

EFFECTS OF INADEQUATE ACCESS TO CLEAN DRINKING WATER IN MANSA DISTRICT: A CASE OF MUCHINKA WARD

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ABSTRACT : Globally, over 40 percent of people are affected by water scarcity and the scenario is likely to worsen as the climate changes. In fact, it is projected that by 2050, one in four individuals will suffer from inadequate access to clean water. To circumvent such a situation, one of the purviews of the United Nation's Sustainable Development Goals is to ensure that there is adequate access to clean water and sanitation by all by 2030. However, not much is known about the status on the access to clean drinking water in rural areas especially that findings are location, time and context specific. To address this knowledge gap, we used primary cross-sectional data collected from 160 residents of Muchinka Ward in Mansa. In the interest of robust findings, mixed methods using triangulation design was employed to collect quantitative data via a pretested household survey questionnaire and qualitative data via focus group discussion and key informant interviews. To achieve the overall objective of assessing the effect of inadequate access of clean water, we used statistical package for social scientists (SPSS) to apply the one sample t-test, the control function and the principal component analysis. The results reveal that resident have inadequate access to clean water as 93% use shallow wells, rives and deep wells with cover. Interestingly, the study finds that these water sources are not satisfactory except for piped water which only 6% have access to. In an attempt to probe the effect of this inadequate access to clean water, the study finds that inadequate access has a propensity to reduce school attendance of school going children by 17% and also increase the likelihood of contacting water-related illness by 78%. Therefore, to overcome this problem the study identifies institutional factors as key determinants of inadequate access. Particularly, Luapula Water Supply and Sanitation Company (LpWSSC) lacks excellent service quality delivery and this has led to many households not being connected to piped water source. The findings of the study has important implication for project management in that it presents a situation analysis that donors or non-governmental organizations with an interest in improving access to clean drinking water can use for project planning in the rural areas of Mansa.

KEYWORDS: social effect; Sustainable Development of Goals (SDGs); service quality delivery; water access, Sources of water.

I. INTRODUCTION

For a long time, safe drinking water has been a challenge in Mansa district particularly in Muchinka ward. To realize equitable and universal access to affordable, clean and safe drinking water for all by 2030 is one of the critical demands of the Sustainable Development of Goals (SDGs). Therefore, people of Muchinka ward equally need safe drinking water for their day today healthy living. However, this goal has not been realized fully in Muchinka ward. The residents depend on unsafe sources of water such as shallow wells, which is used for drinking, domestic use and food production. It is on this account that the subject of this paper is on the effect of inadequate safe drinking water. Therefore, this chapter gives an account on the background to the study, and then exposes the research problem and the research objectives and questions after which the rationale of the study is presented.

II. BACKGROUND TO THE STUDY

Water supply that is easily accessible, affordable, safe, and reliable is important for a healthy and good social life. Yet, in a long time, close to a billion people in third world nations have not been able to access safe and sustainable water supply. To ensure water requirements for laundry, food and personal hygiene, and other domestic use is met, it is estimated that a minimum of 7.5 – 50 liters per individual per day is needed (Howard et al., 2003). Likewise, in most sections of Zambia, especially Luapula Province one of the pivotal issues to social wellbeing is inadequate access to clean drinking water. More specifically, access to clean water in urban and rural areas stands at 86% and 50%, respectively.

Generally, the average rate of access, according to WHO and UNICEF 64% and this is among the lowest rate in Sub-Saharan Africa (SSA) with the lowest access rate. One potential reason behind this is that revision of water policy and development of the water resource management act was only done in 2010 and 2011 respectively. Additionally, in an attempt to improve water accessibility in rural areas, the National Rural Water Supply and Sanitation Programme (NRWSSP 2006-2015) was officially development and this commitment was reflected in the Sixth National Development Programme 2011-2015 (SNDP). Overall, the plan was aligned with the Millennium Development Goals (MDGs) so as to increase water accessibility to 75% by 2015. In support the Japan international cooperation agency (JICA) guides that the Zambia's national coverage rate must be strategic in a manner that it eventually reaches 100% in 2030. However, access to clean drinking water in Luapula province is reportedly low. Divided into 11 districts, the province is located in the northern part of the country with a land area and population of 51,000 km² and 991,000 respectively. Interestingly, 80% live below the poverty line which partly explains the high inadequate access to water (CSO, 2010). Also, the provincial capital, Mansa, with more females than males has 20 wards, one of which is Muchinga Ward – densely populated with the number of persons per square km being 23.1 and a growth rate of 2.4%.

III. RESEARCH PROBLEM

Among the 20 wards in Mansa district, Muchinka ward is not among the wards that are connected with piped water from Luapula Water Supply and Sanitation Company for the period of 13 years yet has been a priority project area for some time. That is from the time the Commercial Utility was formed in 2008. The ward has four schools, two markets, four churches and one clinic and has 4,712 households making the ward the most populated in Mansa district (CSO, 2010). Impliedly, the residents of Muchinka ward face inadequate access to clean drinking but instead majority make use of water from vendors whose quality is unverified, unprotected shallow wells, and surface water from the river. In addition, for a good number of households, water sources are relatively far from their homes, and making female households who are mostly responsible for fetching water highly vulnerable to attack from wild animals and also men engaged in bad vices. Despite this, there is little empirical evidence on the factors influencing inadequate access, its social effect and whether their current water source is satisfactory. It is against this backdrop that this present study seeks to assess the effect of this inadequate access to clean drinking water.

IV. RESEARCH OBJECTIVES

- To determine whether the alternative sources of drinking water are satisfactory among the residents of Muchinka Ward;
- To evaluate the social effect of inadequate access to clean drinking water in Muchinka Ward;
- To assess the factors affecting access to clean drinking water in Muchinka Ward; and
- To assess the effect of inadequate access to clean water in project areas of Muchinka ward.

V. RESEARCH CONTRIBUTIONS

It is very important for researchers as this paper adds vital empirical evidence important in realizing improved access to clean water and sanitation. Given that the study area is typical of a rural setting in SSA, it provides a good example for similar areas to comprehend the factors at play in propelling inadequate access to clean water.

VI. LITERATURE REVIEW

WATER SOURCES FOR DOMESTIC USES IN NIGERIA: A household survey was conducted in Nigeria to examine the water sources used by resident in Edo state by Okadigwe and Efe (2017). The investigation through oral interviews, structured pre-tested questionnaires and observations sort to find information on how much water costs, different sources of water, the people involved in collecting water, how the state supplies water and what it should do to assist in minimizing the problems. It was revealed that generally, rain water stored in wells was one major source. From the research almost all the respondents stated that they obtain domestic water from dug out wells with the assistance of roofs assisting during the rains.

Water boreholes for commercial purposes were only owned by four families who sold water at N5 per ten liters. This is out of the reach of a lot of residents in this society to satisfy the demands of water. Also, the closest stream, Umutu stream, is very far from the households as it is located about 20 kilometers away from the state. What is worse is that the state has a non-functional water board. It was therefore, concluded that owing to the inadequate operators, poor power supply, and broken equipment and poor maintenance as reported by respondents, the water sources are inadequate. This is because there is a high probability that the available water is contaminated, thus not fit for use (Okadigwe and Efe (2017).

GROUNDWATER AS A MAJOR SUSTAINER OF WATER IN SUB-SAHARAN AFRICA : Xu et al (2019) conducted a crucial study on groundwater in Sub-Saharan Africa. It was shown that it plays major role in supporting efficient and effective water supplies as well as livelihoods. Given that its intrinsic ability to buffer the fat changing climate and drought and it ever availability in high quality, it presents an excellent source of drinking water. It no wonder majority in North and Southern African countries use this source of water for drinking. However, one of the critical and genuine concerns raised is the inability by most SSA residents to appropriately extract this water for their drinking needs.

VII. EFFECTS OF UNCLEAN WATER

Ensuring availability of clean water and a good sanitation is always a point of emphasis by the World Health Organization (WHO), policy makers and researchers alike. In support, it is now a well-acknowledged fact that poorly managed water and sanitation facilities expose households to avoidable health risks (Radjenovic & Sedlak, 2015). Evidently, this is explicitly indicated in the SDGs because of its grave consequence or association with diseases such as dysentery, cholera, hepatitis A, polio, diarrhea and typhoid. In addition, other land uses have gravely affected access to clean drinking water for hundreds of millions of people. For instance, fresh water is either chemically tainted or poisoned due to inadequate management of agricultural industrial and urban wastewater.

ECONOMIC CONTEXT OF SANITATION IN DEVELOPING NATIONS : A study by Van Minh and Nguyen-Viet (2011) established that economically, there is a substantial cost linked to poor sanitation in developing countries. For instance if the MDG target on water and sanitation, it would have a global cost of US\$38 billion where 95% is a contribution of sanitation (Smets, 2009). To circumvent this in the third world nations, US\$28 per capita spending translating to an annual spending of US\$14 million for sanitation is necessary to meet the SDG target (Crocker & Bartram, 2014). The empirical evidence demonstrates that sanitation investment is socially and economically worthwhile (Malik et al., 2012). For every money invested in clean water and sanitation, the return is significantly more in terms of the realization of the SDGs (Patil et al., 2020).

THE IMPACT OF WATER SCARCITY SOCIALLY AND ECONOMICALLY IN WESTERN CAPE, SOUTH AFRICA : Following a study on the economic and social effect of water scarcity by Vaal university (2018) in Western cape, South Africa, it was established that inadequate water can result in the impediment to economic wellbeing because various sectors heavily depend on this resource. The mining, agriculture and tourism sector is a case in point considering these sectors cannot thrive without adequate access to water (Garcia & Pargament, 2015; Jiang, 2009; Kellner, 2021). Consequently, at macroeconomic and microeconomic level the outcome is far-ranging i.e. profit reduction, employee layoff and slow business growth which makes communities more vulnerable.

QUALITY OF DRINKING WATER IN RURAL BANGLADESH : Akter et al. (2016) conducted a research in rural Bangladesh on drinking water and concluded that quality water must have a pH of 7 but limits within $\text{pH } 7.4 \pm 0.4$ which is slightly alkaline and considered acceptable. Regarding mineral concentration, WHO recommends 0.3 mg/L as standard but iron and manganese concentrations were more than the standards making it unsuitable for consumption. Based on the water quality index (WQI) only 67% of the sampled areas had poor quality drinking water due to higher content of iron, arsenic and manganese. The recommendation therefore, is that public health improvement is a prerequisite at household level and this can best be done through raising awareness on what constitutes water quality (Akter et al., 2016; Sasikaran et al., 2012).

THEORETICAL FRAMEWORK : A SET OF ASSUMPTIONS OR AN ASSUMPTION EXPLAINING THE NATURE AND EXTEND OF A PHENOMENA IS REFERRED TO AS THE THEORETICAL UNDERPINNING OF THE STUDY. IT USUALLY PRESENTS THE DISCOURSE OF VARIOUS SCHOLARS ON REASON BEHIND THE EXISTENCE OF A THEORY AND ITS APPLICATION ON THE SUBJECT (KOMBO AND TROMP, 2011). THIS STUDY WAS GUIDED BY TWO THEORIES NAMELY WATER URBANISM THEORY AND HYGIENE AND SANITATION THEORY.

WATER URBANISM THEORY : Water Urbanism a theory advanced by Shannon et al. (2008) postulates that a constructed ecosystem necessary to comprehend the notion of cities and water. Within an urbanized ecology different system (agriculture and industry use, water retention, culture, water harvesting, sewage and recycling, water access, rainfall, and, re-collection) are considered as important opportunities for designing interventions. Given that there are multiple points in the cycle, the theory suggests a wide range of practices that is likely to contribute in promoting participatory practices fostering resilient communities through continuous management of the urban eco-system. According to water urbanism theory, towns have changed around a river

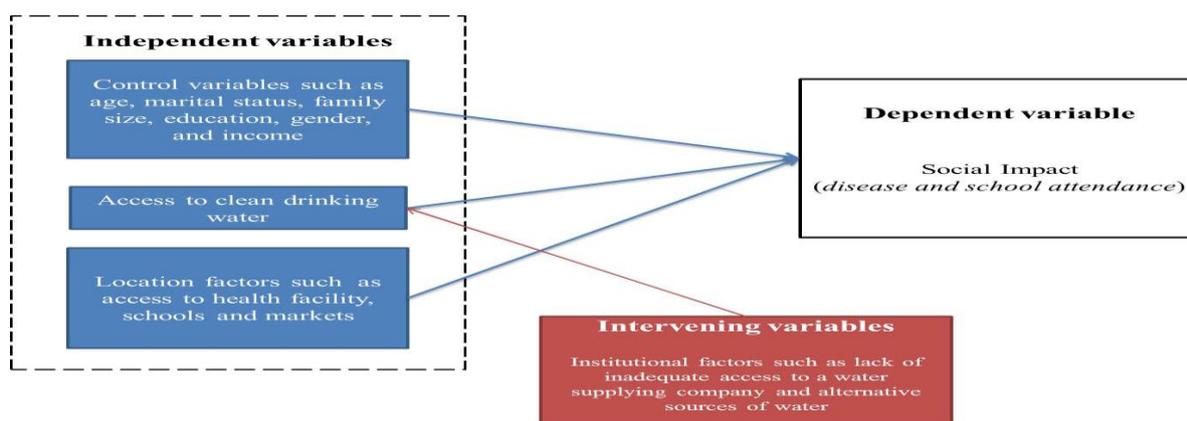
or a coastline bearing an osmotic relationship, yet although water is important to their identity and appeal, it is not prioritized in their design. The relation with the past is a key implication in the landscape design (Shannon, 2009).

HYGIENE AND SANITATION THEORY : The hygiene and sanitation theory advanced by Wasike (2010) emphasizes on cleanliness and with no germs. This also extends to the organizations that permits hygiene to be successful. This theory suggests that it includes interested people and organizations in the community who include political leaders, faith-based organizations and non-governmental organizations. If there should be meaning to hygiene and sanitation, they should be wide casting of the net wide. Despite polluted water being major cause of infectious illnesses, the health is affected through the spread of organic and inorganic chemicals that are dangerous to health and include chlorinated solvent that result in cancer, trihalomethenes that are toxic to liver and kidney, heavy metals such as lead damaging nerve and brain and birth defects and polychlorinated biphenyls causes liver damage, and may also lead to cancer. Additionally, the provision of safe drinking water and the effective removal of bodily waste by suppliers and food handlers are essential for human health and well-being

The United Nations covenant on Economic, Cultural and Social Rights (2002) signed by 140 countries observes has stated that water is a limited natural and a public good, important to life, and healthy; The human Right to water is Indispensable needed to lead a healthy life in human dignity (Coomans, 2011; De Schutter et al., 2012). It is a perquisite to the realization of other rights of people. Owing to increase in deforestation, pollution, climate change, increased population and lack of infrastructure for water processing in Muchinka ward, access to safe and clean water has led to poor sanitation and hygiene. Further, the social-economic status has not been spared. For example, processing industries such as those involved in foods and beverages are unable to operate as they need water to run their business.

VIII. CONCEPTUAL FRAMEWORK

Based on the theoretical underpinning and the existing literature on inadequate access to clean drinking water, a conceptual framework was constructed showing the interrelationship of the dependent and independent variables. By definition, to realize the set objectives of a study. According to Hayes and Preacher (2014) the independent variable also called the explanatory variables explain the variation in the dependent variable or gives an indication of the influence on the dependent variable. In this case of the key independent variable is inadequate access to clean water which we hypothesize has an influence on the increase in the prevalence of water related diseases and decreases schooling school attendance. However, institutional factors and quality of alternative water sources has been noticed to accelerate or delay the delivery of clean drinking water and as such make up the moderating and intervening variables. Figure below shows the Conceptual model showing social effect of inadequate of safe and clean water.



GAPS IN THE LITERATURE : Despite many studies conducted on the effect of inadequate access of clean drinking water on society, the reviewed studies share three common weaknesses. First, the lack of applying empirical models to evaluate the social impact denying development of policy to support measures due to lack of empirical evidence. For instance, most studies (Lowery & Morse, 2013; Nounkeu & Dharod, 2020; Sijbesma & Postma, 2008) followed a qualitative approach and the variables used were not uniform to allow for replication and development of similar policies in similar settings. Second, the nature of the main explanatory variable in previous studies was captured as access to clean water rather than inadequate access which has more

policy implication for improvement of the social aspect of society as advanced by Budiono et al. (2020). Finally, to the best of the knowledge of the researcher, the link between inadequate access to clean drinking water and social aspect impact has hardly been accentuated and recognized in previous studies in Zambia yet it is one of the important issues in the SDGs. Hence, the current study was taken to explore the effects of inadequate access of clean drinking water in Muchinga ward of Mansa District.

IX. RESEARCH METHODOLOGY

Mixed methods using triangulation design for the research strategy was employed to gather and interpret meanings for numerical and non-numerical data which eventually assisted to comprehend social life by studying target populations. Quantitative method via household survey by self-administering a household questionnaire was implemented while qualitative method through key informant structured interviews was done to collect data (Gibson, 2017; Turner et al., 2017). First, for the interviews, purposive sampling was applied to select the ward where the study would take place as this is one of the priority project areas for Luapula Water and Sanitation Company. Second, four (4) communities were randomly selected for the survey study where the self-administered questionnaire data collection was addressed. Finally, using the simple random sampling was used to select 174 residents for the household survey (obtained from the formula of sample size in Equation 1). The household head was specified as the main respondent for the study during the survey. From the population of ward 32,985 according to CSO Census 2010), a sample size, of 174 residents were randomly selected using household lists from community leaders in the ward. The sample size was based on the calculation proposed by Kadam and Bhalerao (2010) guided by the following parameters: (i) N which is the population of the (ii) a confidence interval of 95% (Z-score 1.96) and, (iii) a precision / MOE of 6% and (iv) a proportion of the sample that has inadequate access to water which is widely pegged at 62% among the stakeholders. The self-administered questionnaire was developed in a manner that each section addressed the set specific objectives and included a section of demographic characteristics. Majority of the questions were closed ended and not intellectually demanding to prompt participation from the respondents. For each section the questions were succinct and carefully set to make sure the suitable words were used. As the respondents rate all their alternative source of water using a five-point scale (5 for very good, 4 for good, 3 for fair, 2 for poor, and 1 for very poor). Key informants interviews (KIIs) with Government officials, Civil Society Organizations and community and Luapula Water and Sanitation Company was conducted to gain more insights into the effect of inadequate water access (Nounkeu & Dharod, 2020).

X. FINDINGS AND ANALYSIS

SOCIOECONOMIC CHARACTERISTICS : Majority of participating households were discovered as headed by females as representing 51% female and 49% are male headed. One contributing factor this is the high divorce rate, sexual and gender-based violence (SGBV) and polygamy. This is consistent with the find of CSO (2010). Intuitively this explains why shallow wells are preferred because according to (Mwalupaso et al., 2019) women tend to make use of available and convenient water sources to accommodate time for house chores. With regards to age, most (53%) household heads are in the 31-45 age group consistent with the population in the district (Mansa) and the country (Zambia).

Cross tabulation of proximity to health facility and connection to LPWSSC

Connected to LPWSSC	Household near health facility		Total	Percent
	Yes	No		
Yes	4	20	24	15
No	26	110	136	85
Total	30	130	160	100

Alternative sources of drinking water are not satisfactory except for LpWSSC: The study established that majority (66%) of residents use shallow wells as their main source of drinking water while 15% and 13% use deep wells with cover and the river respectively. Even though water from shallow wells is boiled, filtered, put in the sun or chlorine is added to make it safe for drinking, there are a lot of reservation on whether it is safe for drinking (Arnold & Colford, 2007; Sobsey et al., 2008). This is because in most rural setups the level of contamination has hardly benefited from empirical evidence, thus, the policy support measures are far from

adequate (Wu et al., 2018). Interestingly, only 7% use treated water - 6% from piped water and 1% from water vendors. Impliedly, 93% are not certain of having clean water but the important scholarly question is, from the perspective of the residents are they satisfied with their main water source for drinking?

ONE SAMPLE T-TEST RESULTS ON ALTERNATIVE DRINKING WATER SOURCE : The t-statistic of 9.042 indicated that piped water source was significantly more than satisfactory for drinking. Having examined all the alternative sources of drinking water, we fail to reject the H1. Therefore, apart from piped water all the alternative source of water was found less than satisfactorily.

Drinking water source	T-statistic	p-value	Mean (Test Value = 3)
River	-5.903***	0.000	1.34
Water vendor	-0.831 NS	0.407	2.92
Shallow well	-4.308***	0.000	1.88
Deep well with cover	-3.579***	0.000	2.05
Piped water	9.042***	0.000	3.87

Notes: *** represents significance level of 1% while NS represents not significant.

It is clear from the previous section that there is inadequate access to clean water as 93% of the residents have little access to treated and certified clean drinking water. So, one of the important policy question the study tried to address was; is there any social impact of inadequate access to clean drinking water in Muchinka Ward? To do so, a robust control function (CF) approach as described in Tadesse and Bahigwa (2015) and Wooldridge (2015). The treatment variable, inadequate water access, is captured via a dummy where 1 represents access to clean water (use piped water or water vendor) and 0, otherwise (shallow well, deep well with cover and river).

PROBIT REGRESSION ESTIMATION (STAGE 1 OF CF)

Explanatory variables	Marginal Effect	S.E
<i>Socioeconomic characteristics</i>		
Gender	0.260 NS	0.209
Education	0.506*	0.274
Monthly income	0.060**	0.026
Age	-0.075***	0.024
Family Size	-0.215***	0.050
Marital status	0.003 NS	0.027
Occupation	0.434***	0.134
<i>Institutional characteristics</i>		
Proximity to health facility	0.337 NS	0.386
Have school going children	0.214 NS	0.248
<i>Instrumental variables</i>		
Distance to the water source	-0.834**	0.287
Contact with stakeholders on drinking water purification	0.208***	0.007

Notes: *, **, and *** represents significance level of 10%, 5% and 1% while NS represents not significant.

The second stage of the CF is our main model as it is in the evaluation of the social effect of inadequate water access. The social factors captured the variables – water- related sickness of a family member and children missing school because of water related issues. To ensure that the finding is reliable and free from the three sources of endogeneity, we calculated the residuals from the first stage which was used in the second stage together with the treatment variables (Amadu et al., 2020). This is very important because the inadequate access to water is not random but rather households may self-select based on some observable household characteristics.

MEAN SCORES OF FACTORS AFFECTING ACCESS TO CLEAN WATER.

Statements	Mean	SD
Lack of information on the available options	4.85	1.20
Programs and activities without involving residents	4.80	0.15
Unknown organization structure/contact person for water providers	4.63	0.90
Lack of collaboration with Ministry of Local government/ council	4.54	0.35
Lack of formal reporting or system for checks and balances	4.20	1.38
Irregular and inconsistent water sources	4.05	1.41
Other important players are not consulted	3.95	1.40
Poor record keeping of number of houses unconnected to LpWSSC	3.90	1.72
Late connection of new connection by LpWSSC	3.73	1.50
Lack of sustainable sensitization on what constitutes clean water	3.68	1.60
Changes in training schedules on how to make water clean for drinking	3.55	1.03
Lack of knowledge on ensuring water is clean for drinking	3.05	1.35
Wrong/erroneous registration of new connection by LPWSSC	3.0	1.09

The means scores are from 4.83 to 3.0 and all the captured elements are considered critical factor in the access of clean water. The highest is lack of information on the available options (mean = 4.85) which, basically means that residents believe this is among the vital factors affecting access to clean water. To a large extent, the existence of one single branch in town and only one health facility in the area has greatly contributed to the lack of essential knowledge on clean water. Information acquisition ought to be systematic and strategic to override the existing beliefs, norms and culture especially in rural areas of developing nations (Gray, 2008).

FINDINGS FROM QUALITATIVE DATA SOURCES

One resident lamented that: “Most people say shallow wells are very fine to draw drinking water from but they are very contaminated to a point that we as a family get sick and this makes me to miss going to the market for business and also the children miss school. I wish there was a way of having piped water but the procedure seems complex and we do not have the financial resources to sustain the payment. Otherwise, I am very dissatisfied with the shallow wells and any other alternative apart from piped water” To amplify on the social impacts, one of the stakeholders during the KIIs (interviews) indicated that, *“Inadequate access to clean water makes family access poor quality water for drinking and has cost implications. Given that there is only one health facility and some households stay far from that health facility, they spend more money to purchase the needed medicines and also other chemicals for water purification. In some instances, they wrongly apply the chemicals and still get sick and this affects their day to day businesses and well as school attendance.”*

IX. CONCLUSION

Given the finding of the study, fostering adequate access to clean water cannot be overemphasized as its social impact is detrimental to national development. Particularly, extensive inequalities in coverage of improved water sources propelled by institutional factors are discernible from the results of this study. Researchers and policy makers alike should take note that a common method will not be favorable for all communities in Mansa rather interventions should be made to meet the specific needs of each ward. On the whole, institutional factors mediated or attenuated the magnitude of access to improved water sources. In addition, other factors are also behind the inadequate access to clean water, suggesting that this subject in Mansa is huge and multifaceted and must be addressed in whole while at the same time taking into consideration interdisciplinary research and policy interventions that covers business management, culture, project planning and management, economics and human behavior.

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