Theory of Technological Politics and the Disparity in Access to Improved Water Sources

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

In 1996 under Nelson Mandela's rule, South Africa wrote into its constitution the mandate guaranteeing access to sufficient food and water as a basic right. The new promise of access to water marked the end of forty-six years of harsh segregation under apartheid law and brought hope to the rural black population (Piper, 2014). Today, however, South African residents still do not receive equal access to water.

According to the South Africa Living Conditions Survey 2014/2015, more than 70% of people received piped tap water from water supply infrastructure within their household or yard, and 83% of people received water from a municipal water service provider (Akinyemi et al., 2018). While infrastructure exists across the country, providing potable water to households, the quality of service and operation varies tremendously amongst the provinces. Across Western Cape, an urban wealthy white province, 96% of households received consistent access to municipally provided tap water, whereas 66% of households received intermittent municipal water service in Limpopo, a poor rural black province (Akinyemi et al., 2018). The municipal service in Limpopo provides water to the communities on a scheduled service depending on the season, ranging typically from two to four days per week during the wet season and at most two days per week during the dry season (Edokpayi et al., 2018). The poor quality and maintenance of the water distribution infrastructure extending to these communities requires the frequent need for repair, during which time the municipal water service ceases completely. Therefore, although the water distribution system does technical work to provide households with safe drinking water, it also does significant social and political work.

If we continue to think that the water delivery technology only performs technical work, we will miss how it functions to advantage the wealthy, white, ruling class and marginalize the

poor, blacks in South Africa. Drawing on technological politics, I argue that the employment of water distribution systems expresses and shapes power relations by privileging some and disenfranchises others based on socioeconomic status and geographic locations. Langdon Winner's Theory of Technological Politics describes the ability of technology to "embody specific forms of power and authority" and whether intentionally or unintentionally, reflect and reify social relations of power and privilege (Winner, 1980).

Specifically, I will analyze how the water supply infrastructure in South Africa both privileges and deprives certain people based on a variety of demographics. The access to water and the benefits of its use benefit those with political and economic power. Thus, the water delivery technology in South Africa creates a political and social divide between those who can afford and have access to water distribution networks and those who do not.

I will begin by outlining the history of racial inequality in South Africa and by introducing the applicable function of Technological Politics. I will then discuss a specific water distribution network and use statistics to demonstrate the inequitable water distribution in South Africa in relation to socioeconomic status and race. I will end by discussing the water meters used in South Africa to highlight the inherent political qualities of technology and how social presences rather than technological limitations advantage wealthy urban white citizens and prevent poor rural black citizens from receiving adequate water services.

Background

When the National Party gained power in South Africa in 1948, the all-white government implemented a policy known as apartheid that created a system of institutionalized racial segregation that kept the country's majority black population under the control of the small white minority (Blakemore, 2019). Under apartheid, the distribution of water was racially biased and

access to water privileged those with access to land and political and economic power (Piper, 2014). For years, nonwhite South Africans experienced direct discrimination that prevented them from attaining basic necessities and achieving a satisfactory quality of life. The policies of white supremacy empowered the white South Africans while further disenfranchising black Africans. Resistance to apartheid became increasingly fiercer over the years, leading to both peaceful and violent protests. During the 1980s, the protests finally sparked international interest, which pressured the National Party into negotiations with the African National Congress, the anti-apartheid political movement, beginning the transition towards majority rule. In the South African general election in 1994, Nelson Mandela was elected president, finally bringing an end to apartheid (Blakemore, 2019).

Literature Review

Many scholars have researched and studied water infrastructure and accessibility in numerous countries around the world. They have provided a wealth of explanations in regards to the various situations and have analyzed many of the sociotechnical forces at work. Although scholars are aware of the relationship between technical and social forces that shape the development and implementation of water infrastructure, they fail to explore the underlying motives behind the inequitable distribution of water that prohibits millions of people worldwide from receiving an adequate and sanitary water supply.

Silva-Novoa Sanchez employs the concept of sociotechnical tinkering to demonstrate the relationship between water infrastructure, power, and politics. Sociotechnical tinkering refers to the acts of tinkering with the infrastructure to abstract, direct, store, drain, and spill water. Through the study of the piped water system in Moamaba, Mozambique, Silva-Novoa Sanchez reveals that sociotechnical tinkering not only redistributes water, but it also allows a range of

actors to exercise control over water flows. Water flow is determined not in a top-down fashion but by actors such as engineers, construction workers, operators, and water users who tinker with and make use of the emerging nature of water infrastructure. Silva-Novoa Sanchez asserts that acknowledging these acts of tinkering allows one to recognize water service provision and water governance processes in general, since acts of tinkering with infrastructure are visible and traceable marks that indicate people's attempts and struggles to access and claim water (Silva-Novoa Sanchez et al., 2019). While Silva-Novoa Sanchez does address the relationship between power and infrastructure, he fails to analyze how the technology privileges some and marginalizes others based on socioeconomic status.

Tiwale utilizes a framework of unpacking that separates the networked water infrastructure by its various elements, corresponding technical properties, planning, designing, implementation, operation, and maintenance to highlight how planners, engineers, and network operators use their authority to shape the network and manage the water flow. He describes how network planners in Lilongwe, Malawi, deliberately controlled the development of the network to favor water distribution toward the newly planned, more affluent Northern and Central Zones and away from the low-income area of the Southern Zone (Tiwale, 2019). Although he does address the inequality in water distribution between the affluent and poor citizens, he focuses more on the actors manipulating the elements of the water infrastructure rather than how the infrastructure itself deprives certain people of water supply services based on a variety of demographics.

While several scholars agree that there is a lack of adequate potable water access and management in numerous countries around the world, no consensus has emerged concerning the economic, political, and social factors that influence the lack of water supply. Scholars have not

yet thoroughly considered how the water distribution technologies empower those in higher socioeconomic status and certain racial groups and marginalize those in lower socioeconomic status and other racial groups. In this paper, I will use technological politics to analyze how the water delivery technology in South Africa privileges and advantages certain groups while overlooking and excluding others.

Conceptual Framework

The science, technology, and society (STS) concept of Technological Politics provides an effective framework for analyzing the explicit and implicit political properties within the water distribution system in South Africa because it shows the flaws in the technology as it is integrated from production into society. Langdon Winner defines Technological Politics as the ability for technical things to have political qualities. He defines politics as the "arrangements of power and authority in human associations as well as the activities that take place within those arrangements." Winner asserts that technologies can be accurately judged not only for their efficiency and productivity, but also for "the ways in which they can embody specific forms of power and authority." (Winner, 1980). In other words, he explains how technologies, whether intentionally or unintentionally, reflect and reify social relations of power and privilege. The apparent political properties can be interpreted in two ways: first are instances in which the creators of technological artifacts explicitly develop the artifact to settle an issue in a particular community; second are cases in which artifacts within man-made systems lend themselves to a particular political relationship. Regardless of their invention or the intention behind the deployment, technological artifacts are not neutral and have certain social consequences associated with them that can be defined in political terms. Technological politics highlights society's structural classism and racism and how they are embodied in technologies. In the

analysis that follows, I will draw on Technology Politics to argue that the employment of water distribution systems expresses and shapes power relations by privileging some and disenfranchising others based on socioeconomic status and geographic locations.

Analysis

Water Treatment Facilities and Distribution

The water distribution infrastructure in South Africa, whether intentionally or unintentionally, advantages wealthy urban white areas and marginalizes poor rural black areas. The communities located in the Vhembe District of Limpopo Province, South Africa, rely on treated, municipal water as their primary source of drinking water. The water for the treatment facility is drawn from the Mutale River and pumped to a retention basin, where it undergoes standard treatment, which includes pH adjustment, flocculation, settling, filtration, and chlorine disinfection. Once treated, the water is pumped to two elevated tanks that provide water to numerous adjacent regions (Edokpayi et al., 2018). The municipality typically provides taps throughout rural communities, but distributes water to these taps infrequently, sometimes only once or twice a month. As a result, residents resort to storing water within their households, which increases the risk of recontamination.

The dam constructed at the water treatment facility, labeled “A” in Figure 1, was designed to create a reservoir to hold water for the plant. However, as the water sits in the reservoir, sand settles out and accumulates directly in front of the intake pipes and destroys the pumps. Repairs for the pumps take months to resolve, and little effort has been made to prevent sand from sliding into the pumps or to dredge the reservoir to remove the sand and increase its capacity. Due to the accumulation of sand, the reservoir has substantially decreased in volume, further reducing the available water supply for residents.

Figure 1 – Images of the Mutale intake

Left: Mutale intake in 2006 (Kahler, 2006). Right: Mutale intake 2016 (Kahler, 2016).

Consider the satellite images of the Mutale intake facility in Figure 1. The image on the left shows the capacity of the reservoir in 2006, and the image on the right portrays the striking difference in reservoir capacity ten years later. Labels “B” and “D” in the image on the left used to connect by a wide area of water, but as seen in the image on the right, land now connects the two points, and the area of water between the two points has substantially shrunk. Additionally, the capacity of the reservoir has decreased around point “C” as sand has accumulated and settled. As a result of the reduced capacity of the reservoir, residents serviced by the Mutale treatment facility experience increased interruptions in service and a lack of ample water supply.

Not only is the reservoir filling in with sand, but recent measurements reveal that there is a 45% loss of water in leaks just at the treatment plant, not including loss in the system or the loss when the water is pumped uphill to the storage tanks. On top of this, the water treatment facility has not had adequate turbidity standards for two years, and the chlorine measurement is only 1/20th of where it should be (Kahler, 2020). As a result, even when the municipality provides water to the residents in the communities, the quality of water does not adhere to the prescribed South African minimum standards nor the World Health Organization recommended guidelines for safe drinking water (Hagenmeier et al., 2017). Consequently, residents are at increased risks for waterborne diseases and other detrimental health effects.

Although the Mutale intake facility is only one example of a flawed water distribution center, the situation is the same in all the black, rural areas throughout South Africa. According to the 2011 Census, 79.2% of South Africans were Black African, 8.9% were Coloured, 8.9% were White, and 3% were Asian, Indian or another race ("Race, ethnicity and language in South Africa," 2014). Although whites only account for 8.9% of the population, the majority of them live in the Western Cape Province (15.7%) and Gauteng Province (15.6%). According to the Statistics South Africa 2017 General Household Survey, 98.7% of households in Western Cape Province have access to piped tap water, whereas only 74.7% of households in Limpopo Province have access ("General household survey 2017," 2018). As seen in Figure 2, there is a direct correlation between the percentage of whites in the province and households with access to piped water. Additionally, the average household income for whites is six times higher than that for blacks, which creates a political and social divide between those who can afford and have access to water distribution networks and those who do not.

	Black	Coloured	White	Households with Piped Water	Rate Municipality Services 'Good'	Interruptions in Water Services
Percent of the population	79.2%	8.9%	8.9%			
Western Cape Province	32.8%	48.8%	15.7%	98.7%	88.1%	1.3%
Gaunteng Province	77.4%	3.5%	15.6%	97.1%	78.6%	7.8%
Limpopo Province	96.7%	0.3%	2.6%	74.7%	36.4%	50.1%
Eastern Cape	86.3%	8.3%	4.7%	74.2%	52.2%	35.6%
No access to piped water	10.9%	1.5%	0.7%			
Monthly income (Rand)	5,051	9,347.67	30,427.83			

Figure 2 – South Africa Statistics

From Figure 2, an inverse relationship exists between the perceived quality of water services provided by the municipality and the number of interruptions; not only do residents in Western Cape receive water from the municipality on a more reliable basis, the water they receive is also of better quality. The treatment facilities distributing water to the Western Cape adhere to a schedule of delivery far more consistently and do not run out of chemicals needed for

the treatment process. The difference between the Western Cape and Limpopo: residents are predominantly white and wealthy in Western Cape, whereas residents are primarily black and poor in Limpopo. In fact, according to data from Stats SA, 13.3% of households headed by blacks lack access to an improved source of water, while only 5% of households headed by whites still lack access (Pretorius, 2019). As seen from the statistics, society's structural classism and racism are embodied in the water distribution technologies; the technologies express and shape power relations by privileging some and disenfranchises others based on socioeconomic status and geographic locations.

Water Meters

The installation of prepaid water meters is an example of an instance in which the creators of technological artifacts explicitly developed a technology to settle an issue in a particular community. Despite the water meters having a practical use (acting as a way to regulate the water usage of residents and bill them for the amount of water they used), they were "designed and built in such a way that it produces a set of consequences logically and temporally *prior* to any of its professed uses" (Winner, 1980).

During apartheid, residents had resisted through organized boycotts in which they refused to pay for services such as housing, water, and electricity. When Mandela took power, residents were hopeful that their apartheid-era debts would be erased, but it gradually became clear this would not be the case. In order to repay the debts of the apartheid government, Mandela accepted a loan from the IMF with conditions that guaranteed corporations such as Suez economic power and control over water delivery services. Poor people received bills that they either refused to pay or simply could not pay. As a result, Suez shut off taps without warning, and the city of Johannesburg evicted residents who would not pay. As nonpayment increased, Suez began

introducing prepaid water meters into households, which required tokens to turn on the water. Although the end of apartheid brought an end to direct racial segregation, the unemployment rate among blacks more than doubled in the decade after apartheid ended. Consequently, many homeowners did not have sufficient tokens to pay for the newly installed meters, which prevented them from receiving adequate water access. In some instances, residents had no water at all and were unable to even put out fires in their household. They were left to watch their houses burn (Piper, 2014).

The prepaid water meters led to more resistance and protest amongst the poor, black South Africans. While these residents were required to prepay for their water service, people in the wealthier, white areas of Johannesburg received water on credit, meaning they did not have to pay until the end of the month or bill cycle (Couzens, 2015). Since many poor residents were unable to prepay for the water services, they were left without water for considerable periods of time each month.

The water meters combat our natural tendencies to see technologies as inherently "neutral tools" to be used in a variety of ways as they directly encompassed purposes far beyond their immediate use. They served as a barrier between poor black people and water, preventing residents from being able to obtain the water they deserve. Without any other plausible information, the only basis for the difference in payment method is race, not something in the design of the technology. Therefore, the water meters demonstrate that technologies have political qualities that reflect and reify social relations of power and privilege.

Conclusion

In this paper, I have used the sociotechnical concept of Technological Politics to analyze

and assess the water distribution technology in South Africa to demonstrate how the distribution and operation of water delivery systems advantage the urban wealthy white communities and disenfranchise poor rural black communities. Through an analysis of water treatment facilities and the installation of prepaid water meters, it is evident that significant social, political, and economic factors play a part in the quality of and access to water in the provinces. The political implications and social consequences are considered with the development of the technologies in order to highlight the inequality in access to improved drinking water. With this knowledge in mind, the general reader will be more aware of the ways that power relations have shaped which areas, urban or rural, have access to a piped water supply.

References

Akinyemi, B. E. (2018, April 26). Factors explaining household payment for potable water in South Africa. Retrieved October 21, 2019, from https://www.tandfonline.com/doi/full/10.1080/23311886.2018.1464379.

Blakemore, E. (2019, April 26). The harsh reality of life under apartheid in South Africa. Retrieved February 20, 2020, from https://history.com/news/apartheid-policies-photos-nelson-mandela.

Couzens, E. (2015). Avoiding Mazibuko: Water security and constitutional rights in Southern African case law. Retrieved February 20, 2020, from https://www.ajol.info//index.php/pelj/article/view/128771.

Edokpayi, J. N., Rogawski, E. T., Kahler, D. M., Hill, C. L., Reynolds, C., Nyathi, E., Dillingham, R. (2018, February 7). Challenges to sustainable safe drinking water: A case study of water quality and use across seasons in rural communities in Limpopo Province, South Africa. Retrieved October 21, 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6310213/.

General household survey 2017. (2018, March). Retrieved April 6, 2020, from http://www.statssa.gov.za/publications/P0318/P03182017.pdf.

Kahler, D. M. (2006). *Satellite image of Mutale intake 2006*.

Kahler, D. M. (2016). *Satellite image of Mutale intake 2006*.

Kahler, D. (2020, February 11). Phone interview.

Piper, K. (2014). *The price of thirst: Global water inequality and the coming chaos*. Minneapolis, MN: University of Minnesota Press.

Pretorius, L. (2019, May 1). Frequently asked questions about water in South Africa. Retrieved April 6, 2020, from https://africacheck.org/factsheets/frequently-asked-questions-about-water-in-south-africa/.

Race, ethnicity and language in South Africa. (2014, January 18). Retrieved April 6, 2020, from https://welections.wordpress.com/guide-to-the-2014-south-african-election/race-ethnicity-and-language-in-south-africa/.

Silva-Novoa Sanchez, L. M., Kemerink-Seyoum, J. S., & Zwarteveen, M. (2019). Water infrastructure always in-the-making: Distributing water and authority through the water supply network in Moamba, Mozambique. *Water (20734441), 11*(9), 1926. https://doi.org/10.3390/w11091926

Tiwale, S. (2019). Materiality matters: Revealing how inequalities are conceived and sustained in the networked water infrastructure – The case of Lilongwe, Malawi. *Geoform, 107,* 168-178. https://doi.org/10.1016/j.geoforum.2019.09.005

Winner, L. (1980). Do artifacts have politics?, *Daedalus 109*(1), 121–136.