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SPECIAL ISSUE**

**“IMPLICATIONS OF
THE 2021 JACKSON
WATER CRISIS:
PAST, PRESENT,
AND
FUTURE”**



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Table of Contents

Editor's Overview	3
Acknowledgements.....	4
Journal Articles	5
Challenges of an Aging Water System: The Jackson Water Crisis --- A Research Commentary Harvey Johnson, Jr.....	5
The Role of Black Churches amid COVID-19 and the Jackson Water Crisis Ashley W. Jones, Ph.D., Antonio J. Gardner, Ph.D.....	22
Water System Challenges in the Face of Population Declines: The Jackson, MS Experience Stephanie Otts, John J. Green, Anne Cafer, Olivia Deans, Catherine Janasie, Cristiane Q. Surbeck, and Kristine L. Willett	39
An Explanation of the 2021 Jackson Water Crisis and Policy Suggestions for Sustainable Water Infrastructure in Jackson, Mississippi --- A Research Commentary Jae-Young Ko, Ph.D.	56
The Jackson Water Crisis: A Qualitative Thematic Analysis of Online News Reporting Pedro M. Hernandez, Ph.D.	72
An Analysis of the Jackson Mississippi Water Crisis using Social and News Media Rishabh Shrestha, Ting Xiao, Dawn E. Wilkins.....	89
A Different Path Forward: Using Privatization to Avert Future Jackson (MS) Water Crises Sam Mozee, Jr., Ph.D., Sheryl Bacon, MPA, ABD.....	106
Epilogue	127
Journal Publisher Information.....	129

Editor's Overview

The Mississippi Urban Research Center (MURC) at Jackson State University is proud to release this special edition of its Online Journal of Rural and Urban Research titled *"Implications of the 2021 Jackson Water Crisis: Past, Present, and Future"*.

This edition is being released to coincide with the anniversary of the February 2021 Ice Storm/Water Crisis. Included are articles from academicians, researchers, and practitioners that discuss not only the water crisis' social, economic, health, and political effects, but also perhaps more importantly, provides "real-world," research-based recommendations on how to deal with future crises. The focus of this journal is to offer unique insights on the water crisis from a then, now, and future perspective.

The articles presented in this journal edition are in keeping with the Mississippi Urban Research Center's mission of using basic and applied research to address urban problems and public policy for the purpose of improving the quality of life in urban areas. This special edition of the Online Journal of Rural and Urban Research provides information for use by public, private, and nonprofit organizations, as well as everyday citizens who also seek to improve the quality of life in urban communities. To all the authors, reviewers, editors, and other individuals who helped produce this special edition, we sincerely thank you for sharing your time, talent, and expertise on this project.

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* Please accept our sincere gratitude for your professionalism and conscientiousness in helping to ensure and maintain this journal’s high standards for quality.

Journal Articles

Challenges of an Aging Water System: The Jackson Water Crisis --- A Research Commentary
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ABSTRACT

One of the fundamental responsibilities of local government is the provision of safe drinking water. Although a fairly simple mandate, there are a number of challenges that make achieving that mandate difficult. This article examines some of those challenges in the context of “The 2021 Jackson Water Crisis”. It also recounts the sizable financial investment in the City of Jackson’s water system from 1997 to 2013. This period covered the three terms of Jackson’s first African American mayor, whose diverse administration had to overcome certain challenges in addressing system deficiencies in a much different political environment than his predecessors. Those challenges included: (1) the historic disparity in the provision of municipal services to local residents; (2) a decreasing population and dwindling tax base; (3) an increasing rate of poverty among the water system user base; and (4) adverse intergovernmental policies that placed the burden of financing improvements on local government and rate payers. Major conclusions identified in this article include Jackson expended or obligated nearly \$150 million from 1997 to 2013 for water and sewer related projects; Jackson’s high rate of poverty is the most enduring challenge local officials face in attempts to correct the conditions in the system that contributed to the 2021 crisis; and adequate preparedness for events such as the winter storm of 2021 will require cooperation and resources from multiple levels of government. Recommendations for addressing the challenges discussed include Jackson adopting a “game plan” using the *Water Master Plan* as a guide; local officials making a long-term (20-year) commitment to implementing that plan; Jackson aggressively soliciting intergovernmental assistance; and Jackson pursuing changes in existing resource distribution policies.

Keywords: water, City of Jackson, crisis, challenges, Johnson

Introduction

One of the fundamental responsibilities of local government is the provision of safe drinking water. Although a fairly simple mandate, there are a number of challenges which make achieving that mandate difficult. This article examines some of those challenges as they relate to the aging

municipal water system in Jackson, Mississippi. These challenges are discussed in the context of what has been termed “The 2021 Jackson Water Crisis”.

The winter of 2021 will long be remembered as one of the most brutal on record. Although the ice storms and extremely frigid weather could be felt in many parts of the country, it was in Jackson where these unprecedented weather conditions literally shut down Jackson’s aging water system. The shutdown led to a crisis that was both a natural and man-made disaster. Some have argued the 2021 Jackson Water Crisis was the result of a lack of commitment on the part of local government to make needed improvements to an aging water system. At the time, there was widely repeated discourse that the elected officials in the City of Jackson had not paid any attention to, or provided any local resources for, maintaining and improving the municipal water system; thus, creating the crisis (Ladd, 2021). This article offers a contrary view, recounting Jackson’s sizable investment in the water system from 1997 to 2013, a period that covers the three terms of Jackson’s first African American mayor, whose diverse administration had to overcome, or at least mitigate, certain challenges in addressing system deficiencies in a much different political environment than his predecessors.

Mayor’s Background and Experience

Although journal research articles are not normally written with “first person” language, it is from that unique perspective that the challenges discussed can be better understood and internalized by the reader. I was elected as the first African American Mayor of Jackson on June 3, 1997. Prior to my election, I had spent my professional career in the field of planning and community development. I had developed a particular expertise in assisting resource-poor communities (many with Black mayors) in obtaining funding to develop and/or improve their water and sewer systems. Additionally, I served as board president of a national non-profit organization whose primary mission was the provision of technical assistance and funding to ensure that disadvantaged communities had safe drinking water. Therefore, I entered the Mayor’s Office with a unique perspective on the critical challenges of maintaining and improving Jackson’s water system.

One of the major challenges of an aging water system is its complexity of components. The next section briefly discusses those components that make up the Jackson water system, and will serve to better acquaint the reader with the system's origin, set-up, operations, maintenance, and costs.

Water System Components

Supply

The primary source of water for the Jackson water system is the Ross Barnett Reservoir. The 52 square mile, man-made reservoir is under the operational control of a state agency, the Pearl River Valley Water Supply District (PRVWSD). A unique arrangement with the PRVWSD requires that reservoir water is perpetually made available to the City of Jackson (Barnes, 2012). This arrangement for the financing and construction of the reservoir dates back to the late 1950's, early 1960's. The citizens of Jackson contributed \$15.5 million to finance the massive project, and the taxpayers of Hinds County (which also included Jackson taxpayers) contributed an additional \$36 million (Barnes, 2012). A very small portion of Jackson's water supply is from groundwater sources.

Through annexations, several water wells are a part of the system, and act as the supply source for users in Southwest Jackson and the Byram area. For many years, Jackson has aimed to abandon these wells and connect their distribution lines to those of the more reliable surface water supply. However, in order for the wells to be taken out of service, a number of transmission line installations and other improvements had to occur. During the winter of 2021, the well system was serving as the water source for an estimated population of over 20,000.

Treatment

Water that comes from both surface and ground sources must be treated for public health and safety reasons, and to comply with mandates imposed by federal and state regulations. The Jackson water system is served by two treatment facilities. The oldest treatment facility, the J. H. Fewell plant, was constructed in 1914. By 1997, the plant had been cited by the Mississippi Department of

Environmental Quality (MDEQ) for discharging sludge and other contaminants into the Pearl River in violation of federal law (Neel-Schaffer, 2012).

The second treatment facility, the O. B. Curtis plant, was constructed in 1992, and is located in the City of Ridgeland in adjoining Madison County. Its location next to the Ross Barnett Reservoir gave immediate access to the reservoir water supply, and eliminated the sole reliance on water coming directly from the Pearl River. The initial treatment capacity of the Curtis plant was 25 million gallons per day (MGD), with the intent of eventually expanding the capacity to 100 MGD and eventually taking the Fewell plant off-line.

Storage

Adequate storage is required to meet peak demands for drinking water, non-potable uses and fire protection. According to the Water Distribution System Rehabilitation Master Plan Update, dated December 19, 2012, Jackson has 14 elevated storage facilities (Neel-Schaffer, 2012). At the time of the Update's issuance, two additional storage facilities were already funded or under construction.

Distribution

Various sizes and types of piping are relied upon to deliver water to system users. Although all components must work together to make the system fully functional, it is the distribution component that provides the most obvious indicators of system failure. Leaky and broken water lines generate the most public outcry relating to the water system, especially when they result in loss of water pressure and mandatory boil water advisories. Before reaching the consumer, Jackson water travels through transmission lines (ranging in size from 54" to 12" in diameter) and smaller distributions lines (which can be as small as 2" in diameter). The smaller distribution lines connect to the transmission lines, and the users' service lines connect to the distribution lines. The 2012 Master Plan Update maintenance records indicated there was an average of five water main breaks per day and that approximately 90% of those breaks were in the smaller distribution lines (Neel-Schaffer, 2012).

Challenges

Citizens rarely consider the age of a water system and the impact that age has on service delivery, they just want clean water to come out when they turn on the faucet. The interruption of service due to busted water mains (whether caused by regular “wear-and-tear”, or by catastrophic weather events) can be attributed to the age of the system. Discoloration of treated water and failure to meet federal and state regulatory standards can also be tied to the system’s age. To keep the system operational and providing services to city customers at an affordable rate, Jackson must overcome many challenges. The following sections discuss those challenges.

Equalization of Services

The “equalization of services” concept was born out of the disproportionate provision of municipal services brought before the federal courts during the Civil Rights Movement. One of the most prominent court cases occurred here in Mississippi. Andrew Hawkins and other Black residents of the Town of Shaw sued the Mayor and Board of Aldermen for not providing the same level of basic municipal services to black neighborhoods in the town as White neighborhoods (Hawkins, 1971). A 1971 ruling by the Fifth Circuit of the United States Court of Appeals found that the town’s past discriminatory policies and practices had denied black residents equal protection under the 14th amendment of the U.S. Constitution (Hawkins, 1971).

Hawkins v. Shaw is referenced because one of the discriminatory practices listed in that case was the placement of undersized water distribution lines (4”, 2” and 1-1/2” in diameter) in the Black areas of Jackson, as opposed to primarily 6” lines in the White areas. Undersized lines (less than 6”) can produce low water pressure that is inadequate for fire protection.

Upon entering the Mayor’s Office in 1997, I viewed the equalization of municipal services as one of the mandates of my election. The Black community expected me to equalize the provision of municipal services, including adequate water service and fire protection. Historically, many Black areas of Jackson had poor water service and fire protection due to being served by undersized lines.

The City of Jackson's *Master Plan Updates* recommended the replacement of lines less than 6" in diameter (about 100 miles of them throughout the system) as a priority, pointing to historical high maintenance, poor water quality, and fire protection issues (Neel-Schaffer, 2012). These recommendations laid the groundwork for the expenditure of resources towards the replacement of small lines in underserved areas. However, generating the significant amount of public funding needed to equalize the provision of water service present two very real challenges. The first challenge is the prospect of educating rate- payers on the need to replace water lines that are not broken or leaking; and the second challenge is convincing the general public that the equalization improvements should be targeted to certain areas of Jackson. A large proportion of the water line breaks during the 2021 winter storm was in undersized lines.

Loss of Population

The City of Jackson is the central city in the Jackson Metropolitan Statistical Area, which consists of Hinds, Rankin, Madison, Copiah and Simpson counties. Like many other central cities in U. S. metropolitan areas, Jackson's population decreased during the period 1997-2013 (U.S. Census, 2020). This decline was part of a trend that started in 1980 when Jackson had a population of a 202,895. The 2020 U. S. Census Bureau population estimate was 153,701 (U.S. Census, 2020). Some would argue that deficiencies in Jackson's quality of life (poor streets, crime, low-performing schools) were the driving factors behind Jackson's population decline. While these factors cannot be dismissed, other factors beyond the control of Jackson must also be considered when seeking causes for the loss of population.

One such factor is the allocation of federal transportation resources. The 1956 National Interstate and Safe Highways Act created a system of national highways to support commerce and national defense, paid for with 90% federal funding. The resulting interstate highway system has greatly aided in the tremendous growth and development of suburbs, often at the expense of central cities. In the Jackson area, the allocation of federal transportation funding continues to favor and

encourage suburban growth. The allocation to, and expenditure of, federal transportation funds by suburban communities surrounding Jackson has been a major factor in the loss of population in the central city, and the explosion of suburban growth and development.

Another factor that is often not considered when assessing the decline in Jackson's population is actions by the courts. In 1997, the Mississippi Supreme Court de-annexed a 20 square mile area south of Jackson called Byram, and an approximate five square mile area to the north abutting the City of Ridgeland. Subsequently, the courts denied Jackson's petitions to re-annex the areas, granted the incorporation petition filed by Byram residents, and allowed the City of Ridgeland to annex the majority of the area in Madison County that was previously in the corporate limits of Jackson. These actions by state and county courts not only cut off any future opportunities for Jackson to expand its borders to the south and north, they also essentially decreased Jackson's population by the thousands while also shrinking its tax base.

The above, rarely cited factors aided in a significant population shift that saw the population of Jackson decrease, and the populations of the six suburban cities that share boundaries with Jackson (i.e., Clinton, Ridgeland, Flowood, Pearl, Richland, and Byram) significantly increase. Perhaps more telling than the loss of population is the disparity of growth between the central city and the suburbs. According to U. S. Census Bureau data, housing units in the City of Jackson decreased by 1.5%, while the collective number of units in the six cities immediately adjacent to Jackson increased on the average of 30.7% from 2000 to 2010 (U.S. Census, 2020). Jackson had to address the challenge of delivering water to the remaining population by operating a system with increasing improvement needs and a declining user base. Moreover, the service area did not shrink proportionally, remaining essentially the same size as when Jackson had a population of over 200,000. Getting the water system back in operation during the weeks following the winter storm of 2021 for a 100 + square mile area frustrated city officials and citizens alike.

Poverty

Mississippi is often referred to as the poorest state in the nation. In 2010, the U. S. Census recorded the State's poverty rate at 22.4 %, compared to the national rate of 10.5% (U.S. Census, 2020). What is even more noteworthy, however, is that the Capital City of Mississippi (Jackson) had a poverty rate of 25.4% in 2010. Amazingly, Jackson has a higher rate of impoverished residents than that of the poorest state in the nation. During my three terms as Mayor, the high incidence of poverty among Jackson residents presented one of the most critical challenges in developing and implementing plans to maintain and improve Jackson's water system.

Those Jacksonians who moved to the suburbs were, for the most part, the more affluent residents, leaving behind a less affluent user base. A great many of the remaining residents had limited ability to pay increasingly high "water bills", which actually consist of water and sewer user fees, and a garbage pick-up fee. Systematic and periodic rate increases are required to generate sufficient revenue to properly operate the system. Between 1997 and early 2010, water user fees in Jackson had increased by 104%, with future, periodic rate increases being a necessity (Neel-Schaffer, 2012). These required rate increases place a disproportional financial burden on those city users living in poverty.

Poverty, when coupled with a declining population and shrinking tax base, has tremendously affected Jackson's ability to raise resources solely from its user base at a level to provide for all of the maintenance, improvement, and upgrade needs of its aging water system. The lack of resources, in turn, prevented Jackson from effectively preparing the water system for catastrophic events such as the 2021 winter storm.

Nominal Federal and State Assistance

The U. S. Conference of Mayors has argued for years that infrastructure in American cities is crumbling, and that federal assistance is urgently needed to assist local governments in addressing this problem. The amount of resources required to address the nationwide problem of poor and failing

infrastructure is so massive that making needed improvements cannot be the sole responsibility of local government. This is especially true in the case of a city like Jackson, where there are limited local resources to fund system improvements. The current initiative in Washington, D.C. to fund a nationwide infrastructure program is long overdue.

Federal laws, such as the Safe Drinking Water Act and the Clean Water Act, have long mandated that certain standards are met and maintained in operating a municipal water system. These laws reflect national environmental policies, but compliance is placed squarely on the shoulders of local government. Absent an adequate federal grant making mechanism in-place to assist localities in complying with these costly standards, they are commonly referred to as “unfunded mandates”.

In the mid-1990’s, the federal government started reducing infrastructure financial assistance through grants and started providing more loan assistance instead. This significant change in federal funding policy shifted the financial burden of funding improvements from the federal government to the local level and using state government as a conduit to facilitate that shift. Thus, increasing the financial burden being placed on low- and moderate-income citizens.

Up until about 10 years ago, Congressional earmarks were relied upon to compensate for the lack of grants for water system improvements coming directly from federal agencies. Earmarks are funding requests written into federal legislation by Members of Congress that direct funding to specific projects. Earmarks require a two-step process (i.e., legislative authorization and legislative appropriation), which is very political and lengthy, and involves some uncertainty. For instance, I have witnessed a multimillion-dollar earmark make it through the authorization phase, but was never appropriated.

The City of Jackson has long floated the notion of annual, direct funding from the State of Mississippi to offset the loss of taxes on state-owned, tax-exempt real estate. This revenue stream from states to local government is called Payment in Lieu of Taxes (PILOT). A 1990 study commissioned by Jackson recommended that the City pursue measures to put PILOT funding in place

for Jackson. Over the years, PILOT legislation has been introduced in the Mississippi Legislature on behalf of Jackson, but the efforts have not been successful (Ladd, 2021). PILOT funding would provide a steady, reliable stream of revenue that could be used to help pay for infrastructure improvements, as well as other municipal services.

Some might point to the 1% sales tax legislation that was first passed and signed into law in 2009 as a glowing example of State assistance to the City of Jackson in addressing its infrastructure problems. The legislation, passed during a time of high crime rates in Jackson, placed a priority on police and fire protection. In an unprecedented move, it created a nine-person commission to oversee and approve expenditures. The 2009 law was only the second time that the State Legislature had authorized the collection of a local sales tax. The first was in Tupelo decades earlier for water supply improvements; however, an oversight commission was not part of that legislation. It appears that the Legislature did not have the same level of trust and confidence in the elected officials in Jackson as it had for Tupelo's elected officials. Moreover, the legislation gave the Mayor of Jackson only two appointments on the commission; the "local chamber of commerce" four appointments (with the Mayor choosing them from a list of eight names submitted by the chamber); and the Governor, Lt. Governor and Speaker of the House each having one appointment. The most obvious flaw of this law was in the creation of a local commission with the overwhelming majority of its members not being subject to the Mayor/City Council appointment process; and even more alarming, the commission was granted the power to oversee and approve the expenditure of tax dollars collected in the City of Jackson. Citizens expect, and rightfully so, that this most important government function of directing the expenditure of public dollars for the public good to be the responsibility of the Mayor and City Council who they elected, not that of non-elected persons whose business interests could overshadow public interests. The commission created a tremendous public accountability problem. It was an affront to local political leadership, and in light of the Tupelo local sales tax structure, an affront to the political gains made over the years by Black citizens in Jackson.

In 2011, during my third term, Jackson managed to convince the Legislature to amend the 2009 law to make infrastructure improvements the top priority of the 1% sales tax collections. However, Jackson was not successful in getting the Legislature to remove the commission or to reduce its power. Supposedly, to address the concern that the commission had the power to approve expenditures, the new law gave the commission the power to review and approve a master plan in which projects to be funded had to be listed. Additionally, the commission was slightly re-structured, but at Jackson's expense. The new law called for a 10-member commission: the Mayor having three appointments with the consent of the City Council; the "local chamber of commerce" having four appointments, without the consent of Jackson; and the Governor, the Lt. Governor and the Speaker of the House having one appointment each. Although Jackson's appointments were increased from two to three, the chamber was now able to make appointments directly to commission, circumventing Jackson entirely.

Few citizens recognize the amount of discretion that has been taken away from the Mayor and City Council in directing local option sales tax dollars to infrastructure improvement projects that local officials determine to be in the best interest of the public. With the commission having the power to approve the master plan, projects (though they may be worthy from Jackson's perspective) will not be funded if they are not in the approved master plan. Inherent in the power to approve is the power to prioritize; that is, the selection of projects that are most likely to be approved are the ones that are most favored by the commission. This structure creates a natural tension between Jackson and the commission, as evidenced by the recent demand by the commission that Jackson repay \$20 million in loans made in 2018 and 2019 to pay for infrastructure-related projects. The implication is that the commission feels it has the authority to lend tax dollars to the local jurisdiction in which they were collected.

Conclusions

During my three terms as the Mayor of the City of Jackson, a great deal of time, energy and financial resources was spent in operating, maintaining and improving Jackson's aging water system. In response to my inquiry during the first few months of my third term regarding how much we had accomplished, and how far we had to go in addressing problems with our system, the Public Works Department staff issued an update on February 1, 2010 (City of Jackson, 2010). The report indicated that \$72,716,591 had been expended or obligated on various improvements to the water distribution system from 1997 to the issuance of the update. An additional \$75,897,388 had been expended on improvements to supply and treatment facilities during the timeframe covered by the report. The total expenditures of nearly \$150 million were funded almost exclusively with local resources, with only \$2,800,000 coming from federal grants, according to the report (City of Jackson, 2010).

Under my administrations, Jackson committed local resources, on the average, of about \$10 million a year on water system improvements. Some notable projects included rehabilitation of the Fewell Treatment Plant to alleviate the illegal discharge of contaminants into the Pearl River; avoiding the imposition of hefty fines by MDEQ; expanding and stabilizing plant capacity; rehabilitation and expansion of the Curtis Treatment Plant approximately doubling its capacity; funding the design and construction of two water storage facilities (one in the Mid-Town area and the other in South Jackson) increasing storage capacity by 6.5 million gallons; installation of a 54" Express Water Main connecting the Curtis and Fewell treatment facilities; and initiation of a program to systematically replace aged water transmission mains and undersized distribution lines. Though extensive and costly, these improvements, as well as others, were not enough to avert the crisis that occurred in the winter of 2021.

The process of effectively addressing system deficiencies is long term and costly. The *Master Plan Update* issued on December 12, 2012, indicated that an estimated \$446,015,000 would be needed over a 20-year period for Master Plan-related water system capital improvements. Nearly a

year later, a *Master Plan Report*, dated November 15, 2013, estimated that recommended improvements would cost \$516,992,000 over a 20-year period (Neel-Schaffer, 2013). While more recent estimates are likely to be even higher, it is safe to conclude that Jackson is looking at over a half-billion-dollar price tag for correcting deficiencies in the water system.

The challenges that faced Jackson over the past decades are still present today, with some being even more pronounced. The high rate of poverty in Jackson still creates a tremendous impediment to raising enough local revenue to pay for needed system improvements. As the out migration of Jacksonians to the suburbs continues, the percentage of water system users who have a limited ability to pay for rising costs to maintain and upgrade the system increases. Poverty is perhaps the most enduring challenge as Jackson attempts to correct the conditions in the system that contributed to the 2021 crisis.

There is still the need to equalize the delivery of water services in the older, underserved areas of Jackson, which are predominantly occupied by Black and low-income residents. The aged and undersized lines in these areas have historically been the lines mostly likely to fail, causing inordinately high maintenance cost. These lines failed during the extreme winter weather event of 2021, and are likely to fail in future events. Additionally, left in their present condition, these lines will continue to drive up maintenance costs due to the high number of leaks that occur during normal operations.

It is abundantly clear that Jackson, and its water system users (a great many of whom are living in poverty) cannot continue to bear the costs of improving the system to the extent that the impact of future natural or man-made disasters can be mitigated. Major water system improvements have been financed, for the most part, with loans and bond issues supported by a population with a poverty rate higher than that of the State of Mississippi. It is also clear that adequate preparedness for events such as the winter storm of 2021 will require the infusion of resources from multiple levels of government.

Recommendations

Given the above, Jackson might consider the following recommendations as it moves forward in addressing deficiencies in the water system. Some recommendations state the obvious, while others are more nontraditional. First, Jackson must adopt a game plan and stick to it, making adjustments as circumstances dictate but consistently moving toward the long-range goals of the plan. For instance, periodic assessments of the water fee rate structure must be done, and the appropriate adjustments made to satisfy bond holder requirements, as well as to meet routine operational costs. Over the years, Jackson has engaged in a systematic approach in maintaining and operating its water system. The original *Water Master Plan* was prepared in 1985, updated in 1997; and received a subsequent update in 2012. These updates, along with succeeding ones, constitute the game plan, and their recommendations lay out the strategy that should be followed.

Second, and in connection to the last point, a plan that is prepared and sits on the shelf, no matter how comprehensive, is of no use. The game plan should include a water system capital improvement plan, which spells out improvement needs, as well as the cost of implementation. It is well established that local revenue alone cannot pay for the improvements, even with periodic rate adjustments. Jackson must consider this reality in devising a funding strategy to ensure long term, continuous plan implementation. There is a longstanding adage in the field of planning, attributed to Anthony Cantonese, that in essence says, “the planner disposes, but the politician deposes”. The successful and full implementation of the game plan will depend largely on the political will of local elected decision makers. Some decisions during plan implementation will not be popular and/or embraced by the community at-large.

Finally, Jackson must aggressively solicit intergovernmental assistance in resolving the problems that are plaguing its aging water system. The condition of municipal infrastructure across the nation has reached such a critical point that local governments, including Jackson, cannot solve the problem alone. The massive infrastructure initiative that is being considered by Congress, and

hopefully will be passed by the time of the publication of this article, is absolutely needed. However, the resulting funding must be sent directly to local governments, and they must be given discretion in addressing local infrastructure priorities. The federal government appears to be finally stepping up to do its part in providing funding to resolve critical infrastructure issues (including the need for water system improvements) at the local level of government.

Jackson city officials must push state government in Mississippi to follow the lead of the federal government in providing financial assistance to localities in the improvement of municipal infrastructure. There are several initiatives that could be proposed to the State Legislature on behalf of the City of Jackson. The first would be the creation of a Payment in Lieu of Taxes (PILOT) program for Jackson. The concept was first placed on Jackson's agenda over three decades ago and is now even more relevant. Moreover, there are many models in existence where state governments are making payments on an annual basis to support the provision of municipal services. Although "a steep hill to climb" in terms of eventual passage, it must be consistently, and insistently, placed on Jackson's legislative agenda.

The next legislative initiative is even more provocative than a PILOT program, but it deserves some consideration as localities in the metropolitan area seek funding solutions to their service delivery problems. I recommend that Jackson consider adding a regional sales tax proposal to its legislative agenda. The taxing district would include municipalities in Hinds, Madison and Rankin counties. The proceeds from the regional tax would be distributed to municipalities based on population. Such a tax would address the "commuter tax" debate that has been raging for years, while recognizing that metropolitan residents (especially Jackson residents) are supporting a regional economy, rather than the economies of individual jurisdictions. One of the mayors of a suburban community has remarked that Jackson is the "trunk of the tree" and if the trunk dies, so will the "branches" (bedroom communities). This attitude must be embraced by the communities surrounding Jackson, and operationalized through true regional cooperation, such as a regional sales tax. If the

currently prevailing attitude of “us against them” does not cease, the future success of the entire metropolitan area is in peril. There is no future for the Jackson region if the trunk of the tree is allowed to decay and die.

Although the prospect of regional sales tax legislation being passed by the Legislature to some is laughable, other opportunities exist for the State to do better by its Capital City. One such opportunity, and the third legislative initiative, is further amendment of the Jackson 1% Sales Tax law. Over the years, the relationship between Jackson (by far, the State’s largest urban area) and the Legislature (dominated by rural interests) has been tenuous; however, it seems to have worsened with the change in Jackson’s demographics. Legislation passed ostensibly to assist Jackson has routinely included oversight and advisory commissions/committees unique to legislation for the City of Jackson. In this connection, Jackson must press the Legislature to restore the power, and rightful responsibility, of overseeing the expenditure of local option sales tax dollars to the Mayor and City Council by dissolving or re-structuring the 1% Sales Tax Commission. This needed change in the law would place millions of dollars under the direct control of local elected officials, allowing them to use public funds to correct some of the deficiencies in the water system that contributed to the 2021 Jackson Water Crisis.

The attitude and remarks of some top statewide elected officials during the “2021 Jackson Water Crisis” when many Jackson residents were literally suffering from the lack of water service, clearly reveals what one local newspaper editor termed “a race problem” in the State Legislature (Ladd, 2021). The race problem should not just be associated with the Legislature, although the editor’s assertion is not necessarily misplaced. The problem is much more pervasive. It is present in the allocation of resources, in the attitude of surrounding communities toward Jackson, and in the belief that the elected leadership in the City of Jackson lacks the ability to govern effectively. Perhaps the biggest challenge that we face as a state in seeking long term solutions to prevent a re-occurrence of “The 2021 Jackson Water Crisis” is seriously working to resolve the race problem.

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The Role of Black Churches amid COVID-19 and the Jackson Water Crisis

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Abstract

Nationwide, the COVID-19 pandemic has exposed the depth of inequities in the United States. While dealing with the challenges presented by COVID-19, the mid-February 2021 winter snowstorm exposed many cracks in Jackson, Mississippi's infrastructure by leaving nearly 40,000 of its Black residents without water. After weeks without clean water, local churches mobilized and responded to the crisis within their community by distributing water. This study examines the community's resilience in using churches as a vehicle to cope with a water crisis during the COVID-19 pandemic. The authors' conducted semi-structured qualitative interviews with six Black pastors in Jackson, Mississippi for the purpose of obtaining an in-depth understanding of grassroots mobilization efforts to provide clean water for Jackson residents. An analysis of data collected revealed five themes: (1) historical context of access to water; (2) organizing in a crisis within a crisis; (3) use of technology to spread the word; (4) building and maintaining capacity; and (5) the Black church as a pillar in the community. Key study recommendations include encouraging respective African American churches to document emergency preparedness plans and increasing African American church representation in municipality emergency preparedness plans.

Keywords: water, crisis, Jackson, Black church, COVID-19

Introduction

In a year unlike any other, many have witnessed countless acts of heroism and resilience in the Black community amid the COVID-19 pandemic. Yet, the COVID-19 pandemic has exposed and exacerbated many racial inequities in the United States. The mid-February 2021 winter snowstorm exposed many fractures in Jackson, Mississippi's infrastructure by leaving nearly 40,000 of its Black residents without water (Stribling, 2021). While national news media was focused on Texas which was also suffering from the major storm, Jackson, Mississippi's capital city, received little national

media mention. As stated in a news account after weeks without clean water, “on March 17, the city of Jackson, Mississippi finally lifted its boil water notice. But Jackson’s water crisis laid bare the budget, infrastructure, and equity issues that leave cities like Jackson vulnerable to future extreme weather” (Schwartz, 2021, para 5). The 2021 water crisis did not emerge as a sudden catastrophe but one that could be classified as “passive infrastructural violence,” defined by Rodgers and O’Neil (2012) as “the socially harmful effects derived from infrastructure’s limitations and omissions.” While local leaders called on the Republican-led state government to intervene, responses from those government officials to the water crisis ranged from non-existent to limited. This left residents to fend for themselves in places that reeked of raw sewage, and limited their ability to follow the CDC’s handwashing recommendations to combat the pandemic. State leaders continued to place the impetus on the city of Jackson to fix its problems.

Religion is an important, yet often ignored social determinant of health, and religious institutions play a substantial role in the lives of African Americans (Hardison-Moody & Yao, 2019). For instance, faith-based organizations have promoted immunization in at-risk and underserved populations, promoted physical activity programs to tackle chronic diseases, have been safe havens for migrants, and have intervened to contain infectious diseases such as Ebola and HIV. It is believed that the health status outcomes of African Americans will improve throughout the community if health education and outreach programs are promoted through faith-based settings (Hardison-Moody & Yao, 2019).

In addition to serving as vaccination sites within the city, Jackson churches again turned to addressing the immediate crisis by distributing water (Farrish, 2021; Thompson, 2021; Ware, 2021). Historically, the African American church has been identified as a vehicle to support, address, and disseminate health information for underserved populations (Holt et al., 2017; Markens, Fox, Taub, & Gilbert, 2002). The purpose of this study is to examine the Black church’s role as a community resource in response to the 2021 Jackson Water Crisis during the COVID-19 pandemic. This study

provides a more detailed account of actions by the churches that can serve as a blueprint for future public health crises within similar communities.

Theoretical framework

Using the *Community Readiness Model* as a framework, this study explores the faith community's preparedness to tackle the 2021 Jackson Water Crisis and its impending policy and community-level implications.

Methods

Participants

Six pastors of six different churches in Jackson, Mississippi participated in this study. To meet inclusion criteria, they self-identified as: 1) Black or African American; 2) pastors of predominantly Black churches in Jackson, Mississippi during the Jackson Water Crisis; and 3) who were at least 18 years old. Although not in the protocol, all pastors further self-identify as male.

Material

A semi-structured interview guide was developed to explore the following topics: participants' and the churches' connection to Jackson; the impact of the water crisis on church congregants and community members; strategies used to mobilize during the Jackson Water Crisis; the advantages and disadvantages of collaborating with other entities; and the churches' preparedness to deal with similar crises in the future as detailed in Table 1.

Recruitment

Fifteen churches were identified via an internet search of church listings in the Jackson, MS city limits, and their pastoral leadership was further identified using the churches' websites and/or social media accounts. Once identified, prospective participants were sent recruitment letters via email to participate in a study about the church's response to the Jackson Water Crisis. If prospective participants were unable to join the study, or had joined the study and completed the interview, they were asked to refer another pastor to participate in the study.

Table 1

Guiding questions for interviews

Interview Guide
<ol style="list-style-type: none"> 1. Tell me a little about yourself and your church? 2. Describe the neighborhood and your congregation. 3. How did your church become involved in relief efforts? 4. What was the impact of the crisis on your church and community members? 5. What made it easy for your church to provide resources to your church and community members? 6. What made it difficult for your church to provide resources to your church and community members? 7. What other entities supported your church's efforts to provide resources to your church and community members? 8. What were the benefits of working with other entities to provide these resources? 9. What were the barriers to working with other entities to provide these resources? 10. What do you perceive to be your church's role in addressing issues like the Jackson Water Crisis in the future? 11. If you could do anything differently the next time such a crisis arises, what would it be? 12. Is there anything that we did not ask that you would like to share?

The *Community Readiness Model* gauges a community's preparedness to tackle a specific issue or project (Oetting, 1995). The model's premise lies within nine stages as outlined and defined in Table 2 (Edwards et al., 2000).

Table 2

Stages of the Community Readiness Model with corresponding definitions

Stages of Community Readiness Model	Definitions of Stages of Community Readiness Model
<i>No awareness</i>	Issue is not generally recognized by the community and/or leaders as a problem; no knowledge about the problem.
<i>Denial/resistance</i>	At least some community members recognize that it is a concern, but there is little recognition that it might be occurring locally; do not support using available resources.
<i>Vague awareness</i>	There is a local concern, but there is no immediate motivation to do anything about the problem; there are little resources available.
<i>Preplanning</i>	Planning is beginning. However, efforts are not focused or detailed; limited resources are available.
<i>Preparation</i>	Active leaders begin planning in earnest. The community offers modest support of their efforts; some resources are available to support the issue.
<i>Initiation</i>	Adequate information is available to justify efforts. Activities are underway; resources have been obtained and allocated to support.
<i>Stabilization</i>	Activities are supported by administrators or community decision-makers. Staff are trained and experienced; continuous support.
<i>Confirmation/expansion</i>	Efforts are in place. Community members are comfortable using services, and they support expansions. Local data are regularly obtained.
<i>High level of community ownership.</i>	Detailed and sophisticated knowledge exists about prevalence, causes, and consequences. Effective evaluation guides new directions. The model is applied to other issues.

Procedures

Participants were invited to take part in the study via Zoom. Arrangements were made to schedule a time when the participants could meet with either the principal investigator or co-investigator. Email reminders were sent to participants the morning of the scheduled interviews.

Participants were provided with an emailed copy of the consent form outlining study procedures and asked to find a private area to complete the interview in the reminder email. Once the participants arrived via Zoom for the interviews, the study protocol was reviewed, and verbal consent to proceed with the study was obtained. After consent was obtained, the recording of the interview commenced. The semi-structured interviews lasted approximately 45 minutes. Written memos were recorded during all the interviews, and nonverbal data was captured to inform the investigators of the context in which answers were provided throughout the interview process. When the interviews were completed, the interviewers thanked the participants for their time.

Upon completion of the interviews, the audio and video recordings of the interviews were downloaded. When the download was completed, the audio files were uploaded to a password-protected storage device, and the video files were discarded. The audio recordings of the interviews were then sent to Scribie Audio Transcription Services for transcription. Once the transcripts were received, they were cleaned by the principal investigator, using the uploaded audio files for accuracy.

Data analysis

A general inductive approach for qualitative data analysis was utilized with a priority on focused coding, consistent with grounded theory coding techniques (Charmaz, 2014). Nvivo Qualitative Data Analysis Software was used to organize notes, code the transcripts, and develop themes. Through this approach, themes emerged and results were organized to reflect consistent emergent themes across the interviews. Ethics approval for all study procedures was obtained by the Mississippi State University Institutional Review Board.

Results

The Role of the Church in Crisis

All (n = 6) pastors described their churches as located in the inner city of Jackson, MS. The pastors all described diversity in where their congregants lived; some lived within the same neighborhoods as the church and others commuted from neighboring cities. Collectively, the pastors of the churches described diversity in their respective congregations' makeup around socioeconomic status level. Five of the six pastors self-disclosed their educational status, with those who disclosed possessing a graduate-level degree.

First Theme

Five themes emerged during the interviews. The first theme to emerge from the interviews was the historical context for access to clean water and the lack of infrastructure stemming from poor city planning. Jackson's aging infrastructure theme reveals the friction between past decisions about resource allocation in urban African American-led cities:

"The crisis of water in Jackson, MS is an inherited problem, and it happens with many cities who go through transitioning from the White establishment to that of African-American, or whatever. The infrastructure was never maintained and totally repaired during prior administrations, so now the present administration inherits multi-million dollar needed repairs every year we've had water problems. Because the infrastructure is old, we have the main breakage and we have a lot of boil water experiences because the infrastructure can no longer maintain this city and endure the cold weather, so this year was no different from any other year." P2.

One pastor (P5) cited never being a consumer of the drinking water supplied to his household through the water system in his home. He suggested that the water crisis was exacerbated but was not outside of the norm in which members of his congregation often had accessibility issues to potable

water before the formal crisis. City infrastructure has been suggested as a critical factor in how the water crisis came to be:

“I know since I moved back to Jackson, I’ve been drinking bottled water. And even with making the ice, I make ice with bottled water. I don’t trust some water at all, so there is some frustration. But at the same time, people are kinda used to it, and we don’t blame anybody, we know we have to be careful not to point fingers at any one leader or any group of leaders because it’s not their fault. We have an aging infrastructure, and it should have been addressed 50 years ago. So how can you blame the current leaders for something that should have been done a long time ago, the thing to do now is, let’s get to work on it.” P3

This trend of increased use of bottled water and decreased use in tap water is emblematic of instances in many areas that deal with consistent tap water contamination due to passive infrastructural violence (Hobson et al, 2007; Rosinger and Young, 2020). Households across Jackson became dependent on bottled and/or filtered water for drinking, potable water for preparing food, brushing their teeth, and bathing. With uncertainty over the water quality and its dangers, everyday hygienic tasks that were monotonous and routine for many Americans became, for many Jackson residents, complicated tasks to manage during a pandemic.

Second Theme

The second emergent theme was organizing in a “crisis within a crisis”. This theme highlights three components of the *Community Readiness Model* --- preplanning, preparation, and initiation. The churches in this study were already managing the COVID-19 pandemic, which saw the shutdown of churches for in-person service as a previous proactive shelter-in-place order by the state of Mississippi forced the initial shutdown. Churches continued independently worshipping via social media to decrease the risk of super-spreader events during church services. The shutdowns led to some churches serving as COVID-19 testing and/or vaccination sites and providing technology to the public school district. Therefore, some collaborative efforts within and among churches were

occurring with support from other community partners. When the water crisis occurred, only one church of those interviewed was in disarray scrambling to get resources and collaborate with other churches. This church had not been actively providing COVID-19 testing or vaccinations but did provide weekly meals for congregants and community members during the pandemic. Although not explicitly stated, the pastor suggested behind-the-scenes connections that placed some churches at an advantage for receiving external resources over others.

The pastors did, however, provide insight on the actions taken to respond to the Jackson Water Crisis. All pastors in the study cited having external resources that facilitated resource sharing with their congregations and communities. The pastors described limited local support in their efforts. The crisis gained national attention, so many of the churches received donations from other churches and organizations in several states away from Mississippi including Georgia, Florida, Michigan, Texas, and Virginia. Donations came in the form of bottled water, food, toiletries, and financial grants. During both the preplanning and preparation stage, many of the pastors reported coordinating with other local churches to allocate resources that were being provided.

During the initiation phase, services offered by the churches in this study included providing bottled and potable water, preparing and/or packaging meals, and covering hotel room expenses for congregants who simply wanted to take a bath in clean water. Due to the water crisis, hygiene and sanitation became major concerns as the water was not accessible in most of the city, and the recommendations for preventing the spread of COVID-19 involved handwashing and sanitizing hands and surfaces. Additionally, many pastors expressed a deep concern for senior members of the community and congregation, many of whom have chronic health conditions.

Third Theme

When detailing how messages were shared about the resources that were being disseminated by the churches, the pastors cited the use of technology to spread the word, which is the third theme. One pastor shared, “the amazing thing was when we began to hear from people we didn’t know. I

guess we often hear about the ills of social media, but there's a lot of good in it, and so people saw what we were doing on social media, they saw what other churches were doing on social media, and people don't mind supporting you, if they know or they feel confident about where their money is going, and social media did that." While some congregants were initially reluctant to use social media platforms and applications, the shutdowns associated with the COVID-19 pandemic primed the congregants for what was to come in the form of the water crisis. The pastors were able to utilize social media such as Facebook to spread the word about events to share resources. Traditional media platforms such as radio advertisements and local news coverage further amplified the spread of messages in the communities. The church text messaging systems were another underutilized resource before the pandemic that proved to be useful during the pandemic and water crisis. Additionally, in the wake of COVID-19 many churches transitioned to online platforms for giving which made it easier to receive charitable donations from individuals across the country wanting to contribute to relief efforts:

"The pandemic forced us to do virtual church and it also forced us, we already had it but it forced the members to begin to use online giving. We already had online giving before the pandemic, but it became really popular after the pandemic. So when the water crisis hit people from all over the country right away, they knew they could go to Mountain View's website, press the green online giving button, and it's real quick and easy. So, the pandemic prepared us. It made the transition into water crisis mode, really, really easy. The crisis itself was not easy but knowing what to do and how to do it was already set up for it." P3

Fourth Theme

The pastors were asked what they would do if such a crisis arose again. One pastor shared that the churches had never worked collaboratively preceding the Jackson Water Crisis, which is the fourth theme, building and maintaining capacity. The pastors emphasized the need to collaborate with other churches and the need to network with other people and entities to ensure that they were

situated to tackle such similar crises in the future. The pastors also acknowledged the need to be aware of the strengths and capabilities of members of the respective churches, and to capitalize on what the congregation collectively does well. Yet another pastor, P1, discussed the need for those in positions to share available resources. He mentioned that the water crisis is ongoing, and pastors should be made aware of anything that could benefit their congregants and the surrounding community members:

“I think the first thing, and this is something that came up in our conversation with Marshall is, we want, I think we need to have some kind of emergency protocols for the church in our church, and many churches, this hit us and we just floundered a little bit. We were shooting in the dark. You know next time around it would be good to have a plan, a protocol in place, and then . . . figure out how we maintain and sustain inter-denominational networks. So that something hits, we kind of know whom to call what to do, ‘cause that’s one of the things I was doing quite a bit of is saying, okay, this is coming, Morning Star can’t hold it or it’s gotta go to New Destiny. Already having that stuff in place to say, we’re getting something X amount or more, we already know we need to get it over to this church because this church can’t do it, and so just kind of knowing that ahead of time, if we... I think going forward, it would be great to kinda have a strategy in place as opposed to just kind of winging it, which I think most of us did during the water crisis.” P1

Fifth Theme

Lastly, there was consensus amongst the pastors on the Black church as a pillar and focal point in the community, specifically the Black communities within Jackson, MS. When describing the visibility role of Black churches in the community, one pastor stated, “The church oughta have a good reputation in the ‘hood that they are” P6:

“One thing that made it easy or easier is the mere fact that I’ve been fortunate enough to pastor a church, where people understand the importance of being relevant in the community. You know some churches... some organizations don’t view ministry outside the church, as important as ministry inside of the church, so what made it easy for us is the mere fact that our members were open to the idea. Matter of fact, the gentleman... I shared his name, who was over the emergency services, whatever department that is, he said to me that this was a location that they thoroughly enjoyed working in. We provided lunch for them every day, the doors were open, they were here, we had people who are assisting them to pass out the water, even though that was the soldier’s responsibility, we had people here working every day, so that made it easier knowing that we had staff in place, we had people who saw the vision and saw the necessity of being a blessing in the community that always makes it easier when you have people who are ready to work, on short notice.” P4

“This is but one example of the necessary good churches do particularly Black churches, and in a time when the Black church’s relevance is often called into question. I think moments like these remind us that as imperfect as our churches are, they’re still necessary. They are still indispensable, so hopefully, this moment will show how to help this indispensable institution be stronger and better moving forward so that we’ll be around 50 or so years or the next 100 years or the next once-in-a-century storm or pandemic hits. We’ll be around... Well, you and I won’t be around in 100 years, but we’ll have a strong church that is able to not just survive but thrive.” P1

Discussion

The experiences of these ministerial leaders who participated in this study shed light on the many challenges that remain in hindsight of the 2021 Jackson Water Crisis. The impact of the water crisis was far-reaching and is still ongoing although many attempts are in progress to remedy the city’s aging infrastructure. These narratives guide what churches as an indispensable institution in the

Black community can and/or should be doing to have an impactful community presence. As documented elsewhere, the Black church is the center of the Black community; and the Jackson Water Crisis amid the COVID-19 pandemic highlighted its relevance (Patillo-McCoy, 1998). Consistent with the literature, many of the narratives expressed that community members saw the church as a trustworthy resource when city officials and others were not adequately meeting their needs. While many were waiting on the declaration of a state of emergency, the structure of the churches made it easy to swiftly mobilize volunteers and leverage national connections.

The churches in this study had strengths that made responding in a time of crisis easy for them. Externally, the Jackson Water Crisis received not only local and state-level attention but national attention as well. Churches in this study were well-connected to other churches in neighboring communities and other states. This network of pastors and churches nationally made community mobilization efforts easier with resources coming in at rates that were sometimes overwhelming given the churches' capacity to organize and store the resources. Locally, the network of pastors was strong with most pastors being able to contact other pastors when resources were in abundance. Given that the churches were already organized around COVID-19 prevention and relief efforts, internal capacity was already increased with leaders knowing which members of the congregation were able to complete efficient and effective tasks in this time of crisis.

Recommendations

Several pastors alluded to the need for churches to have documented emergency preparedness protocols to assist them in dealing with natural disasters and other crises appropriately. Most recently, the FAITH! (Fostering African American Improvement in Total Health) program, the first academic–community partnership between the Mayo Clinic and African American churches, developed emergency preparedness manuals and disseminated COVID-19-related health messages (Brewer et al., 2020). While acknowledging the organizational policy-level changes that can occur within the church, many pastors shared that the church as an institution is limited in its capacity to make

changes. They emphasized the need for consistent civic engagement to ensure citizens are active in elections and are holding city and other elected officials accountable for the measurable amount of change that needs to take place. The physical church can be a place in which those conversations occur, but as one pastor noted, though they can continue to distribute bottled water, the church cannot turn the water back on for its congregants and community members nor ensure that the water is safe for consumption. These types of changes must come about through public policy (McLeroy et al., 1988). In summary, data from this study suggest that African American churches need well-documented emergency preparedness plans for their respective churches and respective cities. Secondly, municipalities should incorporate African American churches into their emergency preparedness teams and plans to be well-equipped for such crises.

Limitations

This study had some limitations. The data was self-reported, and the small sample was limited to one geographic location. This limits the transferability of the findings; however, it can be beneficial in providing valuable insights from the participants' experiences in the Jackson Metro area.

Future research should explore the development of a church community coalition, using the *Community Coalition Action Theory*, to address issues such as water insecurity, food insecurity, or gun violence within the city. While many pastors relied on their networks to help assist with relief efforts, a more concerted coalition could be established that would allow for adequate preparation, better use of human capital, efficient data collection, and streamlined approaches to resource distribution to ensure all affected citizens are equitably served. Additionally, this will ensure high-level community ownership as outlined in the *Community Readiness Model* so no one church bears the burden of addressing an issue. Lastly, further exploration is needed on the remaining three stages of the *Community Readiness Model* --- stabilization, confirmation/expansion, and a high level of community ownership. After successful execution on this issue, the model could be used to inform

and tackle other heavily emphasized issues such as food insecurity. Pastors in this study highlighted food pantries and feeding ministries, but rarely utilized the term “food insecurity” in their descriptions of the missions of these ministries. Additional research should explore the depths of food insecurity experienced by those who were affected by this temporary but prolonged water insecurity.

Conclusions

Faith-based organizations have strong traditions of working for social justice and against inequality in communities of color. To prepare these institutions to continue to flourish and address future public health crises, public health professionals, health educators, and other professionals and leaders must view partnerships with faith-based organizations as pivotal to swiftly engaging with Black communities, who are traditionally, socially, and economically marginalized and medically underserved. This research has the potential to transform emergency preparedness for issues such as the Jackson Water Crisis using a reliable resource, the church, within Black communities.

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Water System Challenges in the Face of Population Declines: The Jackson, MS Experience

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Abstract

Jackson, Mississippi has faced numerous challenges with its drinking water and wastewater systems in part to infrastructure aging, deterioration, and weather crises. These issues contribute to subsequent environmental and public health problems. This study uses an interdisciplinary case study approach that combines the lenses of public health, civil engineering, law and policy, and population and development to generate an in-depth understanding of the 2021 Jackson Water Crisis. Drawing on the *Community Resilience Framework*, this study integrates a number of key issues in a single discourse, which is often not done at the national level. While there are many concerns, three of the most important are: (1) shrinking population; (2) infrastructure failures and legal violations; and (3) increased maintenance and compliance costs. This study argues these three challenges are interconnected and mutually reinforcing, and collectively contribute to the problem of poor water quality in Jackson, Mississippi. As a result, the authors recommend that policymakers: (1) increase federal and state investment in Jackson's water infrastructure to enable compliance with environmental laws; (2) ensure that investment decisions are made based on a full accounting of the costs; (3) develop comprehensive plans for staffing and improving operations in partnership with community stakeholders; and (4) pursue innovative methods of generating revenue for the City in light of a shrinking population and tax base. These recommendations should take into account community voices that can assist State and City officials in developing more resilient communities.

Keywords: water, infrastructure, crisis, population change, health, civil engineering, law, policy

Introduction

What individuals see in looking at and trying to interpret the world around them is partially the result of the lens being used. In attempts to understand and respond to problems, it is common to use one particular lens. For instance, in thinking about water systems, it may seem the most obvious lens would be focusing on the public health outcomes associated with water contamination or the technological feats of engineering needed to improve the system. Although informative on their own, such singular perspectives will only provide limited images and partial solutions. Instead, to identify and work through the complexities, it is necessary to use a variety of different lenses, singularly and together.

The City of Jackson, Mississippi (City), the state's capital and most populous city, has a population of approximately 153,701 (U.S. Census Bureau, 2020b). Jackson's residents are 82.2% African-American, and 25.4% of the residents are living in poverty, with a median household income of \$38,922 (U.S. Census Bureau, 2019).

Jackson's water system is in crisis. Despite ongoing repair efforts funded by millions of dollars in loans, water and sewer rate increases, and revenue from a 1% sales tax imposed in 2014, challenges still seem to outweigh corrective efforts. The City of Jackson is currently operating under two separate federal enforcement orders for noncompliance with federal and state law (U.S. v. Jackson, 2012; U.S. EPA, 2021, July 1).

To complicate matters, in February 2021, Mississippi was hit with a historic winter storm. Freezing temperatures caused power outages, burst water pipes, and water system equipment malfunctions. At the height of the crisis, an estimated 40,000 City residents lost water service, some for over three weeks (Harris, 2021; City of Jackson, 2021). Although severe, this was not the first time such problems occurred. Just three years before, in January 2018, freezing temperatures caused over 100 water main breaks in the City.

The Jackson Water Crisis of 2021, while unique in many respects, is indicative of larger national conversations about aging infrastructure, its impact on health and wellbeing, and the disproportionate burden of these impacts borne by low-income communities and communities of color. However, these conversations neglect to engage with the complex network of contributors and downstream consequences of this aging infrastructure. An interdisciplinary approach is critical to a complete understanding of these issues.

A particularly useful theoretical framework to accomplish this is community resilience, a solutions-oriented approach to integrating multiple community systems (e.g., health, education, government, infrastructure) to address community-wide issues in an equitable way. Community resilience provides a path for action that accounts for disparities across demographic groups and places. The *Community Resilience Framework* (CRF) outlines these systems in more detail, but this study will focus more specifically on the health (public health and population), government (law and policy, development), and infrastructure systems (civil engineering).

The authors seek to address the shortcoming in the broader literature around aging infrastructure and its consequences by presenting a case study that views the Jackson Water Crisis through an interdisciplinary set of lenses that pull from public health, civil engineering, law and policy, and population and development into a cohesive set of recommendations informed by community resilience. Each lens provides a particular tint, scale, and focus. The research team includes a toxicologist, civil engineer, environmental attorneys, and rural sociologists, and the research draws upon diverse information from government and scientific reports, news coverage, regulations, and population data.

When overlaid, these views reveal multi-faceted challenges that will require innovative solutions to address the development and redevelopment needs of Jackson and other places facing similar problems. Drawing from CRF, the findings gleaned from this interdisciplinary approach have

the potential to provide an actionable set of recommendations that ultimately move the needle for improving community wellbeing and resilience.

Public Health Lens (Health System)

Water is a basic necessity of human life. Clean water is needed for drinking, cooking, and bathing. Additionally, wastewater must be managed. Lack of access to clean water impacts both individual and public health. It contributes to the spread of infections and water-borne diseases from bacteria and parasites such as *E. coli*, *Cryptosporidium*, and *Giardia* (Benedict et al., 2017). According to the Centers for Disease Control (CDC), over 7 million Americans get sick every year from diseases spread through water (CDC, 2020). Exposure to contaminants, such as arsenic, lead, and chemicals like fertilizers or pesticides, has been linked to certain cancers, chronic diseases, and childhood development impacts (Levallois & Villanueva, 2019).

Significant improvements in water quality have been made, but challenges remain. The American Society of Civil Engineers (ASCE) gave both Mississippi's drinking water and wastewater infrastructure an overall score of D (ASCE, 2021). When pipes break or equipment fails, there is a loss of water pressure that increases the risk that pathogens can enter the drinking water system. Boil water advisories are issued in such situations to protect public health, but the need to rely on bottled or boiled water causes significant additional hardships, both economic and social, for Jackson residents. On January 11, 2022, there were six active boil water notices for Jackson (MSDH, n.d.). Further, Hinds County, where Jackson is located, has the highest number of children with elevated blood lead levels in the state (MSDH, 2017). In February 2016, the Mississippi State Department of Health (MSDH) urged Jackson residents to take precautions before using tap water, such as flushing faucets and installing filters specifically to reduce exposure to lead (MSDH, 2016).

Poor and minority communities are disproportionately affected by polluted waters and failing infrastructure (Hanna-Attisha et al., 2016). It is these adverse effects on public health caused by unsafe drinking water that drive many of the legislative mandates highlighted in this study.

Civil Engineering Lens (Infrastructure System)

Jackson lies along the Pearl River. A dam was built on the Pearl River north and upstream of the city in the early 1960s to create the Ross Barnett Reservoir, which now serves as Jackson's primary source of drinking water. As the Pearl River flows out of Jackson towards Louisiana, it carries with it a significant portion of Jackson's wastewater.

The City of Jackson's drinking water and wastewater infrastructure is aging and complex. The drinking water system consists of three components: the O.B. Curtis water treatment plant (WTP), the J.H. Fewell WTP, and a groundwater well pumping and treatment system (U.S. EPA, 2020, March 27). Each of these systems has a different source of water --- the Ross Barnett Reservoir, the Pearl River, and a groundwater aquifer. The methods of water treatment for each system vary because of the quality of the water source and how recently the system was built or retrofitted.

Jackson's wastewater system likewise consists of three components. The Savanna Street Wastewater Treatment Plant (WWTP) collects wastewater from its location in South Jackson to the Madison County line on the west side of the Pearl River and discharges to the Pearl River. The Trahon WWTP, located south of the Savanna Street WWTP, collects wastewater from southwest Jackson and discharges to the Big Creek, a tributary of the Pearl River. Presidential Hills WWTP collects wastewater from northwest Jackson near the Natchez Trace Parkway, U.S. Highway 49/Medgar Evers Drive, and I-220. This WWTP discharges to the Bogue Chitto Creek, which drains to the Big Black River (Waggoner/AJA, 2017).

The WTPs and WWTPs are complex operations requiring multiple reactors, pumps, sensors, tanks, chemical feeds, and other supporting equipment and instrumentation. Drinking water treatment systems also include distribution pipes and water towers or tanks to transport water from the WTPs to the population. Wastewater treatment systems include sewer collection pipes that transport wastewater from the population to the WWTPs. To operate Jackson's open-air plants, distribution, and collection pipes under varying weather conditions requires specialized staff 24 hours per day,

seven days per week. The staff consists of certified operators, chemists, and engineers. Changes in weather or in the conditions of the water source require carefully balancing chemicals and water flow rates to ensure the required quality of drinking water and wastewater. Inadequate staffing increases the vulnerability of Jackson's water facilities to shocks, such as the 2021 winter storm, and the time needed for necessary repairs and response actions.

Adding to the Jackson Water Crisis is the loss of a contract with the West Rankin Utility Authority (WRUA) and the associated \$3.5 million in annual revenue. The WRUA serves several suburban cities south of the Jackson. In 2002, the WRUA entered into a contract with Jackson to send untreated wastewater to the Savanna Street WWTP in exchange for paying a proportionate share of the facility's operation and maintenance costs (City of Jackson, 2020, October 27). Due to concerns over possible future rate increases associated with planned Savanna Street WWTP upgrades, the WRUA sought and received a permit from the Mississippi Department of Environmental Quality (MDEQ) to operate its own wastewater treatment plant. Although Jackson challenged the permit, WRUA's wastewater treatment plant came online in September 2021. Jackson estimates that the withdrawal of WRUA from its system will result in a 25% rate increase for remaining customers to cover the shortfall (Stephens, 2018).

Resilient funding mechanisms and technical know-how are necessary for running resilient water infrastructure. Without these, public health continues to be at risk. Therefore, laws and policies are necessary for enforcing robust infrastructure management.

Law and Policy Lens (Government System)

With respect to law and policy, the analytical lens to view the Jackson Water Crisis is the regulatory regime and framework. The two most relevant laws are the federal Safe Drinking Water Act (SDWA) and the federal Clean Water Act (CWA). At the federal level, the U.S. Environmental Protection Agency (EPA) has the authority to regulate under both the SDWA and CWA. In Mississippi, delegated authority for SDWA and CWA implementation rests with the Mississippi State

Department of Health (MSDH) and Mississippi Department of Environmental Quality (MDEQ) respectively. Jackson has struggled with SDWA and CWA compliance issues for decades.

The SDWA is the primary federal law that ensures the quality of Americans' drinking water. The EPA sets standards for monitoring and treating water for more than 90 regulated contaminants. Local governments operating public water systems (PWSs), such as the City of Jackson, must comply with these requirements. Having particular relevance to the Jackson Water Crisis is the regulation setting the standard for how much lead can be in drinking water, known as the Lead and Copper Rule (LCR). PWSs have to monitor and control lead and provide specified public notifications if lead levels exceed the rule's Action Level of 15 parts per billion (ppb). The LCR also requires some PWSs to institute a method of corrosion control, which is meant to control the amount of lead that leaches into drinking water from plumbing.

Jackson has reported multiple violations for each of its WTPs since 2015 (EPA, 2020). On July 1, 2021, Jackson entered into a settlement agreement with the EPA related to violations of the SDWA, LCR, and regulations relating to filtration and disinfection. This agreement is an escalation of enforcement actions that commenced following a SDWA compliance inspection in February 2020 and focuses on three main issues: (1) inadequate staffing; (2) high turbidity (sediment) levels; and (3) sub-optimal corrosion control. A March 27, 2020 Emergency Administrative Order required Jackson to take multiple actions related to its water system, including developing plans for equipment repairs at its treatment plants and providing alternate drinking water sources when specific conditions are met (U.S. EPA, 2020, March 27). EPA issued a Notice of Noncompliance on April 26, 2021 for total haloacetic acids (disinfection byproducts) exceedances and failure to optimize corrosion control (U.S. EPA, 2020, April 26). A second Notice of Noncompliance was issued on May 11, 2020 for a range of violations, including personnel, monitoring, and reporting requirements (U.S. EPA, 2020, May 11).

The 2021 settlement agreement establishes a strict implementation schedule for actions required to bring the system into compliance with the SDWA. Jackson was required to immediately

implement a comprehensive equipment repair plan to address maintenance backlogs at the Fewell and O.B. Curtis WTPs. By August 1, 2021, Jackson had to provide the EPA with a comprehensive staffing plan for how it would ensure that a certified operator is onsite at all times, as well as plan for how it will develop an updated materials evaluation to identify the presence or absence of lead service lines in the system (Judin, 2021). As of the submission of this study for publication, there is no publicly available information to show whether this deadline was met.

The CWA is the primary federal law regulating the nation's water bodies and focuses on preventing and reducing water pollution in the nation's waters (33 U.S.C. 1251(a)). The CWA established a permitting system for point sources (for example, discrete conveyances like pipes, ditches, or sewers) known as the National Pollution Discharge Elimination System (NPDES) Program. Under the CWA, all point source discharges of pollutants into bodies of water under federal jurisdiction require a permit.

Discharges from municipal WWTPs and storm water systems are subject to NPDES permitting requirements. In March 2009, a 100 million gallons per day (MGD) pump failed at the Savanna Street WWTP. The pump failure resulted in untreated wastewater being discharged into the Pearl River in violation of Jackson's NPDES permit (U.S. v. Jackson, 2012). Additional illegal discharges of untreated wastewater were documented by MDEQ throughout the summer of 2009. To settle an enforcement action by MDEQ in 2010¹, Jackson agreed to pay a \$240,000 civil penalty and develop a Sanitary Sewer Overflow (SSO) response plan to minimize environmental impacts from such events. Discharge violations at the Presidential Hills WWTP from December 2009 – February 2011 resulted in a MDEQ enforcement action and \$22,500 civil penalty in August 2011 (U.S. v.

¹ MDEQ has delegated authority from the EPA to administer and enforce programs under the CWA. MDEQ may initiate enforcement actions, as it did against the City in 2010. It can also request that the EPA take the lead on enforcement if state actions are not sufficient to generate compliance.

Jackson, 2012). In May 2012, MDEQ issued to Jackson a revised NPDES permit for the Savanna Street WWTP that included more stringent effluent (e.g., discharge) limits for nitrogen, phosphorus, and other nutrients (U.S. EPA, 2012). From 2009 – 2012, Jackson experienced at least 2,300 SSOs events.

In 2012, Jackson entered into a comprehensive settlement with the EPA for past and ongoing violations of the CWA that required Jackson to: (1) develop and implement plans to improve operations at Jackson's wastewater treatments plants; (2) eliminate SSOs; and (3) minimize prohibited bypasses by 2030. The settlement agreement also assessed a \$437,916 civil penalty and Jackson agreed to spend an additional \$875,000 on a supplemental environmental project in low-income areas of Jackson (U.S. EPA, 2012).

It is unclear if Jackson has the resources to comply with the EPA orders. In addition to the \$1.3 million in penalties associated with the SDWA order, the total compliance costs for both orders are estimated at over \$1 billion (\$400 million for the CWA order and \$642 million for the SDWA order) (U.S. v. Jackson, 2012; U.S. EPA, 2021). In its semi-annual report submitted on March 31, 2021, Jackson reported due to a lack of funding, several projects required by the settlement agreement had been deferred for a period of time or until additional funding can be secured (Waggoner/AJA, 2021, March 31). Due to a lack of funding, Jackson is no longer accepting applications to participate in the supplemental environmental project, which is focused on repairing private lateral water lines, despite over \$700,000 remaining in the project's escrow account (Waggoner/AJA, 2021, March 31). Although ultimately voting to approve the SDWA administrative order, Jackson's City Council members expressed reservations about how to pay for the required compliance actions (Warren, 2021).

Failure to comply with either order could result in additional enforcement actions, such as assessment of civil penalties placing an additional financial burden on Jackson. Further, if lead

service lines are found within the distribution system, Jackson will need to replace them according to timeframes set forth in the LCR (40 C.F.R. 141.84).

Population and Development Lens (Health and Government Systems)

Population and development are interconnected (Gould, 2015). Demography is core to the study of populations with its focus on characteristics and changes in human populations between places and over the course of time. This lens highlights the important impact of births, deaths, and migration on shaping population. Furthermore, demographic change can both influence and be influenced by social, economic, and environmental factors. Health is directly associated with fertility and mortality, and the combination of engineering and law and policy can result in physical infrastructures and institutional arrangements that sometimes support and other times challenge public health, quality of life, and general wellbeing. Thus, population dynamics both drive and are driven by the development needs of the population.

Using the population and development lens to view the Jackson Water Crisis, attention focuses on population change, especially declining populations which impact customer and tax bases. Although communities of all sizes across the country are struggling with aging infrastructure (ASCE, 2021), communities experiencing out-migration and depopulation (i.e., “shrinking”) face problems due to decreasing revenues and customers, as well as challenges with insufficient tax bases (Doyle et al. 2020). Population decline results in financial loss which is associated with reduced quality of infrastructure that can further exacerbate population loss and, depending on the location, increase cost burdens on minority and low-income communities. Such decline, however, does not lead to reductions in system needs. As noted by Faust, Abraham, and McElmurry (2016), “During these economic contractions, the footprint of built infrastructure does not adjust, but rather remains stable, ultimately creating an excess of underfunded and underutilized infrastructure” (p. 129). Using the *Community Capitals Framework* concerning the intersection of diverse assets (ranging from human and social to financial and built), this situation may be seen as a downward spiral (Emery & Flora,

2006). The concerns transcend the rural-urban continuum, although their complexities and potential solutions may vary according to geographic context.

In terms of population, the City of Jackson's 2010 population count from the Decennial Census was 173,514; however, the population decreased to 153,701 as measured by the 2020 Census. There was a loss of 19,813 people, representing a -11% change (see U.S. Census Bureau, 2021).² This change includes the numerical balance of births and deaths, as well as the influence of net-migration. Another way of "seeing" the population change in Jackson is to note the estimated 18.0% of housing units [+/- 2.6%, 90% CI] that were thought vacant in 2019 (U.S. Census Bureau, 2019). Jackson has been deemed a "shrinking central city," a typological designation shared with 80 other cities in the United States facing not only population loss, but also heightened unemployment and poverty (Ribant & Chen, 2020).

Given that county-level geographic boundaries are more consistent than city boundaries (because cities can annex additional land over time), it is also informative to look at population trends at the county level, which provides the basis for a longer-term historical perspective and comparison across age groups. Hinds County has a population that consists of more than just Jackson (with the city including some territory outside of Hinds County), but the trends are evident. Hinds County faced net out-migration (more people leaving than coming in over the time period) from the 1980s to 2020 (Winkler et al., 2013; U.S. Census Bureau 2020a), thus contributing to depopulation. The exceptions to this pattern were among teenagers and young adults in the traditional college age groups (20 to 24 years in the 80s, 90s, and 2000s, and 15 to 19 years in the 80s). This out-migration in Hinds County was much different than, for example, the adjoining Madison and Rankin Counties. Other than slight

² There has been concern expressed about 2020 Census counts in the context of the pandemic. Another useful source of the population data are the official population estimates. Comparing July 1, 2010 and vintage July 1, 2020 estimates, there was an estimated population loss of 15,880 people, or -9% change (see U.S. Census Bureau 2020b).

net out-migration for people 20 to 24 years in the 2000s in Madison County and in the 1980s for Rankin County, both counties had net in-migration during this period (Winkler et al. 2013).

Additionally, an examination of the population estimates for more recent years (2010 through 2020), shows the estimated overall population change and the portion of that change due to out-migration. For Hinds County, the U.S. Census Bureau estimated domestic net out-migration in nine of the past ten years. In terms of total population change, some of this is offset by international net in-migration and more births than deaths (what is referred to as natural increase), but even so, the overall population was estimated to have declined by 17,751 persons over the course of the past decade (U.S. Census Bureau 2020). Such changes in population influence the number of paying customers, tax revenues, and overall business activity. Thus, so-called shrinking cities face constraints with respect to water systems, including but not limited to those that are fiscal, personnel, and regulatory (Faust, Abraham, & McElmurry, 2016).

Findings

Jackson's drinking water and wastewater infrastructure involves complex systems that are costly to operate, maintain, and consistently provide access to clean water and protect public health. As Jackson's infrastructure aged, routine maintenance and technological upgrades were forgone due to chronic underfunding of drinking water and wastewater systems. There are many factors that contribute to this underfunding, including a national policy shift away from federal infrastructure funding and shrinking Jackson revenues due to out-migration.

The City of Jackson now faces a significant public health crisis from its water infrastructure. Catastrophic failures and regulatory violations are common. Jackson residents are at risk of lead exposure through their drinking water, and often receive frequent boil water notices that interrupt service and reduce access to clean water for drinking, cooking, bathing, and cleaning. As a shrinking city, Jackson will struggle to finance \$1 billion of infrastructure repairs and upgrades, as well as future operational and maintenance costs. Jackson's revenue-generating options are limited by its

customers' ability to pay their water bills, as well as a loss in the number of customers due to de-regionalization of the water system and out-migration.

Policy Recommendations

Based on these findings, the authors recommend the following policy actions.

1. Increase federal and state investment in Jackson's water infrastructure to ensure reliable access and enable compliance with environmental laws. While Jackson may be able to obtain some financing through state revolving loan funds, federal grant programs, or public-private partnerships, these are unlikely to be sufficient. Even the recent passage of the \$1.2 trillion federal Infrastructure Investment and Jobs Act in November 2021 will not adequately funnel enough funds to Jackson. Pursuant to the state revolving fund formula, only \$429 million for water infrastructure will be available for the whole state of Mississippi over five years (White House, 2021). However, the state's 20-year investment need for water infrastructure is \$4.8 billion (U.S. EPA, 2018).
2. Ensure that investment decisions are made based on a full accounting of the costs. The ongoing water system failures and their associated negative public health outcomes impose societal and economic costs, including: increased legal fees associated with enforcement actions; increased medical expenses for acute illness or chronic diseases from water contamination; and lost productivity for children exposed to lead.
3. Develop comprehensive plans for staffing and improving operations by the City of Jackson in partnership with community stakeholders. As a step towards addressing inadequate staffing violations, the director of Jackson's Public Works Department is seeking to increase salaries by 20% to improve recruitment and retention (Judin, 2021). Such expenditures are approved by the City Council and require local political support and advocacy. These plans should

account for a shrinking tax base by: (1) considering more efficient, cost-effective resilient infrastructure; (2) taking a smart growth approach to strategic planning; (3) leveraging funds from the Infrastructure Investment and Jobs Act; and (4) cultivating public-private partnerships.

4. Pursue innovative methods of generating revenue for Jackson in light of a shrinking tax base.

One policy solution often promoted for meeting the current and future needs of a water system is consolidation (US Water Alliance, 2018). Water utility consolidation can result in, among other things, greater operational efficiencies, increased access to capital, and improved planning and risk management (U.S. Water Alliance & UNC, 2019).

Conclusions

Cities and their surrounding environs each have unique historical trajectories and characteristics, but there are also some commonalities. This is the case with shrinking cities (Ribant & Chen, 2020) and their water infrastructure (Faust, Abraham, & McElmurry, 2016). Viewed through the lenses of public health, civil engineering, law and policy, and population and development, the Jackson Water Crisis presents an important case for better understanding and responding to water system challenges in the face of population declines. In order for communities and, more broadly, cities, counties, and regions to adapt to changes in the economy and environment, attention must be paid to the intersections and complexities of different domains (Cafer, Green, & Goreham, 2019). This adaptation can be facilitated through the multiple lenses approach presented here. It is essential that future water infrastructure policy and funding decisions are informed by the development trajectories and nuances that may vary between places, including those with decreasing populations.

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An Explanation of the 2021 Jackson Water Crisis and Policy Suggestions for Sustainable Water Infrastructure in Jackson, Mississippi --- A Research Commentary Jae-Young Ko, Ph.D.

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Abstract

The Jackson 2021 Water Crisis was a triggering event that worsened municipal services coming from the city's aging water infrastructure. About 43,000 residents in Jackson, Mississippi lost access to water for three weeks in February-March 2021 due to freezing weather and poorly maintained water mains. This study takes a chronological research design approach through a literature review to define trends and changes in residential population, sales, and property tax revenues in the City of Jackson. This study also examines the two major water infrastructure plans proposed by Mayor Harvey Johnson, Jr. in 2012, and Mayor Tony T. Yarber in 2016, and seeks to explain why those plans failed. This study's recommended policy options include increasing efforts for collecting water bills, and creating a new agency for enhanced inter-local government collaboration.

Keywords: water infrastructure, shrinking cities, blighted city, Jackson, Mississippi, crisis

Introduction

Municipal service infrastructures provide the necessary assortment of facilities and services needed for the community to function. However, in blighted cities with decreasing residential populations and reduced revenue bases (e.g., property tax, income tax, sales tax), the financial means needed to maintain the infrastructure shrinks even though the aging infrastructure demands more financial investments (Clemmitt and Karaim, 2015; Faust et al., 2015; King, 2014).

Jackson, founded in 1821, is the capital city of Mississippi. Currently, the service area of the City of Jackson is approximately 150 squares miles and provides drinking water to about 174,000 people via a water infrastructure system composed of 1,500 miles of water mains and two wastewater treatment facilities (City of Jackson, 2016). The water mains include 112 miles of cast-iron pipe, built over 100 years ago, many of which are in the downtown area. Unfortunately, the water infrastructure

system is seriously out-of-date, causing significant maintenance issues such as high system water loss, which is estimated to be about 40% of treated water (City of Jackson, 2016; Peagler, 2013).

Since the 1920s, Jackson has been the largest city in Mississippi. However, its residential population began declining after peaking at 202,000 in the 1980 Census. Currently, its residential population is estimated at 160,628 in 2019 (US Census, 2021). The volume of out-migration has exceeded in-migration over the last thirty years. Out-migration is related to income levels (Frey, 1980), causing the increasing gap between financial demands and revenue sources.

Impacts of the out-migration cause significant financial stress in supporting infrastructure maintenance (e.g., road, water) and municipal services (e.g., police and fire protection). In addition, decreases in tax revenues contribute to lower K-12 student education. The combined impacts of continued out-migration and resulting financial losses in property and sales taxes contribute to a city's rapidly declining infrastructure (Frey, 1980). Numerous mayors in Jackson have tried to maintain the municipal infrastructures such as announcing new ambitious master plans. Additionally, residents in the city approved a one-percent increase in sales tax in 2014 to secure sufficient funding towards enhancing Jackson's infrastructure (City of Jackson, 2016). However, the effectiveness of implementing those plans has been dubious so far.

The 2021 Jackson Water Crisis

The winter season in 2020-2021 was unusually cold. A large winter storm in February hit multiple Southern states, including Arkansas, Louisiana, Mississippi, Texas, and Tennessee. For example, Texas had experienced a statewide blackout and drinking water problems due to the cold weather. Cities such as Memphis, Tennessee, Shreveport, Louisiana, and Oklahoma City, Oklahoma also experienced citywide issues caused by breaks in the water mains and low water pressures (Hardiman, Hilburn, and Walker, 2021; Victory, 2021). As a result, people in the impacted cities suffered from limited-to-no drinking water service and were advised to control their water use at

home. Cities also advised their residents to boil their tap water before use (Hardiman, Hilburn, and Walker, 2021).

The winter storm that hit the Jackson area in mid-February 2021 was marked by temperatures at or below 32 degrees for February 12 and 13, respectively. The freezing weather continued for the following week. Many Jackson residents lived without water service for a month, even after the winter storm had passed. The city reported that 96 water main breaks and leaks occurred, causing lowered water pressure and stopping water services (Haselhorst, 2021). In addition, 43,000 water customers were under a boil-water advisory. Table 1 presents a timeline of events associated with the 2021 Jackson Water Crisis (JWC).

During the turmoil, Jackson set up distribution centers for drinking and non-potable water at multiple locations citywide. Governor Reeves declared a State of Emergency for Jackson and activated the Mississippi National Guard to distribute drinking water to the people in the impacted area (Haselhorst, 2021). On March 17, 2021, Jackson received an official clearance to lift the precautionary boil-water notice citywide, ending the water crisis. During the crisis, city officials blamed the aging water infrastructure system, and Mayor Chokwe Lumumba stated approximately \$2 billion is needed to fix the water problem (Hardiman, Hilburn, and Walker, 2021).

The 2021 Jackson Water Crisis lasted about four weeks in February and March 2021. Most residents in Jackson could not get municipal drinking water due to numerous water main breaks and broken pipes resulting in low water pressure and boil-water advisories for over a month. The 2021 water crisis can be partially traced to a lack of investments over many years in Jackson's water infrastructure system. This study examines the effects of out-migration, decreasing tax revenues, and failed efforts of Jackson's city government in developing and maintaining its water infrastructure. Finally, this study suggests multiple policy options for enhanced water infrastructure management in Jackson, Mississippi.

Table 1*A chronology of the 2021 Jackson Water Crisis*

Date	Events
February 12-13	A winter storm hit the Jackson area. The high temperatures were 34F and 32F, and the low temperatures were 32F and 27F for February 12 and 13, respectively. The freezing weather continued for the next week. Mayor issued a proclamation of Civil Emergency due to the inclement weather on February 12.
February 14	Governor's Declaration of State of Emergency for Jackson.
February 16	Forty-three thousand water customers were under a boil-water advisory.
February 18	Mayor announced the city did not have a definite timeline for total water restoration. The city set up drinking water distribution centers at multiple locations.
February 19	The city set up distribution centers for non-potable water at multiple locations.
February 22	Many Jackson residents and businesses remained with little to no water. Water customers were under a boil-water advisory due to a high level of turbidity.
February 23	Governor Reeves activated the Mississippi National Guard to provide water.
February 28 to March 1	The city expanded the drinking water distribution center at multiple locations. The city reported that a total of 96 water main breaks and leaks occurred. The water system was still not stabilized, and the water pressure had not yet recovered.
March 2	The city council adopted a one-percent sales tax hike to secure more funding for the water infrastructure and waited for the State legislature's approval. The bill died later without committee consideration in the State Legislature.
March 3	Mayor Lumumba requested \$47 million in emergency funding from Governor Reeves.
March 8	Several areas in Jackson still suffered from low water pressure, and Jackson remained under a boil-water advisory.
March 17	The city officially received clearance to lift the precautionary boil-water notice citywide (end of crisis).

(Sources: City of Jackson, 2021a; Haselhorst, 2021; Stribling, 2021; Victory, 2021; Warren 2021a, 2021b)

Research Methods

This study utilized a chronological research design approach through a literature review. First, the trends associated with changes in residential population, sales, and property tax revenues in the City of Jackson were analyzed. Second, this study conducted a content analysis to: (a) examine major water infrastructure plans proposed by former Jackson Mayor Harvey Johnson, Jr. in 2012, and former Jackson Mayor Tony T. Yarber in 2016, and (b) to examine why these plans failed.

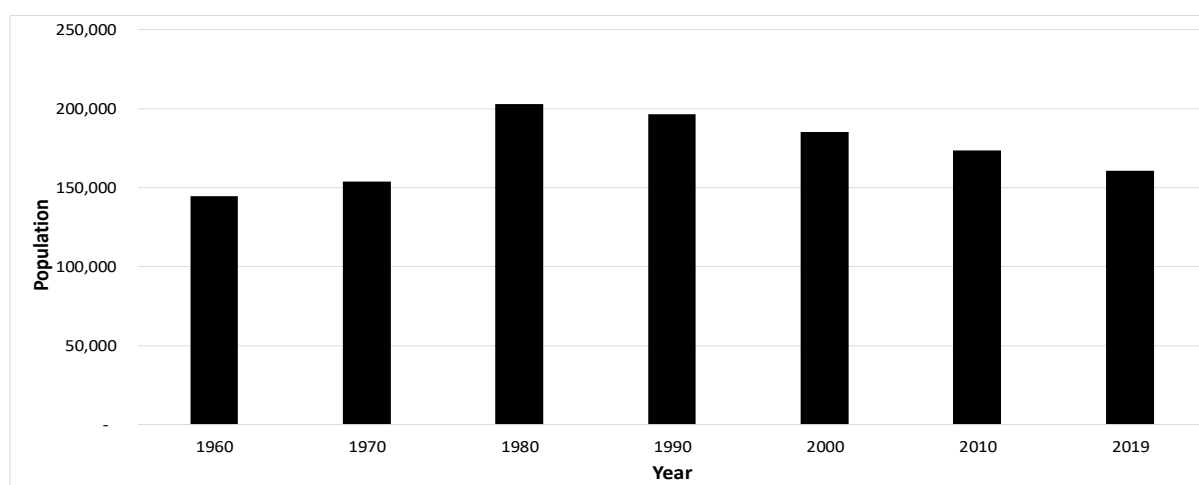
Findings

Continuing out-migration / Associated reduced revenue streams

Jackson has suffered a continuing out-migration over decades. Since the 1950s, many Black farmers have moved out from the Mississippi Delta region due to worsening farming conditions. Jackson was one of their multiple destinations including Chicago, Detroit, Memphis, and other metro areas (Frey, 1980). In Jackson, the in-migration of the Black people has contributed to “White flight” which is also visible in other metro areas across the nation (Frey, 1980).

Figure 1

Residential population in the City of Jackson, Mississippi (1960-2019)



(Source: US Census, <https://census.gov>)

As a result, upper- and middle-class residents have moved to surrounding suburban towns. In 1980, the City of Jackson’s residential population peaked at 202,000 after which out-migration started

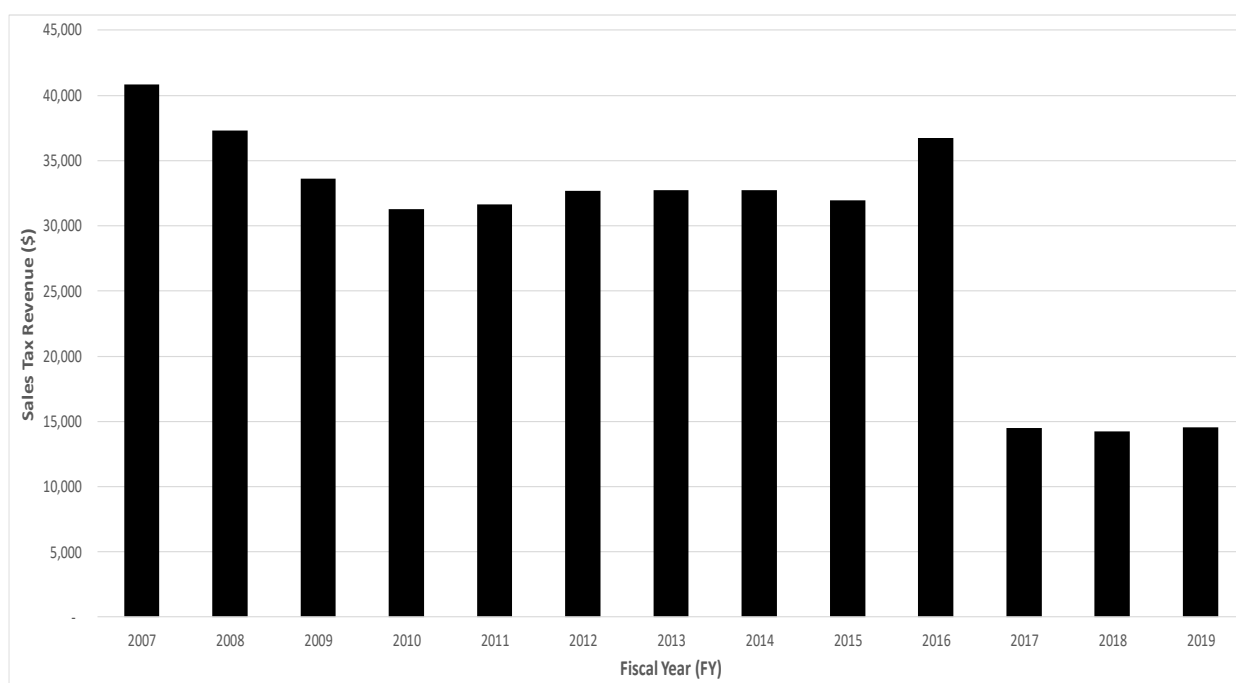
to surpass in-migration. Figure 1 provides a 50-year historical examination of the change in Jackson's population.

The declining residential population, mainly driven by the middle-class White's out-migration to neighboring suburban towns such as Clinton, Flowood, and Madison, have caused negative impacts on the economic bases of Jackson, including loss of business revenue, a reduced tax base, reduction in city services, underfunded public K-12 schools, underfunded police and fire departments, lifestyle and quality of life issues, and aging infrastructure (Frey, 1980; Coates, 2016).

The declining residential population and accompanying decline in sales tax negatively impacted Jackson's financial position. Figure 2 shows the sales tax trend in Jackson, Mississippi, from 2007 to 2019. The trend is roughly proportional to the decrease in Jackson's residential population for that same time period.

Figure 2

A trend of sale tax revenue in Jackson, Mississippi, FY 2007-2019 (in \$1,000)

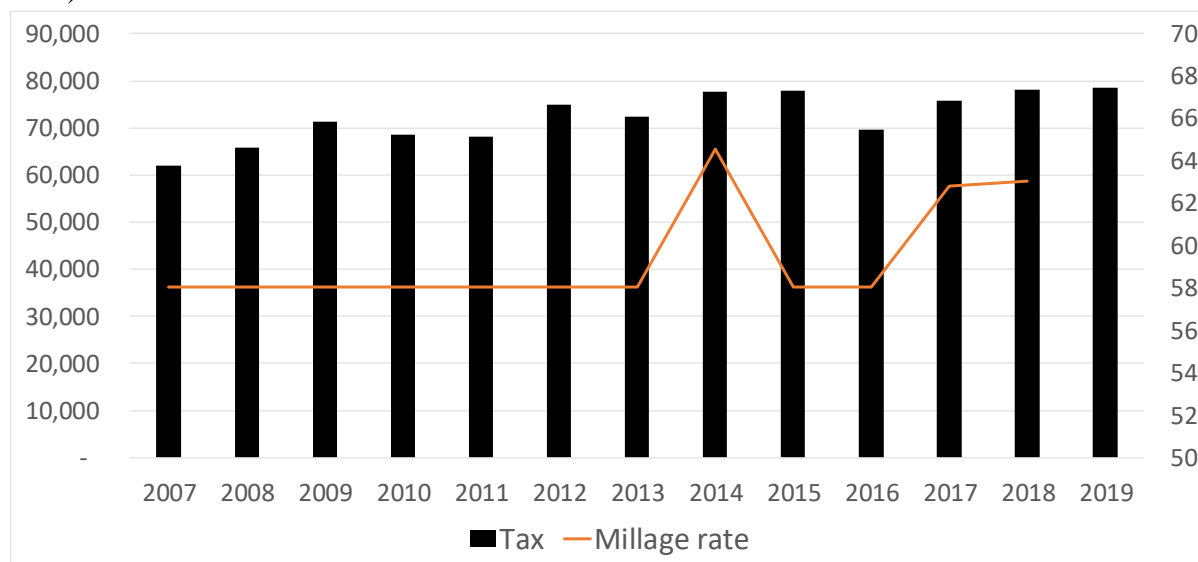


(Source: City of Jackson (2021b), Comprehensive annual financial report for multiple years)

Property tax revenue is another significant financial resource for local governments. A decline in property tax revenue impacts both local and regional economies (Frey, 1980; King, 2014). Due to continuing out-migration, real estate property value has decreased. To compensate for that decrease, Jackson has increased its millage rate to offset lost revenues from property taxes (City of Jackson, 2020). The property tax revenue has been around \$70 million between 2007 and 2019. However, the millage rate has increased from 58.03 to 63.03 during the period (Table 3). The increasing millage rate may be another factor contributing to Jackson's out-migration of former residents to surrounding suburbs with lower property taxes.

Figure 3

A trend of property tax revenue and millage rate in Jackson, FY 2007-2019 (in \$1,000; in maximum mills)



(Source: City of Jackson (2021b), Comprehensive annual financial report for multiple years for property tax; State Dept. of Revenue for millage rate)

Failed comprehensive water infrastructure enhancement programs

A. Administration of Mayor Harvey Johnson Jr. (2009-2013)

During his term as Mayor, Harvey Johnson's administration was under an Environmental Protection Agency mandate seeking the establishment of a comprehensive enhancement plan to

manage Jackson's drinking water and wastewater treatment infrastructure. Thus, the City Council passed a plan to spend \$400 million over 17 years to make sewer improvements as recommended by the Mayor in October 2012 (Peagler, 2013).

Mayor Johnson also set up a \$90-million contract with Siemens Industry, Inc., to renovate the water infrastructure citywide in October 2012 (Nave, 2015a). Following the contract, 65,000 new water meters were scheduled to be installed citywide to measure water usage accurately and for a digital reporting system. In addition, sewer lines and two wastewater treatment plants were renovated (Nave, 2015a). The contract was designed to make \$123 million in savings over 15 years from reduced hiring and vehicle fuel consumption, which were needed for recording water usage from water meters installed in houses citywide and other items related to water infrastructure (Nave, 2015a).

Mayor Johnson issued \$90 million in bonds to pay for the cost and other wastewater facility maintenance projects in June 2013 (Peagler, 2013). However, he failed in his re-election campaign during the Democratic Primary in 2013, and Chokwe Lumumba became the new mayor. Mayor Johnson left city government without appointing a project manager to monitor the implementation of the water infrastructure renovation projects, causing turmoil in the following years.

B. Administration of Mayor Chokwe Lumumba (2013-2014)

During his term, Mayor Lumumba worked hard to pass the one-percent sales tax increase to secure permanent funding to maintain the city infrastructure. Residents in Jackson voted on the sales tax increase in a referendum in January 2014 to be levied over twenty years to secure additional funds for water and road infrastructure improvements (Coates).

The one-percent sales tax initially applied to all businesses in Mississippi making sales, delivery, or installation of property or services within the City of Jackson. However, a House bill passed in April 2014 allowed tax exemptions for particular items (Coates, 2016). For example, wholesales of food and drink for human consumption sold to full-service vending machine operators

and the wholesale of light wine, beer, and alcoholic beverages were exempted from the one-percent sales tax, creating an expected \$8 to 9 million reductions in tax revenue (Coates, 2016).

C. Administration of Mayor Tony Yarber (2014-2017)

Tony Yarber was sworn in July 2014 as Mayor. He brought in Kishia Powell, who served as the head of the Water and Wastewater Bureau in Baltimore, Maryland, and paid her the highest salary ever among Jackson employees. In 2016, Mayor Yarber and Ms. Powell developed a long-term master plan for infrastructure maintenance (“Renew Jackson: A Master Plan for the Municipal Special Sales Tax-Funded Infrastructure Improvement Program for Jackson Mississippi: The Bold New City”), costing \$743 million by 2031 (City of Jackson, 2016). A summary of the master plan is available in Table 2. The master plan included projects for infrastructure maintenance of roads, bridges, drainage, water, and wastewater.

Table 2

A summary of the Master Plan of Water Infrastructure by Mayor Yarber

-
- Total estimated need for infrastructure – roads, bridges, drainage, water, and sewer: \$1.5 billion
 - On Water Infrastructure
 1. A water line replacement program with 2 to 4-inch water lines and cast-iron pipeline replacement
 2. Assist the Fire department with hydrant maintenance and asset management
 3. Water system flushing and where possible water main cleaning and lining
 4. Water system audit including the development of a water system hydraulic and water quality model
 5. Mapping the water system and related appurtenances
 6. Water infrastructure improvement program (Siemens)
 7. Capital improvement programs: \$229 million
-

(Source: City of Jackson, 2016)

However, the problems associated with the water meters installed by Siemens stalled his efforts in implementing the master plan during Mayor Yarber’s tenure. For example, city officials halted all new Siemens meter installations on February 13, 2015, due to increasing residents’ outcries

regarding their water bills (Nave, 2015a). Some of the billing problems came from installing the new water meters. For example, the workers who installed the meters were not appropriately trained. Some of the meters were calibrated to read water usage in gallons instead of cubic feet, causing excessive water bills. Further, significant water leaks were detected on some residents' properties (Ganucheau, 2015; Nave, 2015b). This resulted in Jackson hosting multiple town-hall meetings citywide to resolve conflicts over the water bills (Nave, 2015b).

Mayor Yarber failed in getting the Jackson City Council and Mississippi Legislature to adopt his proposed Municipal Special Sales Tax legislation which was designed to fund his master plan. Kishia Powell resigned from her job in May 2016, and Tony Yarber failed in obtaining his second term as Mayor in the following year.

D. Administration of Mayor Chokwe Lumumba (2017-Present)

Mayor Lumumba developed a lawsuit against Siemens mainly over the problems associated with the water meter and billing system in June 2019 (Haselhorst, 2021). He reached an \$89.8 million settlement with Siemens in February 2020. He also proposed programs to retrieve unpaid water bills not collected over the years. Yet, his administration still struggled with the collection of water bills, and has been dealing with another round of EPA mandates in operating Jackson's wastewater treatment plants (AP, 2021). In addition, the West Rankin Utility Authority in Rankin County started running its own \$75 million wastewater plant in September 2021, expected to create a significant financial loss in revenue for Jackson (Warren, 2021c). Before that, the West Rankin Utility Authority had been paying about \$5 million annually for sending their wastewater to the Jackson wastewater plant over the years (Royals, 2015).

Policy Options to Consider

Jackson is a blighted city and has been reactive to the EPA regulations. Its current water infrastructure has shown significant stress contributing to water main/pipe breaks, low water pressures, and occasional boil water notices. The 2021 Jackson Water Crisis was an alarming event.

Jackson has been unable to renovate and maintain its water infrastructure as previously discussed in this study. It is likely to continue experiencing water infrastructure problems in the foreseeable future. What is needed is a multi-level water infrastructure management plan, therefore the following policy options are offered as recommendations:

Develop diverse efforts to increase revenue

1) Another round of a one-percent sales tax increase is needed. Mayor Yarber proposed a one-percent municipal special sales tax in 2016, and the City Council adopted a one-percent sales tax increase during the 2021 Water Crisis. Both efforts had failed at the Mississippi Legislature. The increased revenues from the increased sales tax rate would secure more funding for water infrastructure maintenance and improve Jackson's Moody and Standard & Poor's credit ratings, while also reducing the interest burden associated with repaying those bonds. Moody's ratings of general obligation bonds and urban renewal revenue bonds for Jackson in 2019 were Baa3 and Ba1, respectively, which are medium ratings (City of Jackson, 2020). Jackson needs measures to boost its credit grade among the rating agencies.

2) A new tax on all guns sold in the city limits should be enacted and increasing the gasoline tax. A new tax on firearms sold within the city limits will generate additional revenue for the city. Currently, the gasoline tax rate in Mississippi is among the lowest in the United States, only above Alaska and Missouri (Cammenga, 2020). Additional revenue from the increased gasoline tax will allow Jackson and other communities to work on infrastructure projects and maintenance continuously.

3) During the Covid-19 pandemic, the federal government has developed multiple financial programs supporting local governments including the American Rescue Plan (ARP), and the Coronavirus Aid, Relief, and Economic Security (CARES) Act. Additional bills for supporting local governments' infrastructure (e.g., Drinking Water and Wastewater Infrastructure Act) have been introduced (Warren, 2021). President Biden's one-trillion-dollar infrastructure bill passed and was

signed into law in November 2021. Jackson should be aggressively pursuing funding from those federal programs.

Increased efforts for collecting water bills and considering the affordability-based water billing

Currently, there are more than \$100 million in unpaid water bills (AP, 2021). In addition, 14,000 of 43,000 customers have not received their water bills (AP, 2021). The hesitancy to pay water bills has been a constant problem prior to the Johnson Administration in Jackson. Furthermore, controversies over the water bill generated by Siemens water meters have added another challenge in collecting the water bills (Ganuchau, 2015).

The cost of providing tap water has been rising nationally, and a high level of delinquency in paying water bills among poor communities has been reported nationwide (Wogan, 2017). Shutting-off a resident's water supply has been a conventional measure used to address delinquent accounts. However, more local governments have implemented a new water bill program based on residents' affordability. For example, the City of Philadelphia has implemented an income-based program for poor households whose income is at or below 150 percent of the federal poverty line (Wogan, 2017).

Jackson is a poor community with a high level of poverty (25.4%) and a low level of median household income (\$38,888 in 2018) (U.S. Census, 2021). After considering the current economic conditions, collecting water bills regularly would be a daunting challenge, even after a new water meter is installed and generates an accurate water bill. Jackson is expected to develop programs for the affordability-based water bill for the poor residents (City of Jackson, 2021b). Currently, Jackson has provided a pilot program to provide assistance to poor people. The pilot program is related to the Mississippi Home Corp Emergency Rental Assistance (ERA) program (City of Jackson, 2021b). However, pressures to provide a permanent payment assistance program will increase, even after the water billing system is stabilized in the coming years.

New agency creation for enhanced inter-local government collaboration

Jackson has been maintaining a turbulent relationship with its neighboring local governments. For example, Rankin County has built its wastewater plant to treat its wastewater in 2021 (Warren, 2021). Before that, wastewater was treated at a Jackson facility. Now, two convention centers in Jackson and Flowood compete to host convention events. In addition, the JATRAN bus service is not available for inter-city transportation between Jackson and neighboring cities (Coates, 2016).

According to an inflow-outflow analysis done by the U.S. Census Bureau (Table 3), more than 70% of jobs available in Jackson, Mississippi, have been taken by the commuters living in surrounding suburbs such as Flowood, Madison, Ridgeland, and other nearby cities (U.S. Census, 2020).

Table 3

Inflow/Outflow job counts in Jackson, Mississippi, for 2017

	Count	Share (in %)
Employed in Jackson, living outside	79,707	70.1%
Employed and living in Jackson	33,920	29.9%
Total employees in Jackson	113,627	100.0%

(Source: U.S. Census Longitudinal Employer-Household Dynamics (LEHD) – On the Map)

The high level of commuters (70.1%) is partially the result of the continuing out-migration from Jackson. It also shows the great need to establish a new influential regional institution to enhanced inter-local government collaboration, like an ‘Annual Mayor Summit Meeting in the Central Mississippi.’ Currently, the Central Mississippi Planning & Development District (<http://cmpdd.org/>) exists. But cases of effective collaborations among local governments through the planning agency are hard to see. We need a more effective communication channel for decision-makers (mayors) to enhanced collaboration among local governments in Central Mississippi.

Conclusion

During the 2021 Jackson Water Crisis, most residents in Jackson could not get municipal drinking water, attributable mainly to numerous water main breaks, pipe bursts, low water pressure, and boil water advisories for over a month in February and March 2021. The water crisis was a triggering event that showed the accumulated impacts of an aging water infrastructure system, dwindling financial resources associated with continuing population out-migration, and failed implementations of water infrastructure plans. A one-percent sales tax increase, more federal funding, and increased collaborations with neighboring cities are warranted for sustainable water infrastructure in Jackson, Mississippi.

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The Jackson Water Crisis: A Qualitative Thematic Analysis of Online News Reporting

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Abstract

On February 14, 2021, a water infrastructure crisis devastated Jackson, Mississippi following a winter storm. This study examined 102 online news articles/postings about the winter storm and the subsequent water crisis. A thematic qualitative analysis was used to review pertinent articles to characterize framing and trends in the water crisis coverage. There were three research questions utilized to guide this study: (1) Were there major institutional failures during the Jackson Water Crisis (JWC)?; (2) What was the thematic coverage of the news media during the JWC?; and (3) What was the role of digital media in the initial stages of the JWC? Using a qualitative thematic analysis method based on journalistic perceptions of the crisis generated four themes: (1) water service interrupted / residents' water needs during the crisis; (2) legacy infrastructure runs parallel with the legacy of racism; (3) "White flight"; and (4) voluntarism and donations. This analysis of the JWC news coverage can serve as a mirror that helps local and state residents and leaders contemplate how they view themselves and are viewed by others. It can also help identify potential policy, institutional, and leadership areas that can be improved to address future water crisis events.

Keywords: water, crisis, Jackson, digital, news media, infrastructure

Background

One of the most recent episodes in the lengthy saga of Jackson's water infrastructure failures started on February 14, 2021, when a winter storm devastated Mississippi. Because of frigid temperatures, major equipment at the Jackson water plant froze causing a significant fall in water pressure and frozen pipes throughout the city. A few days after the storm passed, water pressure rose, and the city's water supply pipe system broke down (Harris, 2021).

Jackson is a typical example of the de-industrialization and economic decline experienced by several mid-sized United States cities after decades of prosperity in the last part of the twentieth century (Economic Innovation Group, 2020; Sadler et al., 2020). According to Sauter (2021),

Jackson, MS, is the third most segregated city in the United States. The city is 82.2% Black and has an overall poverty rate of 25.4% (U.S. Census Bureau, 2021).

On July 1, 2021, the City of Jackson received a Safe Drinking Water Administrative Order on Consent (AOC) from the Environmental Protection Agency (EPA) Region 4 (Warren, 2021). This AOC specified the Comprehensive Equipment Repair Plan (CERP) and the timeline for those repairs. The issues regarding the water supply system were not only limited to the distribution of water; it also included health concerns such as an unsafe level of lead. Jackson's infrastructure saga continues, and the future may be uncertain, regardless of the latest \$4 million from the American Rescue Plan Act (Warren, 2021). However, the city's administration remains hopeful after Jackson's Mayor Chokwe Lumumba addressed the infrastructure bill with President Biden at a virtual meeting on August 10, 2021 (Sanderlin, 2021).

Purpose of the Study

This study examines online news responses to the Jackson Water Crisis (JWC). The aim is to contextualize the news reporting of the JWC thematically. According to the Pew Research Center (2021), the monthly unique visitors in the United States for online news outlets was 32.1 million in 2020, an increase of 11% from 2019. The same report stated that 86% of adult Americans accessed the news using smartphones, computers, or tablets. Consequently, surveying how national and local online news shape stories about the JWC can enhance community awareness. Additionally, the news coverage may highlight those responsible and spark new interest in improving Jackson's water supply infrastructure. Because of the lack of empirical studies examining the online news coverage of the JWC, this study would be the first of its kind for the City of Jackson. In addition, this study examines the JWC through the lens of racial capitalism through online news. The following section presents a theoretical framework used to structure this study and help explain its methods, findings, conclusions, and recommendations.

Theoretical Framework

Grounded Theory (GT) is mainly an inductive process by which theoretical understandings emerge from the data (Elliott & Jordan, 2010). Charmaz (2006) depicted GT as a set of methods that “consist of systematic, yet flexible guidelines for collecting and analyzing qualitative data to construct theories ‘grounded’ in the data themselves” (p. 2). GT’s inductive process differs from the deductive process, where the researcher starts with a theory and then tests hypotheses. GT starts with data reduction, which involves coding and sorting these codes into themes (Braun & Clarke, 2006).

Methods

This study utilized the following research questions, data collection methods and procedures, and analytical approach to examine how online news media outlets framed coverage of the Jackson Water Crisis (JWC).

Research Questions

The following research questions identify the focal points of this study and resulting data collection and analysis procedures:

RQ1: Were there major institutional failures during the JWC?

RQ2: What was the thematic coverage of the news media during the JWC?

RQ3: What was the role of the digital media in the initial stages of the JWC?

Analytical Approach

A thematic qualitative analysis research method was used to uncover the meaning people give to incidents they experience (Merriam, 1998). Thematic analysis (TA) is a procedure for summarizing or coding qualitative information into patterns or themes. This study utilized the Braun and Clarke’s TA approach (2006) to identify and develop key significant themes from online news reporting data. The selected themes were based on what the researcher established as the smallest number of

different posts that tie in with a theme (Heydarian, 2016). One hundred and two (102) unique JWC online news postings addressed the three previously stated research questions.

Data Collection Procedure

Online news articles regarding the JWC were collected from mid-February 2021 to the beginning of May 2021 using the aggregated media search engine known as Google News (<https://news.google.com>). This process included using the following phrases as search terms, “Jackson, MS water crisis,” and “Jackson, MS winter storm.” Other phrases were used, but they ended up not providing any additional data.

All this information served additionally as part of the data corpus (i.e., raw data). Once the data corpus is “processed,” the data is known as the data set. Ncapture software facilitated the collection of Google News data (i.e., the corpus data). Ncapture is a web browser add-on that allows the user to save or capture the content of web pages to be coded and analyzed in Nvivo (QSR International Pty Ltd, 2020). Creswell and Poth (2016) describe coding as the process of subdividing a sizeable amount of raw information (i.e., usually text) and then assigning them into categories. Coding requires assigning “tags” or codes to different text segments linked to different issues. From the processed data set, codes were initially identified. Coding allows the researcher to organize and categorize data into themes (i.e., key groups). The data analysis continues until “saturation” is reached and no additional knowledge may result from further data collection (Paulus & Lester, 2021).

Results

This section presents results to each of the three (3) research questions based upon using the TA qualitative analysis research method.

RQ1: Were There Major Institutional Failures During the JWC?

Data collected for this study shows an overwhelming abundance of references (i.e., national and local news) about government institutions’ disregard of Jackson’s water supply (see Table 1). Based upon an analysis of data collected, government institutions did not adequately deal with the

JWC and neglected Jackson residents. For instance, The Avenue (Brookings Institution publication) posted, “Jackson’s crisis is tied to its inability to proactively invest in infrastructure upgrades. This inability stems from its ongoing economic difficulties --- a challenge that many other localities and water utilities face” (Perry et al., 2021, para. 3). Another article referencing Jackson’s current mayor stated, “Lumumba said the water system’s failure has only served to highlight issues that have existed for decades. The city needs state and federal funding to help replace 100-year-old pipes” (Diaz & Vance, 2021, para. 11).

One of the news media’s roles is to shine a light on public leaders’ actions or inactions. On March 16, 2021, Forbes Magazine (Reimann, 2021) published the following under the subheading ‘Surprising Fact,’ Governor Reeves has not yet put in a request for a federal disaster declaration, according to the Clarion-Ledger. He has until Sunday to do so” (para. 9).

Table 1

Frequency of online news articles and theme appearances for RQ1 and RQ2

Research Questions	Number of News Articles*	Number of Theme Appearances
RQ1: Were There Major Institutional Failures During the JWC?	52	101
RQ2: What was the Thematic Coverage of the News Media during the JWC?		
1. Water Service Interrupted / Residents Water Needs During the Crisis	63	128
2. Legacy Infrastructure Runs Parallel with the Legacy of Racism	49	100
3. “White flight”	33	57
4. Volunteerism and Donations	30	41

*Note that the “Number of News Articles” column does not add to 102 since most news articles depicted more than one theme.

As shown in Table 1, almost half of all the news postings (i.e., 52 out of 102) highlighted institutional failures connected to the JWC. On average, institutional failures were referenced approximately twice per article. Much of the focus of these online news articles centered on criticism on how local, state, and federal institutions failed to act on residents' early concerns and continued to delay aid after the events in mid-February 2021.

RQ2: What was the Thematic Coverage of the News Media during the JWC?

Analysis revealed four major themes, including: (1) water service interrupted / residents' water needs during the crisis; (2) legacy infrastructure runs parallel with the legacy of racism; (3) "White flight"; and (4) volunteerism and donations (see Table 1).

Theme #1: Water Service Interrupted / Residents Water Needs During the Crisis

Table 1 shows that about two-thirds of all the news postings (i.e., 63 out of 102) highlighted instances of service interruptions or residents' water needs associated with the JWC. On average, this theme was referenced twice per article (i.e., 128 times in 63 articles), making it the most cited theme out of all the news postings collected for this study.

The following are several online news coverage accounts from residents that endured the JWC: (a) "Ms. Avant, 62, and her husband have an apartment. On Wednesday, she drove to five makeshift water distribution centers to stock up" (Fentress & Fausset, 2021, para. 5); (b) "Jackson resident Taylor Corso told ABC News that residents were so desperate to flush their toilets, they collected snow and melted it in their tubs to add to the reservoir tank" (Jacobo, 2021, para. 4); (c) "Tamiko Smith, 53, spent several anxiety-filled days scrambling to find clean water to perform the at-home dialysis treatments her husband, Otis, requires four days a week" (Reuter, 2021, para. 6); and, (d) K'Acia Drummer was quoted, saying, "I feel displaced. Now I know what it feels like to live without basic necessities, and it's one of those things that puts you in a different place mentally. My anxiety has been through the roof" (Laughland, 2021, para. 9).

Theme #2: Legacy Infrastructure Runs Parallel with the Legacy of Racism

Table 1 shows that about half of all the news postings (i.e., 49 out of 102) highlighted examples of the legacy of racism associated with the JWC. On average, this legacy was referenced at least twice per article. Jackson's water infrastructure has endured decades of abandonment from the state and federal governments, and many city government officials agree that racism has played a role in infrastructure underfunding. Fedinick et. Al. (2019) examined the relationship between sociodemographic characteristics (in particular race) and drinking water violations. They found that frequency of drinking water violations soared in areas predominantly inhabited by families of color, low-income families, non-native English speakers, families living in overcrowded housing, and families with limited transportation options. They concluded that race, ethnicity, and language had the most significant correlation between slow and unsuccessful enforcement of the Safe Drinking Water Act (Fedinick et. Al., 2019).

The following is a sample of statements (i.e., quotes) reported on digital news media platforms that helped to generate Theme 2: (a) "The state's condescension to and contempt for the city's Black leaders isn't new and wasn't earned. But it is the root cause of this current disaster" (Ladd, 2021, para. 1), in the same article, "This was a system, it's worth noting, that was not exactly handed over to Black leadership in pristine shape, with nary a crack or challenge. It was already in trouble then" (para. 1); (b) "But Jackson was hit by a different kind of beast, one that threatens us all: a government unprepared to handle the effects of climate change and neglectful of the citizens who are most harmed by it" (Pahwa, 2021, para. 2); (c) Mayor Lumumba stated, "...as we look at the success of our state economy, it should be more based on a dignity economy, which expresses the inherent dignity of every community, and not looked so based on issues of race" (Yang et al., 2021, para. 12); and, (d) "The communities that were hardest hit by this water crisis are in South and West Jackson, which, again, are the predominantly or majority Black and Brown communities in the city. So, again, it just shows that it wasn't just another bad weather day for us, that this has been, again, years of neglect to

the majority Black and Brown parts of the city, also just another example of how structural racism works” (Goodman, 2021, para. 19).

Ponder (2017) acknowledged that a local government official from one of Jackson’s majority White neighboring suburbs explained how “Jackson ‘refused’ to discuss regional cooperation... and that Jackson isn’t interested in regional cooperation” (p. 36). Other suburban officials, the state legislature, and the governor shared this sentiment about not being interested in regional cooperation. Additionally, the majority-White officials believed Jackson was a dangerous and violent area. Their perception of the city and Jackson government officials was mistrust and maladministration. However, Ponder attributes Jackson’s problems to state and federal financial mismanagement, misperception, and distrust (Ponder, 2017).

Theme #3: “White flight”

Table 1 shows that about one-third of the news postings (i.e., 33 out of 102) highlighted the connection between “White flight” and the JWC. On average, this theme was referenced more than once per article (i.e., 57 times in 33 articles). “White flight” cannot be described without mentioning the drop in tax revenue that contributed to the deterioration of Jackson’s water supply system.

In 1960, Jackson was around 64% White and 36% Black. In 2020, it was about 16% White and 82% Black (U.S. Census, 2021). Because of “White flight”, the city’s tax base revenue decreased significantly. The following are a sample of quotes supporting the emergence of this theme: (a) “The city has had a dwindling tax base for decades after integrating schools and other public spaces in Jackson triggered a dramatic flight of White residents” (Good, 2021, para. 9); (b) “Jackson’s infrastructure was built at a time when the population was much higher, and ‘White flight’ has led to divestment”; and (c) Lumumba told Fentress and Fausset (2021), “It has left fewer people to maintain what was built for more people” (para. 17).

Theme #4: Volunteerism and Donations

Table 1 shows about one-third of all the news postings (i.e., 30 out of 102) highlighted an example of volunteerism and donations associated with the JWC. On average, efforts to help the Jackson community were referenced more than once per article and came from near and far.

Some examples of organizations that helped during the crisis by providing donations include: the Beau Rivage Resort & Casino, Biloxi, MS, who partnered with Extend a Hand Help a Friend, Gulfport, MS, to distribute bottled water in Jackson (Lotts, 2021); and the University of Mississippi (a.k.a., Ole Miss) Athletics, who organized various events where fans donated cases of water, and also partnered with the University of Mississippi Medical Center and the Mississippi Food Network to help Jackson residents (Ole Miss Sports News, 2021); the New Orleans Pelicans hockey team donated two truckloads of water bottles during the crisis (WGNO Web Desk, 2021); and Philadelphia City Commissioner Omar Sabir, who along with the Wakefern Food Corporation and Nestle, donated a truckload of bottled water to the Mississippi Food Network (Hill, 2021).

There were also several volunteer and community advocacy groups that got involved in helping during the water crisis. The following is a listing of some organizations that helped: (a) the Jackson chapter of Black Youth Project 100 (Changa, 2021); (b) the Mississippi Black Women's Roundtable; (c) The People's Advocacy Institute; (d) The Poor People's Campaign; I Mt. Helm Baptist Church; and (f) the Immigrant Alliance for Justice & Equity (Omokha, 2021). Their efforts included organizing water drives, giving away gift cards for hotel stays and groceries, and providing outreach to help find water to use from neighboring towns. Ponder (2017) described community organizations and activists as follows, "Their narratives invoke cultural and generational memories of survival against the odds, ceaseless resistance against violence and unjust conditions of life, hope for the future, resilience as a people" (p. 37).

RQ3: What was the Role of the Digital Media in the Initial Stages of the JWC?

Usually before and after a weather disaster or a crisis, there is extensive reporting by digital news platforms. This was also the case with the JWC. Since many of Jackson's residents endured more than a month without water or with low water pressure, the "initial stage" of the JWC may be defined as about a month after the Winter storm. This research question shares some similarities with RQ2 (Thematic Coverage); however, to show the role of digital media in the initial stages of the JWC, the focus is on actual events reported and the reporters' viewpoint (for example, local or national). For the purposes of this study, online media news and timelines of events were cross-referenced to identify the level of government response, actions, and approaches during the JWC.

Week of February 7th to the 13th (Before the Storm)

Based on the author's search, one of the first national-level reports of the impending winter/ice storm came from the Washington Post on February 10, 2021, with the headline "Damaging ice storm underway in Mississippi Valley, part of broader winter storm" (Cappucci, 2021, para. 1). One of the first local reports of the severe weather about to hit the area came from WJTV on February 11th, showing that the MS Department of Transportation (MDOT) responded to the winter weather (WJTV, 2021b). February 12th, Mayor Lumumba proclaimed a civil emergency because of inclement weather (City of Jackson, 2021b). February 13th, the Clarion-Ledger (Szymanowska, 2021) and WLBT Staff (2021) (i.e., local news platforms) posted the National Weather Service warnings for the winter storm.

Week of February 14th to the 20th

On February 14th, Lt. Gov. Hosemann on behalf of Governor Reeves declared a State of Emergency. On February 16th, WJTV (2021a) news posted that Jackson's residents were experiencing low water pressure and that a city-wide boil water alert was issued. This WJTV post may have been the first (both local and national) that mentioned any water issue after the winter storm hit the area. On February 17th, the City of Jackson (2021a) posted that they continued to monitor the water

pressure. On February 18th, U.S. News & World Report (2021b) reported that “Mayor Chokwe Antar Lumumba says almost all of Jackson, a city of around 150,000 people, is now without water” (para. 1). February 19th, ABC News reported that Mayor Lumumba could not identify a timeline for restoring the water service. Mr. Lumumba continued by saying, “This becomes increasingly challenging because of the pandemic, because so many residents are at home instead of school, which means people are trying to use water at a higher rate than usual” (Shapiro, 2021, para. 2).

Week of February 21st to the 27th

Jackson’s WAPT posted on February 21st that thousands of residents are still without water (Hannibal, 2021). On February 23rd, WLBT reported that during a press conference, Mayor Lumumba responded to critics of how the water crisis was handled (Warren & Kenney, 2021). Mr. Lumumba stated, “This crisis we are in the midst of is an act of God and was not caused through incompetence; it was not a failure to act from any individuals and was not a failure to act from the administration” (para. 5). By February 25th, WAPT posted that Gov. Reeves hinted at a state takeover of the Jackson water system (Adams, 2021). This study did not find any evidence of the possibility of a state takeover.

By March 9, 2021, three weeks after the JWC, the city of Jackson had not been declared a federal disaster area (Vicory, 2021). It was not until May 4, 2021, that President Biden declared Mississippi a disaster area resulting from two winter storms back in February 2021 (U.S. News & World Report, 2021a).

Conclusions

According to Horsley (2016), “The media’s construction of an event, such as a natural disaster cannot only influence how one thinks about it, but what one does about it” (p. 155). Therefore, this “construction” may be the foundation or catalyst to changes in policy regarding how government and non-government organizations respond to these kinds of events.

The story of the JWC is one that regrettably echoes in many other cities with similar sociodemographic profiles. In 2016, Philip Alston, United Nations Special Rapporteur on extreme poverty and human rights stated, “Decisions would never have been made in the high-handed and cavalier manner that occurred in Flint if the affected population group was well-off or overwhelmingly White. Elected officials would have been much more careful, there would have been a timely response to complaints rather than summary dismissals of concerns, and official accountability would have been insisted upon much sooner” (United Nations Human Rights, 2016, para. 5).

The overwhelming emergence of themes from the data provides evidence of the lack of concern for Jackson residents in the face of clear evidence posted online for everyone to view. The JWC represents an obvious example of social and racial injustice stressing the disdain, dishonesty, and inappropriate crisis management that devastates many disenfranchised communities of color.

Recommendations

The JWC is a textbook example of government and institutional failure to handle emergencies. Mississippi officials should envision a significant overhaul of the state’s Emergency Management (EM) Agency protocols. The agency needs to establish stricter regulations and enforcement at all state and private institutions. This was made utterly clear by a significant number of the news posting examined in this study.

In the absence of meaningful changes in the EM system and other government agencies, partnerships between community/advocate groups and state academic institutions can be formed to seek funds from public and private foundations to deal with community crises. Social workers and other professionals may act as community liaisons, advocates, and activists to develop more substantial political power for underrepresented communities in Jackson and Mississippi.

Financing the construction and maintenance of water infrastructure may include, but is not limited to, issuing municipal bonds, state revolving loan funds, federal grants and loan programs, and public-private partnerships.

Limitations

This study has the following limitations: first, it only reviewed JWC online news coverage from mid-February to the beginning of May 2021. Second, there are a series of disadvantages to conducting a thematic analysis. Although it is flexible analytical method, it can be prone to creating disparity and a loss of consistency when generating themes from the data set (Holloway & Todres, 2003). Third, the researcher's knowledge of the JWC and being a Jackson, MS resident may have affected the inductive analysis process.

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An Analysis of the Jackson Mississippi Water Crisis using Social and News Media

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Abstract

This study presents an analysis of social media posts and mass media communications that occurred during the 2021 Jackson Water Crisis (JWC). The research question addressed is whether social media can be used in real-time to aid municipalities in responding to crises more effectively and with less bias. For this study, both social media posts and online, but traditional mass media articles related to the JWC, were collected and analyzed. Data were statistically summarized to align with the timeline of the crisis. Additional analysis was conducted using “Sentiment analysis” and “Topic modeling” of the social media posts to provide a high-level understanding of the crisis’ impact and the concerns of citizens. Topic modeling helped to identify “tweet” topics which were categorized into four major topic areas: infrastructure, legislative, struggle, and racism. Sentiment analysis helped to find the positivity and negativity of the tweets and news articles. Recommendations identified during this proof-of-concept study included: incorporating aggregate social media data when evaluating public works offices and when allocating government infrastructure funds; and the development and use of an online community-wide crisis dashboard.

Keywords: Jackson water crisis, social media, news media, tweets, sentiment analysis, topic modeling, machine learning

Background

Recently there has been a transition in how citizens acquire news and information about important events. Traditionally, print and broadcast media played a major role in determining what events to cover and how to shape stories for the audience. In recent years, social media has changed the way most people consume information about current events (Hermida, 2010). Social media has also allowed citizens to join in the conversation and contribute to the discussion in real-time. Today, when there is a crisis or significant event, citizens take to social media,

especially Twitter, to post facts, opinions, concerns, suggestions, and sometimes, misinformation (Vicario et al., 2016). During the Jackson Water Crisis (JWC), many people used social media to ask for help, prayers, and donations. They used a range of hashtags, including #JacksonWaterCrisis, #JxnNeedsWater, #JxnWater, #EnvironmentalJustice, #infrastructure, and others. This data is a largely untapped resource of valuable information for community leaders and first responders. This research analyzes tweets and news media data to identify public discussions and their sentiments towards the 2021 JWC; tests the viability of using topic modeling and sentiment analysis to analyze social media posts and mass media communications during the 2021 JWC; and formulates directions for potential policy recommendations.

Definitions

- Algorithm --- a series of instructions telling a computer how to transform a set of facts about a phenomenon into useful information. Algorithms are used for making calculations, data processing, automated reasoning, and making predictions.
- Machine learning --- an application of artificial intelligence (AI) where historical data is inputted into an algorithm, and patterns in the data are identified without the patterns being explicitly designated. A common machine learning task is classification whereby the label/category for new data can be predicted by an algorithm/model using previous data that has labels (answers).
- Sentiment analysis --- a technique that measures the inclination of people's opinions through text analysis, which is used to extract and analyze subjective information.
- Topic modeling --- a natural language computer processing technique/unsupervised machine learning method that scans a set of documents (or tweets), detects common words and phrase patterns, and then automatically clusters similar words and phrases together that best characterize the set of documents.

Research Methods

Study Design

This study utilized a proof-of-concept “exploratory” design whereby the research goal is to demonstrate the feasibility and/or test the viability of using topic modeling and sentiment analysis to analyze social media posts and mass media communications that occurred during the 2021 Jackson

Water Crisis (JWC). The general steps for implementing this type of “exploratory” design include identifying the research goal or problem statement; identifying potential tools to investigate the goal or problem; testing the tools in the gathering and analyzing of evidence collected; and reporting results of the tests. The sections below provide more detail information regarding this study’s research methodology.

Research Question

The research question addressed in this work is whether social media can be used in real-time to aid municipalities in responding to crises more effectively and with less bias.

Study Timeframe

The timeframe for this study is February 10th, 2021, to May 20th, 2021. It is during this timeframe that tweets related to the JWC were collected.

Data Collected

Twitter was the primary source of public opinion data. Tweets related to the JWC for the study’s timeframe were accessed and collected through the snsrape library, a web scraping tool for social networking services (SNS) in Python. The computer programming language Python, and the statistical computing and graphics language ‘R’, were both used in software development for this study. Data was scraped using search criteria such as keyword, start, and end date. Additionally, the geocode location and a radius of the tweets were used in some queries to collect tweets specifically from the Jackson, MS area. All data collected for this project are available at <https://ids.olemiss.edu/data/>

Twitter Data Collection and Preprocessing

To collect tweets that are most relevant to the JWC, a variety of hashtags and keywords were employed such as ‘#Jacksonwatercrisis’, ‘#Jacksonneedswater’, ‘#Jacksonwater’, ‘Jackson

MS water problem', 'Jackson water crisis', 'Jackson water pipe burst', 'Jackson water problem', 'Jackson water outage', and 'Mississippi water crisis'. Some data were collected using general keywords such as 'water pipe', 'frozen pipe', 'water outage', 'water crisis', 'water problem', and 'water shortage', along with the date and the geocode (32.2998 latitude and -90.1848 longitude with radius of 50 km), to collect tweets made from the Jackson area.

For each tweet that matched the search criteria, the tweet text, tweet ID, date and time tweet was posted, user name for the person who tweeted, user location, likes count, replies count, quotes count, and retweet count were collected. Moreover, related tweets for the water crisis in Jackson since January 1st, 2010 were collected to explore whether there were similar problems in the past.

The tweets were investigated and duplicates were identified and removed from further analysis. For sentiment analysis, raw (unaltered) tweet texts were used. After that, the tweet texts were cleaned by removing special characters, symbols, numbers, and hyperlinks. The tweet texts were further tokenized and a list of words was created for each tweet. Stop and noise words, which do not add much value to the analysis, were also removed. The preprocessed tweets were used for topic modeling and machine learning.

Exploratory Data Analysis Procedures

The data collected were analyzed and visualized in various ways. The tweets and news articles were examined over time and by location. The most frequent words in the tweets and news articles were explored. Hutto and Gilbert (2014) introduced VADER (Valence Aware Dictionary and Sentiment Reasoner) to perform sentiment analysis, and it works very well with short texts and texts from social media. VADER provides a compound sentiment score of texts ranging from -1 to +1 which helps to identify whether a given text has positive, negative, or neutral sentiment. Similarly, VADER was used for consistency to perform sentiment analysis on

news articles.

Topic Modeling

Topic modeling is a natural language processing technique and an unsupervised machine learning method that scans a set of documents (or tweets), detects common words and phrase patterns, and then automatically clusters similar words and phrases together that best characterize the set of documents. It is a type of statistical model for discovering the abstract “topics” that occur in a collection of documents. To classify the tweets collected, Latent Dirichlet Allocation (LDA) was used for topic modeling and is a very effective and commonly used method for this purpose (Jelodar et al., 2019). Tweets were ‘preprocessed’ before topic modeling was performed. The text data were tokenized, lemmatized, and stop words were removed before implementing LDA as described by Azad (Azad, 2020). The LDA algorithm returns the topics in clusters of words along with their corresponding weights. The number of topics to be returned was manually set to four to obtain the optimal number of topics.

After getting the topics as a cluster of words, a single representative label was chosen for each topic that effectively describes the topic. Xiong *et. Al.* (2020) described a multi-step process to identify appropriate topics from the word grouping, which was followed in this research. After the cleaning steps, the top three weighted words were selected, and from the top 3 words, the one with the highest weight and that could generalize the entire topic was chosen. For example, below is one of the topics returned by the LDA model:

0.018*”week” + 0.014*”infrastructure” + 0.014*”mayor” + 0.013*”help” + 0.012*”break” + 0.010*”month” + 0.009*”racism” + 0.008*”pandemic” + 0.008*”people” + 0.008*”today”

After applying the rules described by Xiong, the following words were identified: infrastructure, break, and pandemic. From these, “infrastructure” was chosen as the one-word

topic for this cluster.

Labeling of Tweets

The four topics identified from the topic modeling of the tweets were used to hand label each of the tweets. In addition, some tweets that did not fit into one of the four topics were labeled None (N) and removed from subsequent processing. Many tweets could have been placed in multiple topic groups, but one primary topic was selected to reflect the primary motivation for the tweet.

Machine Learning

Once the tweets were labeled with one of the chosen categories, it is possible to use machine learning to predict labels for unseen tweets. To extract features from text documents (tweets), the CountVectorizer from scikit-learn library (Pedregosa et al., 2011), a feature extraction technique for text classification was used. CountVectorizer transforms texts into a vector using the frequency of words in the text. CountVectorizer creates a matrix in which each unique word is represented by a column of the matrix and each text sample (tweet) from the document is a row in the matrix. The value of each cell in a row is the count of the number of occurrences of the word associated with that column (Verma, 2020). For example, `texts = ['I like to go out to eat.', 'I like to eat sandwich']`

The above two sentences are transformed into a sparse matrix as shown below:

	I	like	to	go	out	eat	sandwich
0	1	1	2	1	1	1	0
1	1	1	1	0	0	1	1

After implementing CountVectorizer, columns in the vector were used as features and three different machine learning models were built using the sci-kit learn library in Python: (1) k-nearest neighbor (Fix & Hodge, 1951); (2) a decision tree model (Quinlan, 1986); and (3) a

random forest classifier (Breiman, 2001).

News Data Collection and Preprocessing

Data from news media sources from February 10th, 2021 to June 20th, 2021 were collected using the Google News Application Programming Interface (API) and Python. Search terms ‘Jackson Mississippi water crisis’ and ‘Jackson Mississippi water outage’, ‘Nick Judin JWC’ were effective in retrieving useful data. Some news articles were accessed via searches in Google and other online links. The date published, media source, the title of the article, and article content for each article was retrieved and assembled.

The news data were cleaned and preprocessed before performing analysis on their textual content. The articles were cleaned by removing special characters, symbols, numbers, and hyperlinks before doing further analysis such as topic modeling.

Results

Exploratory Data Analysis with Tweets

A total of 4005 tweets were collected. Figure 1 shows the number of tweets collected each day during the acute period of the water crisis. The most common “mention” in tweets was Governor Tate Reeves (@tatereeves), with 52 mentions.

Figure 1

Number of related tweets from February 10 to April 1, 2021

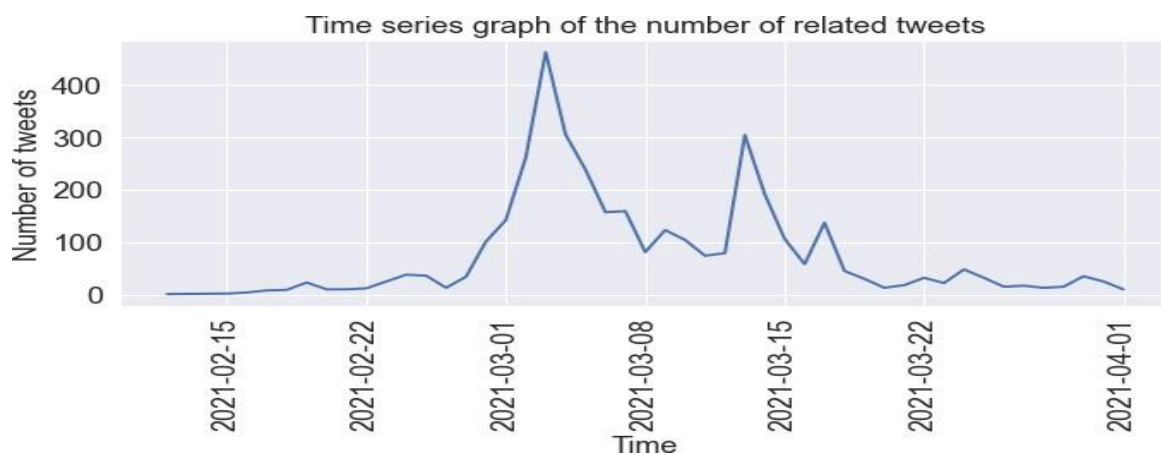
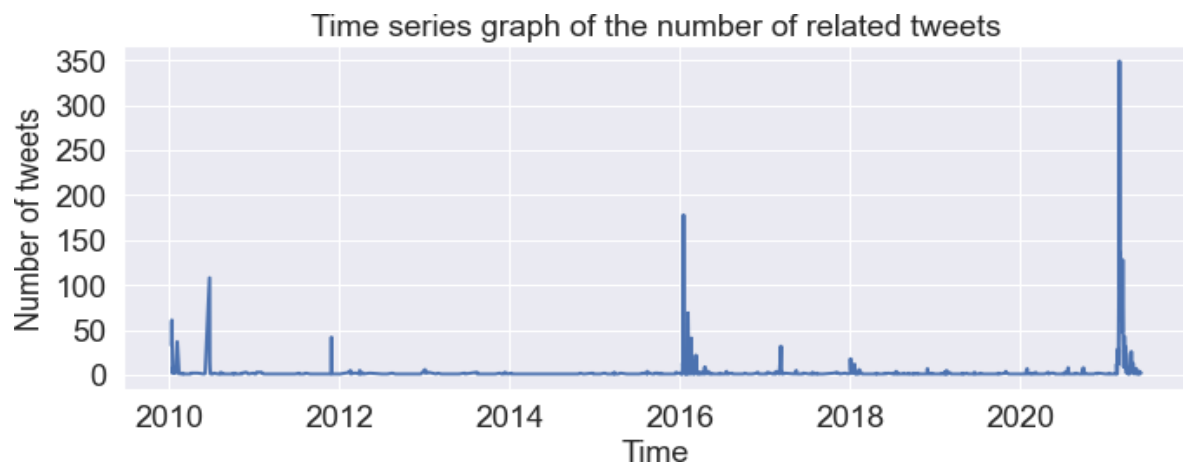


Figure 2 shows the number of tweets since January 1st, 2010 that mentioned the ‘Jackson water crisis’ or ‘Jackson water problem’. This clearly shows there have been a number of issues in the past (most notably in 2010 and 2016), but none were as prevalent as in 2021.

Figure 2

Time series graph of the number of related tweets from 2010 to 2020



While the vast majority of tweets were from Mississippi, there were tweets from all over the country. Of the more than 4000 tweets collected, 75% had specified location information. Some tweets list city and state, others just state, or country, or Earth. Table 1 lists the top 8 cities where the most tweets about the water crisis were made along with their respective tweet counts – approximately 682 total tweets in Mississippi, and approximately 399 tweets were from Jackson, MS.

Table 1

Tweet counts by locations

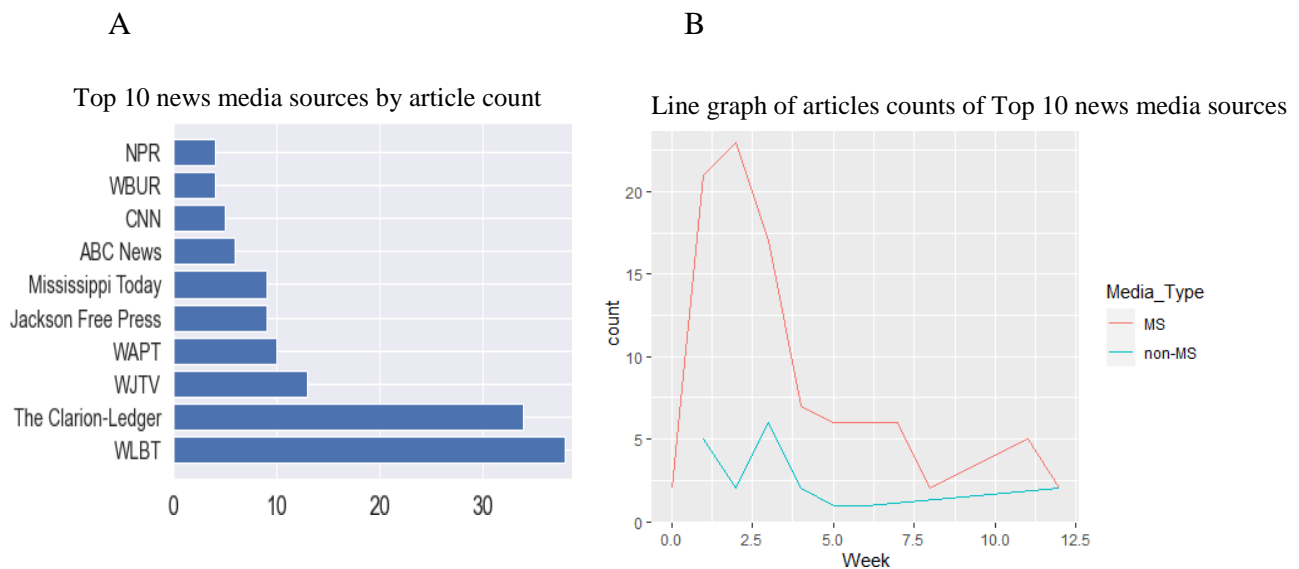
Location	Tweet count	Location	Tweet count
Jackson, MS	399	Chicago, IL	39
Los Angeles, CA	132	Hattiesburg, MS	32
New York, NY	104	Atlanta, GA	31
Washington DC	89	Biloxi, MS	21

Exploratory Data Analysis with News Articles

In total, the corpus of news media sources collected included 224 articles from 78 different sources. Figure 3A shows the number of news articles about the JWC by the top 10 news media sources on the basis of article counts in our collection. Figure 3B shows the counts over the weeks by primary location of media sources (within Mississippi, and outside of Mississippi). The majority of articles were published by Mississippi-based news sources, especially in the early weeks of the crisis.

Figure 3

Media sources with top 10 highest article counts



Topic Modeling

Topic modeling was performed using LDA and the cleanest results were obtained when four topics were requested. The tweets were cleaned and retweets removed, leaving 2814 tweets. The top words for each topic are shown in Table 2. The topics were named based on the following recurring themes: Infrastructure (I), Legislative/Political (L), Struggle (S), and Racism I. There was an overlap of tweets across categories, especially between Infrastructure and Legislative, and between Infrastructure and Racism.

Using these four topics, each tweet was manually labeled and given one of the four topic labels. Some tweets were not related to any of the topics or were duplicates. These tweets were marked N (None) and removed from future analysis. A number of tweets mentioned multiple topics, but the label that best matched the main point of the person posting the tweet was used.

Table 2

Topics in tweets

Topic	Keywords
1. Infrastructure	week infrastructure mayor help break month racism pandemic people
2. Legislative	today tatereeve ignore lumumba infrastructure like flint race talk legislature
3. Struggle	fix week storm continue resident outage month news struggle miss fear
4. Racism	Black resident help week need infrastructure people run storm long

Notes about the tweets:

- There were many tweets about articles written by Nick Judin of the Mississippi Free Press. This was the motivation to do an additional search of the news articles to ensure Mr. Judin’s articles were included in the corpus.
- Several tweets referenced “Nina Simone was right”, in reference to the civil rights songs by the singer, likely “Mississippi Goddam”.
- A few tweets used hashtag #ADOS or #MississippiADOS, referring to the American Descendants of Slavery movement. Most of these posts were categorized under the Racism topic.
- A number of tweets focus on Governor Reeves actions on transgender athletes or lifting mask mandate in the middle of the water crisis.
- Many tweets talked about Texas and their politicians, who were experiencing water issues based from the same winter storm that caused the problems in Jackson.
- Another commonly tweeted article was “Jackson, Mississippi Has a Water Crisis Because Our State Legislature Has a Race Problem”, written by Donna Ladd (2021), founding editor of the Jackson Free press and the non-profit Mississippi Free Press.

A representative sample of tweets from each topic are shown in Table 3.

Table 3

Number of tweets and sample tweets in different topics

Topic	Number of tweets	Sample tweets
Infrastructure	309	<p>“Clean safe water will be a thing of the past if we don’t fix our infrastructure now.”</p> <p>“Sadly, this is a constant problem in Jackson. I lived in the city for 5 years and we were almost always under a boil water notice. Then in swoops a natural disaster that crushes the already broken infrastructure.”</p>
Legislative / Political	373	<p>“The Mississippi Legislature’s effort to assist in the Jackson water crisis has been pared down to a single bill on water-payment flexibility and \$2 million from the capital expense fund.”</p> <p>“Shame, the governor @tatereeves is more concerned about banning trans youth from sports rather than focusing on actual issues...such as Jackson’s water crisis!”</p>
Struggle	717	<p>“Mississippi residents are having trouble finding bottled water for sale. Distribution sites are set up now.”</p> <p>“AN ONGOING STRUGGLE: Mississippi’s largest city is still struggling with water problems more than two weeks after winter storms and freezing weather ravaged the system in Jackson.”</p>
Racism	313	<p>“Black sections of Jackson, Mississippi, are nearing two weeks without water. White areas of town have no problems.”</p> <p>“The water crisis in Mississippi isn’t shocking. It’s a continuous cycle of environmental racism. #ADOS”</p>

Machine Learning

Since the tweets were manually labeled using the four topics of Infrastructure, Legislative, Struggle, and Racism, machine learning was used to see if the category of unseen tweets could be predicted. Tweets marked 'None' were removed. The remaining 1712 cleaned and vectorized tweets included 717 (41.9%) categorized as Struggle, 373 (21.8%) that were marked Legislative, 313 (18.3%) labeled as Racism, and 309 (18%) listed as Infrastructure. For evaluation of the

models, 80% of the tweets were used to train several different models and then each was tested on the remaining, unseen 20% of the tweets. Each model built was used to predict which of the four topics each unseen tweet best matched. The predictions were compared to their assigned labels to determine the accuracy of the model.

Three different machine learning models were built: (1) k-nearest neighbor; (2) a decision tree model; (3) and a random forest classifier. The k-nearest neighbor model had an accuracy of approximately 53.4%, the decision tree model had an accuracy of approximately 69.4%, and the random forest classifier achieved approximately 74.9% accuracy. Given the overlapping nature of the topics, these are reasonable results. Being able to predict the categories would be useful in a real-time monitoring system for use by city managers to aid in their decision making.

Topic Modeling of News Data

Topic modeling was also attempted using the news data. In Table 4, the four topics extracted from news data and their respective keywords are presented. The topics are not as clear as in the tweets. Topic 3 is closest to Struggle. Topics 2 and 4 have parts of Infrastructure and Legislative/Political. Topic 1 does not seem to match any of the topics from the tweets.

Table 4

Topics in news articles

Topic	Keywords
1	system residents lumumba pressure st road crisis still distribution mayor state
2	million system infrastructure crisis help mayor federal would need
3	power people state texas winter without residents weather still storm
4	state residents lumumba people infrastructure mayor system crisis also without

Moreover, there is no significant discussion of Racism in the news articles, unlike the situation in the tweets. Given the more fact-based nature of news articles relative to the more emotional tweets, this was expected.

Sentiment Analysis

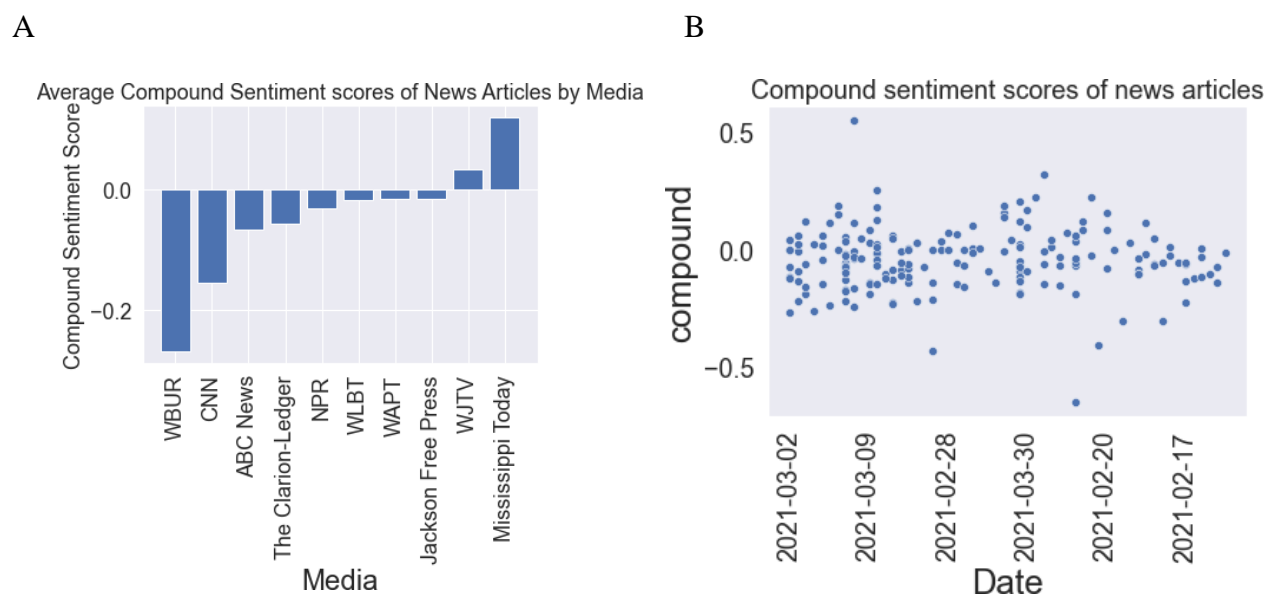
News media articles, which are generally written by journalism professionals, typically focus on facts and conveying accurate information. News articles typically display little sentiment (either positive or negative). On the other hand, tweets are posted by individuals and they have a much broader range of sentiment. This expectation was confirmed by the JWC data that was collected. Using VADER, both the tweets and the news articles were evaluated for sentiment. The measure used is the Compound Sentiment Score (i.e., the sum of the positive, negative, and neutral sentiment scores), which is then scaled to be between +1 (positive) and -1 (negative). Overall, using VADER, the news articles scored an average of -0.0426 and the average tweet score was significantly more negative, -0.4974. The average sentiment scores of the tweets by category were also all negative: Struggle -0.3317, Racism -0.4688, Legislative -0.5200, and Infrastructure -0.52235.

Figure 4 shows the Compound Sentiment Scores of the news articles. Figure 4A shows the compound sentiment score by the news outlet, and Figure 4B shows the compound sentiment scores of each news article over time. There are a few outliers, but the majority of the

articles have sentiment scores between +0.2 and -0.3. There was no significant change in compound sentiment over time. Interestingly, Mississippi Today was slightly positive, while WBUR (Boston's NPR station) and CNN were the most negative with respect to compound sentiment.

Figure 4

Compound sentiment scores of news articles



Popular n-grams

Using the cleaned tweets, with duplicates removed as much as possible, the top 10 most frequent words from each of the four topics were identified in the topic modeling step. Then the most frequent sets of two-word phrases (bigrams) and three-word phrases (trigrams) using those terms were found. Some of the most common bigrams were “crisis continues”, “two weeks”, “month without”, “next outage”, “struggling residents”, “residents fear” and “winter storm”. The common trigrams included “struggling residents fear”, “crisis state legislature”, “long standing problems”, “crisis amid pandemic”, and “month long crisis”. These phrases succinctly summarize many of the tweets.

Discussion

Tweets are extremely valuable to monitor public opinion. Other social media platforms could be included for broader reach. The four main topics that were identified from the tweets were: struggle (41.9%); legislative (21.8%); racism (18.3%); and infrastructure (18%). The number of tweets categorized for ‘Struggle’ was over twice as many as each of the other three topics, which all had similar numbers of tweets. The following sections present the conclusions of this study as represented by the terms “Strengths” and “Limitations”.

Strengths

- Analysis of social media can be done in real time, allowing decision makers and first responders to provide aid and assistance.
- Location data is inconsistent, but if used with city or sub-city markers, could be extremely valuable in crisis tracking.
- Identification of topics that are discussed and tracking them over time is possible.
- Sentiment on the topics is quantifiable and can be passively determined.

Limitations

- Cleaning the tweets and removing near duplicates and retweets is difficult. Sometimes the same tweet is posted multiple times with different mentions.
- Overlapping topics could be modeled better than attempted in this study.
- News articles are often published with only minor changes from the original source and are not as valuable as social media to track a crisis in real time.
- There was not enough data in this case study to see the spread of the story clearly, likely due to the relatively local nature of the story.

Recommendations and Future Work

Social media is a viable means of identifying citizen concerns (potentially in real-time), and to monitoring an infrastructure crisis or natural disaster. The findings from this research study can inform future policy decisions regarding how to improve crisis response methods and practices. The following recommendations, if implemented, could aid in reducing the disparity

of services provided to citizens during events similar to the 2021 Jackson Water Crisis:

- Social media aggregate data should be incorporated when evaluating public works offices.
- Social media aggregate data should be considered when government allocating infrastructure funds.
- Development of city or regional dashboards to aid communities in real-time when a crisis occurs.

The first two recommendations are clear, but the third takes some elucidation. A city dashboard could incorporate data from different sources. Typical data sources include local government data, public survey data, local service data, environment data, crowd-sourced data, and social or news media data (Kitchin et al., 2016). By building a city dashboard, a city can 1) keep citizens informed during a crisis, 2) provide real-time data for city managers and decision-makers, and 3) create a historical record to allow communities to be more resilient in managing future disasters better. Good examples include the dashboard for London (United Kingdom) (<https://citydashboard.org/london/>), and that for Dublin (Republic of Ireland) (<https://www.dublindashboard.ie/>). Moreover, features like crisis prediction and predictive alerts can be added to the dashboard. In commercial crisis dashboards like the NewsWhip dashboard, crisis prediction models were built to guide decisions daily (Quigley, 2020).

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A Different Path Forward: Using Privatization to Avert Future Jackson (MS) Water Crises
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Abstract

This policy study examines the potential advantages and disadvantages associated with cities using “privatization” as a viable method to manage their water systems. A *qualitative research synthesis design* allowed for the systematic compilation, comparison, and assessment of public policies addressing the privatization topic. This study’s major findings include “privatization” being a catch-all term for several different implementation models; the inability of privatization to serve as an effective “one-size-fits-all” implementation tool; the potential for privatization to produce both intended and unintended consequences; and privatization requiring years to implement and evaluate. Depending upon the particular circumstances of each water privatization project, the advantages of privatization do not necessarily outweigh the disadvantages. If a municipality or non-profit entity decides to pursue the privatization option, this study recommends: (1) carefully selecting the appropriate privatization model; (2) carefully structuring contract terms and length to provide appropriate administrative oversight and prevent excessive rate increases; (3) consider entering into public/private/non-profit partnership agreements to increase administrative and fiscal capacity of the water system; and (4) consider entering into some type of “regional water system consolidation” agreement with neighboring cities to share cost and increase capacity. In terms of answering the research question of whether privatization can help Jackson avert future water crises, the accurate answer is “perhaps.”

Keywords: water, privatization, crisis, advantages, disadvantages, municipalities, Jackson (MS)

Introduction

As well chronicled, the February 2021 ice storm produced a series of events that included power outages, transportation stoppages, malfunctioning water plant equipment, and widespread closure of businesses and organizations in the City of Jackson, Mississippi (Sharon & Rowe,

2021; Banks, 2021; Hardiman, Hilburn, & Walker, 2021; Rowe, 2021). The City of Jackson has experienced many water crises-related events dating back to the early 1980s and spanning at least six mayoral administrations (Sharon & Rowe, 2021). While federal, state, and local elected officials discuss ways to fund improvements to Jackson's current water system (including "winterizing" the system to lessen the impact of future ice storms), there are some solutions that seemed omitted from those conversations. One such potential solution is using privatization as a means to upgrade and/or manage the existing water system.

As used in this study, privatization refers to a public entity allowing a private-for-profit enterprise to own and/or manage a service traditionally provided by government (Morgan, England, & Pelissero, 2007). The City of Jackson is currently privatizing some of its services such as garbage collection and street paving (Bragg, 2018). This policy study explores the potential advantages and disadvantages associated with privatizing a public water system. By exploring this policy question, the authors intend to provide research-based evidence that can help policymakers make prudent decisions regarding how to avert (or mitigate) future water crises in Jackson and other cities experiencing similar water issues.

Background

In February 2021, Jackson, Mississippi experienced a series of catastrophic events which ultimately left some residents and businesses without direct access to potable water for over a month. On February 15th and 17th, two severe ice storms hit the city, causing dangerously low temperatures that froze (and then burst) water pipes, and produced ice coverage that made city streets impassable for most vehicles. As a result, the City of Jackson's O.B. Curtis Water

Treatment Plant (built in 1993) shut down due to frozen water and debris clogging its systems (Judin, 2021).

By the time of the second freeze on February 17th, the combination of ice and accumulated sludge caused a major decrease in water pressure within the City of Jackson (Judin, 2021). In the weeks that followed, water mains across the city continued to break because of the freeze, further depriving the system of the pressure needed to supply water to more than 40,000 people across multiple neighborhoods and communities (Rozier, 2021). Due to freezing temperatures and a shutdown water plant, citizens of Jackson found themselves stuck in their homes during a global pandemic with no access to running water.

Prior to the 2021 ice storms, problems associated with the City of Jackson's aging water system were not unknown. Years earlier, Jackson had developed an official administrative plan to improve the city's water infrastructure known as the Water Distribution System Rehabilitation Master Plan, initially drawn up in 1993 and amended in 2013 (Judin, 2021). The 2021 water crisis only raised additional questions regarding the overall effectiveness of that plan.

The water issues experienced by the City of Jackson are part of a larger national problem. A 2016 report by the Brookings Institute states that over 88% of Americans believe the nation's water infrastructure needed to be addressed (Kane, 2016). Similarly, a 2019 policy brief by the Center on Budget and Policy Priorities recommends that states immediately make much needed infrastructure investments (McNichol, 2019). Underscoring this recommendation is Mississippi's 2020 Infrastructure Report Card, issued by the American Society of Civil Engineers, which gave Mississippi a grade of 'D' for its drinking water infrastructure. Additionally, that report cited a

2015 U.S. Environmental Protection Agency estimation that it will cost \$4.8 billion over the next two decades to improve drinking water infrastructure in Mississippi as “much of the state’s current drinking water infrastructure is beyond or nearing the end of its design life” (American Society of Civil Engineers, 2020). Projected water infrastructure repair costs for Jackson range between \$1 - 2 billion (Crown, 2021). The U.S. Environmental Protection Agency (EPA) has issued numerous administrative orders requiring the City of Jackson to improve its water system (Kenney, 2021). At one Jackson City Council meeting discussing an EPA order, Councilman Kenneth Stokes was quoted in the media as saying, “If we’re going to experience these water problems every winter where people are going weeks and months without water, then we need to do something different. If something different means we need to get private companies in here to run our water plant, then so be it” (Kenney, 2021).

Privatization as an Alternative

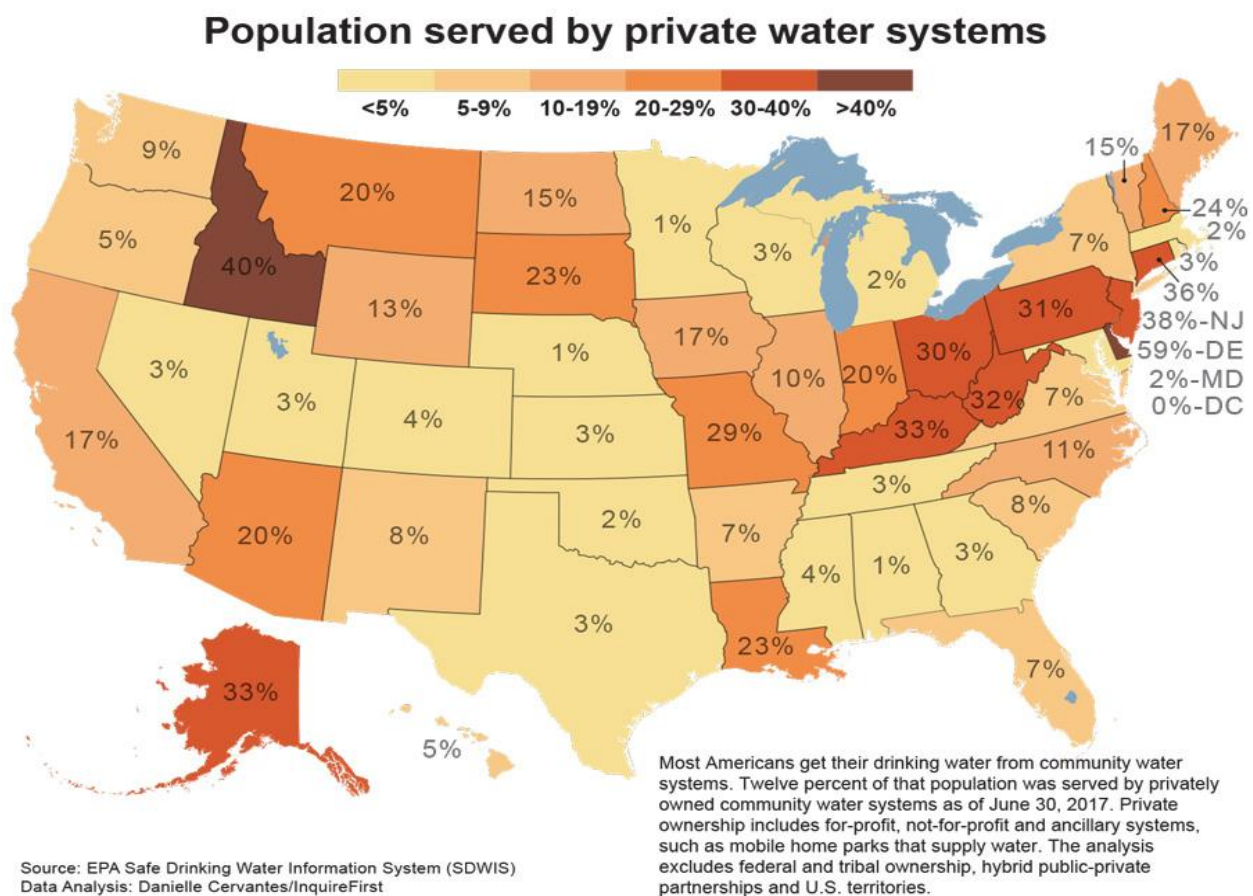
Privatization refers to a public entity allowing a private-for-profit enterprise to own or manage a service traditionally provided by government (Morgan, England, & Pelissero, 2007). As a service delivery mechanism, privatization tends to emphasize values such as efficiency rather than equity, and limiting costs rather than creating or maintaining jobs.

The onset of the 1990s brought about growing considerations of privatization in water service due to changes in regulatory practices and economic interests (National Research Council, 2002). Nationally, there are over 50,000 private water systems (Kopaskie, 2016). Also contributing to the growing use of water privatization was a shift to a management paradigm termed “New Public Management” (NPM) (Andrisani, Hakim, & Leeds, 2000). This

management paradigm created opportunities for local governments with limited resources to meet federal water standards by utilizing private utility companies. As a result, the U.S. saw local governments enter into 186 contracts with private water companies (with a total value of \$19.3 billion) between 1985 and 1998 (Beecher, 2001). Figure 1 shows a map listing the percent of the U.S. population served by private water systems. Privately operated water systems function in over 600 cities across the nation (Varghese, 2007) and service approximately 12-15% of United States residents (Kopaskie, 2016; Rozier, 2021).

Figure 1

Population served by private water systems



There are four main types of privatization models utilized by local governments: (1) outsourcing support services to private companies; (2) private companies operate and manage public treatment facilities; (3) “design-build-operate” contracts to private companies; and (4) the sale of government-owned water assets to private companies (National Research Council, 2002). The first three privatization models, which are the most commonly occurring, involve private companies entering into some type of “transfer of services” contract with governments, wherein they are responsible for the technical operations and management of facilities that remain publicly owned. In the less commonly occurring fourth type, local governments transfer full ownership to private companies (National Research Council, 2002).

Relevancy of Study

As of this writing, the U.S. Congress is considering a \$1.2 trillion infrastructure bill that includes \$55 billion specifically for water projects (Wehrman, Lesniewski, & Shutt, 2021). These funds are in addition to the “COVID-19 American Rescue Plan’s” \$365 billion available for infrastructure projects (Needler, 2021). With the anticipated passage of the \$1.2 trillion infrastructure legislation, cities will be face with monumental decisions regarding how best to utilize these “once in a generation” dollars targeting water projects. Privatization is one of several options that will be available to cities as an implementation tool. This study provides policymakers with up-to-date research examining the advantages and disadvantages of using privatization as an implementation tool for future possible funding.

Research Methodology

Research Question

This study's guiding research question is whether the proposed advantages associated with the option of privatizing a public water system outweigh the potential disadvantages of utilizing such an option.

Theoretical Framework

The theoretical framework guiding this study is the “New Public Management” (NPM) theory of governance. This theory advocates utilizing private sector/market-oriented principles as a means for managing government services more effectively and efficiently. Some of those principles include greater administrative flexibility and transparency; a reduced role of government in providing services; greater emphasis on managerial skills and expertise; less government bureaucracy; the decentralization of services; and greater emphasis on cost-cutting and efficiency (Morgan, England, & Pelissero, 2007) (Pyun & Gamassou, 2017). One of the primary tools associated with this theory is the privatization of services as a means for increasing efficiency and reducing costs (Pyun & Gamassou, 2017). A core tenet of this theory is its reliance on using the private sector to provide goods and services in a more cost- and managerial-efficient manner. According to this theory, using privatization to deliver water services should result in better customer outcomes, fewer operational inefficiencies, and lower costs. This theory provides the context, assumptions, and operational principles needed to assess the advantages and disadvantages of privatizing public water systems.

Study Design

This research study utilized a *qualitative research synthesis design* to examine the advantages and disadvantages of water privatization efforts in cities. This type of research design allows for the systematic compilation, comparison, and assessment of public policies addressing a specific topic (Dunn, 2008).

Study Procedures

Consistent with utilizing a *qualitative research synthesis design*, this study's procedures included reviewing case studies of water privatization policies and activities conducted internationally, nationally, and regionally. This study also reviewed research reports examining the efficacy of water privatization policies and activities occurring over the last 30 years.

Data Collected

The data collection criteria for selecting case studies (n=22) and research reports (n=12) include relevance to the research topic; timeliness of studies and reports; geographic perspective; information source; and studies with definitive outcome findings. Cases used by private water companies as advertising and/or without details regarding contract terms or outcomes were excluded. Key database sources used to identify scholarly journal articles, case studies, and research reports included Academic Search Premier, JSTOR, and EBSCO.

Data Analysis Procedures

The analysis procedures included preparing display tables identifying and comparing key factors listed in the research literature and theoretical framework as being relevant. Analysis also

included utilizing Morestin's "Seven Dimensions for Analyzing Public Policies" to identify and synthesize key research "themes" and findings (Morestin, 2012).

Study Timeframe

The timeframe for this study is the years 1990 to 2021. This timeframe governs the collection and analysis of case studies, research reports, and key review of literature findings. It also corresponds with the emergence of the "New Public Management" paradigm.

Summary of Research Findings

Table 1

Summary of advantages and disadvantages of privatization

Advantages of Privatization	Disadvantages of Privatization
<ul style="list-style-type: none"> • Provides funding and other resources for infrastructure improvements that municipalities may not have • Contracts have potential to offset debt to cities such as unpaid water bills, help fund other city expenditures; and increase city revenue • Possibility of increased efficiency, specialization, and improved water quality • Allows municipalities to shift limited resources to other vital services • Provides municipalities with a range of privatization options 	<ul style="list-style-type: none"> • Increased rates to residents for water service • Higher costs for operation of water treatment plants • Loss of public accountability and potential for corruption in contract negotiations (e.g., steering) • Contract lengths and buyout costs (including legal fees) can make them difficult to reverse • Possibility of no improvement to (or reduction in) service and/or water quality • Potential for serious contamination of water supply • Loss of public sector jobs/Layoffs

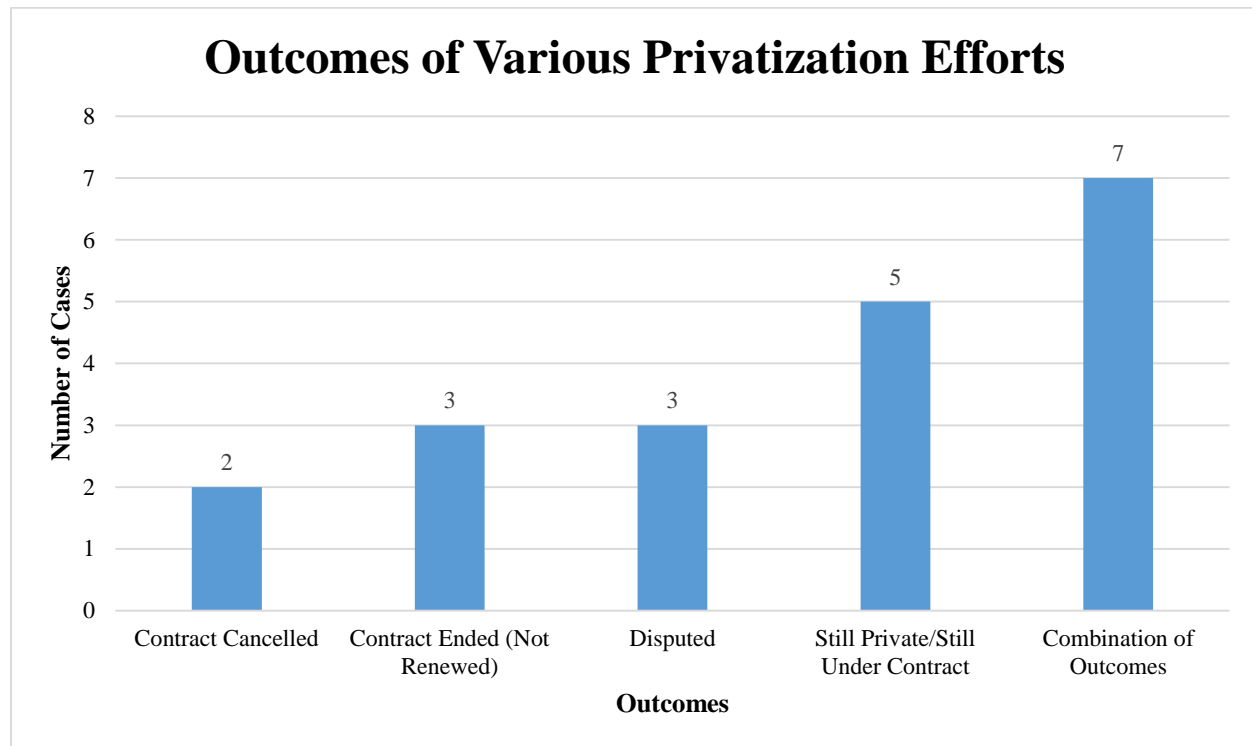
Table 2
Outcomes of various water privatization efforts

Location	Privatization Model	Outcome
<i>International</i>		
Banagalore, India	Design-Build-Operate (Transfer)	Contract cancelled
Chengdu, China	Design-Build-Operate (Transfer)	Disputed
Delhi, India	Outsourcing support services	Disputed
Dams Plan, Zimbabwe	Design-Build-Operate (Transfer)	Contract cancelled
Shanghai, China	Design-Build-Operate (Transfer)	Contract ended
Shenyang, China	Design-Build-Operate (Transfer)	Contract ended
Xian, China	Design-Build-Operate (Transfer)	Contract ended
Yuvacik, Turkey	Design-Build-Operate (Transfer)	Disputed
<i>United States</i>		
Atlanta, GA	Private company takeover of management and operations	Contract cancelled; Customer dissatisfaction
Bayonne, NJ	Private company takeover of management and operations	Still private; Customer dissatisfaction
Charleston, WV	Sale of municipal water system to private company	Still private; Customer dissatisfaction
Flint, MI	Private company takeover of management and operations	Disputed; Contract ended; Customer dissatisfaction
Fort Wayne, IN	Private company takeover of management and operations	Disputed; Contract ended
Gary, IN	Private company takeover of management and operations	Still private
Indianapolis, IN	Sale of municipal water system to charitable trust	Still under contract
Jersey City, NJ	Private company takeover of management and operations	Still private
Lake Station, IN	Sale of municipal water system to private company	Still private
Missoula, MT	Sale of municipal water system to private company	Disputed – contract ended
Mooreville, IN	Sale of municipal water system to private company	Disputed – unable to end contract; Still private
Pittsburgh, PA	Private company takeover of management and operations	Disputed; Contract ended; Customer dissatisfaction
Rialto, CA	Private company takeover of management and operations	Still private
Stockton, CA	Private company takeover of management and operations	Disputed; Contract ended; Customer dissatisfaction

Sources: Araral, 2009; Douglass, 2017; Grafton & Mohai, 2015; Hosea & Lerner, 2018; Ivory, Protess & Palmer, 2016; Jerome, 2017; Kenny, 2013.

Figure 2

Quantification summary of various privatization efforts



Sources: Araral, 2009; Douglass, 2017; Grafton & Mohai, 2015; Hosea & Lerner, 2018; Ivory, Protesse & Palmer, 2016; Jerome, 2017; Kenny, 2013.

The previous tables and figures present this study's research findings regarding the advantages and disadvantages of utilizing privatization to help avert future Jackson water crises. Tables 1, 2, and Figure 2 provide a visual display and comparison of this study's major research findings which in summary are: (a) the advantages of privatization do not necessarily outweigh the associated disadvantages; and (b) the type of privatization model selected, and the level of expertise of the private company, can greatly impact the outcome of the privatization effort. A

listing of “Other Key Qualitative Findings” is included to help identify key themes and issues associated with privatization.

Other Key Qualitative Findings

- A. Citizens are typically willing to pay slightly more for improved water service and/or quality, but report dissatisfaction over increased rates without improved water service or quality (Ivory, Protes, & Palmer, 2016; Douglass, 2017).
- B. State and local policy is often a determining factor in a city’s decision to privatize water service. Legislation passed in Indiana, California, Illinois, Missouri, New Jersey, and Pennsylvania – known as “fair market value legislation” allows for cities to sell their water systems for an appraised value, rather than the more commonly used “book value” (which is based upon the system’s age and original price) as an enticement for cities in need of cash revenue (Douglass, 2017). In contrast, the City of Baltimore passed legislation in 2018 that banned the privatization of water service through a voter-led alteration of its city charter (Biron, 2018).
- C. Economic benefits of privatization are sometimes larger for the private company than for the municipality.
- D. The type of privatization model selected, and the level of expertise of the private company, can greatly impact the outcome of the privatization effort. Changes in technology, management practices, and government cultures can also significantly impact the outcomes of privatization efforts (Andrisani, Hakim, & Leeds, 2000).
- E. Municipalities may not have the internal expertise to effectively monitor contract compliance requirements.
- F. Some components of a “public water management system” tend to be more successful with certain privatization activities (for example, water billing systems, water meter installations, and laboratory assessments) (Andrisani, Hakim, & Leeds, 2000).

Taken collectively, this study’s research findings indicate privatization does not produce uniformly positive results in all instances. While private investments in public water systems and cost savings to public municipalities are often initial advantages, there are many other factors that help determine whether the privatization effort obtains success. The next section discusses in

detail some of the significant issues, challenges, and opportunities identified in this study's findings.

Discussion

In examining this study's findings through the twin lenses of (1) the "New Public Management – NPM" theoretical framework and (2) Morestin's "Seven Dimensions for Analyzing Public Policies", the results are both informative and cautionary. The NPM theory accurately predicted some initial cost savings and streamlining of water service delivery in the projects reviewed. However, the NPM theory only addressed the more easily quantifiable aspects of water system privatization and failed to address those non-quantifiable factors. Morestin's dimensions model helped identify both "quantifiable" factors (e.g., costs, technical feasibility) and "non-quantifiable" factors (e.g., equity, political acceptability, and unintended effects) that emerged in the research findings. In using Morestin's dimensions model to synthesize the research, the major findings included the identification of increased water rates, streamlined labor costs, citizen dissatisfaction, greater governmental flexibility, and issues involving lack of equity. The following sections briefly discuss some of those issues identified in the findings.

Equity/Political Acceptability

The United Nations identified access to water for drinking and sanitation as a human right in 2010 (United Nations, 2014). Closely related to this human rights issue is ensuring that social equity and environmental justice issues are also considered for all communities. A 2019 report by the Thurgood Marshall Institute at the NAACP Legal Defense and Educational Fund found that increasing water rates disproportionately affect marginalized communities and

homeownership rates, as every state has a legal process to place liens on homes for unpaid water bills (Montag, 2019). There is also the ethical matter of water provision being part of government's responsibility for "the common good", and growing calls for government to reclaim that responsibility. This idea is reflected in the trend known as "remunicipalization," as more than 267 cities in 37 countries around the globe have moved water management back to the public sector (McDonald, 2018).

Intended & Unintended Consequences

This study's findings illustrate how water system privatization efforts can produce both intended consequences (e.g., "cost savings", "infrastructure investments"; "governmental flexibility") and unintended consequences (e.g., "citizen dissatisfaction", "lower water quality standards"; "higher service rates"; and "reduced equity/social justice"). Determining which privatization efforts will produce which type of consequences is not easy to evaluate or predict.

Conclusions

Based upon this study's research findings, a decision to privatize a city's water system needs to be evaluated across multiple policy considerations and models before being selected as a potential solution to averting future water crises. Depending upon the particular circumstances surrounding each privatization project, the advantages of privatization do not necessarily outweigh the associated disadvantages. It may in fact create as many problems as it attempts to solve. As indicated in several of the case studies and research reports reviewed, there are instances where certain privatization models have proven more successful for both the municipality and private company than other models. Another key finding is that "privatization"

can produce both intended and unintended consequences, and it can literally take years to implement and evaluate. In terms of answering the question of whether privatization can help Jackson avert future water crises such as the one experienced during Winter 2021, the accurate answer is “perhaps”. This study’s synthesized research findings indicate there are just as many, if not more, disadvantages associated with privatizing a municipality’s water system as there are advantages. If a municipality or non-profit water entity is interested in pursuing the privatization path, the following advice should guide that pursuit --- proceed with caution, the outcome may not be what was originally envisioned.

Recommendations

This section presents several recommendations that a municipality should consider as it contemplates pursuing the privatization of its water system. These recommendations emerge from extracting key lessons learned from privatization projects reviewed in this study.

1) Select the most appropriate privatization model

As discussed earlier, there are several privatization models that a municipality can consider implementing. Figure 3 illustrates this study’s “Spectrum of Preferability” range regarding the four main types of water system privatization models.

Figure 3

Privatization model “Spectrum of Preferability”



More preferable

Outsourcing select support services	Private company takeover of management and operations	Design-Build- Operate-Transfer Arrangement	Sale of water system to private company
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2) Cautiously and carefully structure contract terms and length

Municipalities should consider limiting initial contract lengths to ten-year increments; contract terms should provide for judiciary, environmental, and administrative oversight; and contracts should limit/cap rates to prevent excessive increases.

3) Consider entering into public/private/non-profit partnership agreements

One possible means for municipalities to continue publicly operating their water systems is to partner with a public trust (as implemented in Indianapolis, IN) or non-profit organization. Thirty-eight percent of privately-owned systems in the U.S. are owned by non-profits; however, the EPA reported in 2006 that smaller systems face larger financial strains under these conditions (Davis, 2018). As a smaller-sized city, it may take partnerships with multiple non-profits for Jackson's water system to operate on the same scale and capability similar to larger cities.

4) Utilize more federal and state funding to improve current public systems

Another key strategy to improve water service while maintaining public ownership is to increase funding to cover the gaps left by insufficient and/or declining revenue streams. Directing federal funds from the COVID-19 American Rescue Act, and the proposed \$1.2 trillion federal infrastructure legislation, can help prevent the need for privatization.

5) Consider regional consolidation

Regional consolidation is another potential approach to improving Jackson's water system. This approach involves entering into a collaborative agreement between Jackson and satellite cities like Brandon, Ridgeland, Byram, and Pearl to share their water resources and improve functionality while servicing a wider swath of the local population (Rozier, 2021).

Taken collectively, all of the above recommendations provide policymakers with several viable options for averting future water crises in Jackson and other cities facing similar issues.

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Epilogue

This edition of the Online Journal of Rural and Urban Research (OJRUR) seeks to highlight issues connected to the 2021 Jackson Water Crisis from the time perspectives of past, present, and future. These perspectives are important as they provide insight regarding the origins of the water crisis problem; its current structural, social, economic, financial, demographic, health, and political impact; and its future impact in those same categories. As is evident from reading the articles, the 2021 Jackson Water Crisis was much more than a singular event. It represents a confluence of factors that are constantly at play, and often at odds, with each other. The winter storm only amplified overt and covert issues associated with the water system in Jackson Mississippi.

Each of the journal articles provides a new dimension for understanding the water crisis, and perhaps more importantly, provides key insights and recommendations on how to possibly address many of those issues contributing to the water crisis. Whether the insight is from authors such as former Jackson Mayor Harvey Johnson offering historical context; or Jones & Gardner highlighting the service role of the Black Church; or Otts, Green, et. al. stating the water crisis is a multi-dimensional phenomenon and should be addressed as such; or Hernandez & Shrestha et. al. noting how news and social media coverage help shape how issues are viewed, interpreted, and acted upon; or Ko establishing a link between de-population, city finances, and aging infrastructure; or Mozee & Bacon urging caution when considering privatization as a panacea for solving the water crisis now and in the future.

A key take-away from all the journal articles is that the water crisis that exists in Jackson (and many cities like Jackson across the United States) is not going away. In fact, it is likely to get worse through both natural causes (i.e., aging equipment; more frequent extreme weather events) and manmade causes (e.g., increasing political discord, lack of funding, laws and regulations). But also evident from reading the articles, there are many potential solutions available that can help address the water crisis issue from multiple paths and perspectives. As posed by several of the journal authors, the question is not whether Jackson (and other cities with similar problems) can successfully address the issue, but whether all the diverse parties connected to this issue can set aside their differences and cooperate on solving this crisis. The answer to the latter question has tremendous health, social, and economic implications for Jackson and other cities dealing with similar issues.

The editors of this journal applaud each of the authors for their efforts to provide insight, knowledge, and recommendations that can help Jackson and other cities improve their ability to effectively deal with future water crises, whether natural or man-made. In closing, we thank you for working to improve the quality of life in urban communities.

Journal Publisher Information

About the Journal

The primary focus of the *Online Journal of Rural and Urban Research* (OJRUR), published by the Mississippi Urban Research Center, is to gather and disseminate high quality urban-focused research that can help improve the quality of life in urban areas. The OJRUR periodically issues general and “special topic” call-for-papers that enable the publication of timely research from scholars and practitioners in a variety of disciplines. In keeping with the mission of the Mississippi Urban Research Center, articles appearing in this journal utilize basic and applied research to yield practical solutions to pressing urban problems. The OJRUR is an open access journal that strongly encourages the dissemination of its research to public, private, and nonprofit organizations as well as private citizens. When utilizing OJRUR research, please be sure to give proper attribution (acknowledgement) to the authors who produce the articles.

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Mississippi Urban Research Center

The Mississippi Urban Research Center (MURC) at Jackson State University was authorized through Mississippi Senate Bill 2720, Chapter 512, Section 1, cited as the “Universities Research Institutes Act of 1983” (MS Code § 57-55-17 (2019)). That enabling

legislation states it shall be the function of MURC to conduct basic and applied research into urban problems and public policy, and to make available the results of this research to private groups, public bodies, and public officials. MURC enacts its mission through a wide array of services that includes basic and applied research; policy analysis; consultation and general advisory services; program evaluation; Census data research and training; focus group facilitation services; survey development and implementation services; statistical analysis services; needs assessment services; offering instructional programs, forums, conferences, workshops; and technical assistance addressing urban-based issues.

Jackson State University

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