also decided to replace all public water facilities and fixtures and replacing some lead service lines as well. The comparative analysis shows how the case studies may seem to have more similarities than difference, but the exact details of each situation prove to be different and affected their respective people in different ways. These situations can help people learn about the mistakes made from the past and guide them to proper results to ensure the safety of everyone involved when it occurs again. These water crises are inevitable due to their complexity thus they are not avoidable but can be prevented if proper care is taken or if the situation is handled swiftly and correctly.

Discussion

The topic of socio-technical relationships between water access and quality across the two specific case studies within the United States show how these issues are widespread and involve lots of miscommunication between the people and the government. This research topic relates to the ethical framework of political-social-cultural roots in engineering ethics. The United States tends to have more problems with getting access to clean water in areas of poverty or cities that have a large minority population. The creation of these communities began many

years ago around the 1960s when the African American community started to gain freedom and rights within the United States. As African Americans were moving into more urban areas and slowly becoming integrated with society, the people that lived in the communities presently were not pleased. The real estate agents were trying to segregate the communities by telling the white population to leave their homes and move to more suburban areas since the African Americans were moving into their communities and bringing down the value of their homes. This movement of African Americans caused the white community to be fearful of the new population coming into their community due to the effects of racism and the real estate agents breathing down their necks to sell their properties because their community is making a turn for the worse. This movement was called white flight and separated the white and black populations in many areas around the United States (Frey 1979). This caused the surrounding communities to change as well depending on the demographics of the area. The whiter neighborhoods had access to more businesses and received more funding to improve their communities. While the minority areas had issues getting businesses into their neighborhoods due to fear of the African American, instilled from racism. These minority communities could not get funding to improve their infrastructure or improve their living conditions, these people were just not thought of as being worthy enough to receive basic rights as new paved roads or a supermarket.

All of this racist thinking turned into government leaders not trying to do what is best for the people but using as many cheap alternatives as possible and thus leading to mistreatment and negligence. These kinds of actions can lead to large issues within these communities as police brutality, water crises, and more; both water crises discussed in this paper within Flint, Michigan and Newark, New Jersey relate to this directly. Both cities are known as being areas with a large minority population and have a reputation as not being great cities with high levels of violence

and poverty. Flint and Newark also have similar water crises with the access to clean drinking water being taken away from them due to lead infested water from the usage of old infrastructure and corrosive water pipes. The levels of lead in the water became too high and became a danger to the lives of the people using the water, this led to the two huge water crisis that gained national attention. The populations of these cities found the water quality issues to disproportionately affect the minority areas more than the majority white areas. Any areas affected by the lead infested water were found to be addressed and resolved quicker in whiter areas compared to African American or Latinx communities.

The reasoning why this issue leads to downfalls in the ethics department because the local government was well aware of these issues within the water supply after the corresponding switches and proceeded to ignore the concerns (Banks & Lachney 2017). In the case of Flint, Michigan, the government knew the water supply needed to be treated before usage by the residents to be safe but decided to switch the water supply without the water treatment plans. The government officials announced the water was safe to use and consume and blatantly pushing aside the residents' concerns until they got reports to show the water was negatively impacting the health of many residents in their city. The local government needed to see people getting sick or dying to take action and this has caused lots of health issues among the residents as the developmental issues among children, the rise in cases of Legionnaire's disease, and the death of some residents. Some of the governmental officials in office during the time of the Flint water crisis have been brought up on legal charges for their actions since they acted morally unjust by putting people's lives in danger by accepting cheaper options on the basic human right of access to clean drinking water. For the situation in Newark, New Jersey, the water treatment plant for the city was found to be ineffective causing the corrosion of lead pipes. Thus, these older pipes

started to raise the lead levels in the water, the levels of lead in Newark were failing to comply with the Federal Lead and Copper Rule. After many violations with the Federal Lead and Copper Rule and the New Jersey Department of Environmental Protection, the community united to seek assistance from the local and state government to get access to safe drinking water and get justice for putting people's health at risk. The city decided to take actions after getting the attention of national organizations that the levels of lead were dangerous to the residents of Newark. The city has finally started to replace all of their lead service lines and vowed to replace all of them within 24 to 48 months. These actions only took place because the government officials got in trouble for ignoring the laws surrounding lead levels and the adverse health effects on the community. Similar to Flint, the government officials that were involved with this scandal are getting charged with legal suits since they acted ethically incorrect and morally unjust.

Conclusion

The cities of Newark and Flint have shown two of the worst case scenarios for the issues with water access and quality in the United States, they have proved the importance of the water issues on the socio-technical realm of the country. The socio-technical relationships among water access and quality have proven to be a grand issue that will need to be dealt with due to the severity of the situation. The SCOT and political-social-cultural roots of engineering ethics frameworks that were utilized to analyze the case studies showed the different layers of the issues and how they all connected. Clean water is a basic right for all people of the United States and everyone deserves to have access to clean water no matter where you live. The disparities of water access between more rural and poverty-stricken areas needs to be addressed and discussed amongst government officials to try to mediate the situation. The solutions to these problems can be expensive and hard to implement but the country needs to think more carefully when

allocating funds in the budget to allow the infrastructure updates that are necessary to provide safe water to all. Or ensure the money is used to treat water properly through chemical treatments or a more extensive water treatment plant that will make sure all Americans get clean water. The water crises discussed in this paper show that methods can be enforced to deal with poor water quality when the situation is severe, therefore the problems could be dealt with when they are considered lower scale so the solutions are easier to create and cheaper to implement.

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9

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