Economic Analysis of Household Water Consumption in Yola North Lga. Adamawa State – Nigeria

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Abstract: **This study analysed Household Water Consumption in Bekaji, Yola North LGA of Adamawa State Nigeria from January 2021 to November 2021.The study employed the primary method of data collection where 700 structured questionnaires were administered and 224 were retrieved and analysed. The specific objectives of the study were to examine the source of water in Bekaji and also to evaluate the determinants of water demand in Bekaji. Furthermore, the study found that majority of households in the study area depends on Small Scale Private water vendors for domestic use and inability of public water system to supply adequate water. The study also, found determinants like household size, education, and income of household head to be positively significant in household water consumption. The study recommended full privatization of the water sector in Adamawa State and increase in budgetary allocation for public water agencies.**

I. INTRODUCTION

Water is very essential to life. Up to 60% of human body is water and about 70 per cent of the earth's surface is water but only 0.5 per cent of the water is readily available for human use. Water is a finite natural resource that is very vital not only for the survival of human beings but for agricultural and industrial practices. It is also said that many humans have survived without love but none ever survived without water. Water is life (Beth e tal.,2016).

Access to safe (portable) drinking water is not only a fundamental human right, it also helps a lot in economic growth, poverty reduction and sustainable development (Sheka et al., 2020).Access to clean water reflects the health status of a country (Helen etal.,2018). Access to safe water supply is also a serious issue (Galadima etal., 2011)Inadequate quantity of water supply has serious impact on water resource management and environmental sustainability (Okoye, 2015). Despite the fact that Nigeria has two major rivers crossing its breadth, length and the branches of other tributaries spread all over the country, there is, still a problem of limited quantity and quality of water supply

The demand for clean water is fast increasing at a rate greater than the world's population growth. According to Godwin (2020) as population and urbanization increase, the challenges faced by public authorities in developing economies also increase in scope. One of the leading challenges is their inability to provide this basic need of life-water. The provision of basic utilities such as electricity supply, good roads and well planned urban networks hinder the provision of portable water to household. Another hindrance is lack of political will from the part of government of most developing countries. Adewusi (2015) asserts that the most serious unresolved water problem is the continued failure to meet basic human needs for water and agreed that strong political will and increase in financial commitment by public authorities can improve safe water supply to households in Nigeria.

Water supply network and extension for the coverage of the growing population require huge capital investment. But funding of such investment poses a major problem in developing countries. According to Sheka et al.,(2020) the most common solution proposed is a market-based reform, which includes operating the system on a full-cost-recovery principle, commercialization, or private sector participation (PSP) at various levels PSP in the water industry is one of the alternatives for providing quality and sufficient water and can improve efficiency, extend the coverage of service, bring in more investment, and relieve government from budget deficits.. Given that water is a basic necessity, affordability of service becomes a major issue (United Nation Research Institute for Social Development UNRISD, 2007)

Small-Scale Private water provision plays an important role in water supply, it bridges the gap in water supply from public authorities. According to Wutich *et al*.,(2016) it helps in advancing the human right to water and services a significant number of households (Van Dijk, 2008;Nnaji *et a*l.,2013).it also sustain livelihoods of many young people (Kjellen, 2000).

Over the years, problems from drought, flood, urban water shortages and continuous water contamination the world over, attracted the attention of relevant stakeholders of the need for efficient and effective planning of water resources in Nigeria and other emerging economies (Bello and Tuna, 2014). The need was informed by the fact that only about 61% of citizens have access to safe water in Nigeria. Nigeria fell behind schedule in achieving its Millennium Development Goals (MDGs) of 80 per cent and, below the 66 per cent

average for the Sub-Saharan region. None of Nigeria's water facilities is able to provide uninterrupted water services to its customers and many more are amongst the worst performing on the continent (Joint Monitoring Program JMP, 2013).

This problem is pronounced in the rural areas of Nigeria where a large number of women and children spend productive hours each day working kilometres to collect water from unprotected or unhygienic sources such as open wells, muddy dugouts and streams. In Nigeria, a large population in urban areas still do not have access to good quality water in adequate quantity (Godwin, 2020).

Galadima et al., (2011) reported that demand for fresh water is fast increasing at a rate greater than the world' population growth, access to safe water supply is a serious issue across the globe.

In view of the above, Deborah (2015) asserts that despite the initiative of government in Nigeria and the intervention of international donor groups aiding in the provision of quality water in the country, water shortage and misuse is wide. According to WHO (2010).an estimated 100 million Nigerians still lack basic sanitation and about 63 million do not have access to improved source of water. Against this backdrop, this study examined household water consumption in Bekaji ward, Yola Metropolis- Adamawa State

Statement of the Problem

The need to achieve adequate provision of portable water supply has been recognized by government and development agencies all over the world. This is attributed to its importance to so many aspects of human life in regards to health, dignity, economic growth and development. This also, led to the inclusion of a specific water-related target in the Millennium Development Goals (MDGs) and the sustainable Development goals (SDGs).

In spite of its abundance, it is estimated that about nine hundred (900) million people world-wide do not have access to improved/qualitative drinking water supply. Furthermore, about 330 million of these 900 million people reside in sub-Saharan Africa (World Health Organisation/United Nation Children's Fund WHO/UNICEF, 2010). Further investigation revealed that 1.8 million people die every year as a result of diseases caused by unclean water and poor sanitation (WHO, 2005) cited in (Global Development Network, 2013).

Despite the efforts of government and relevant donor agencies in addressing this pressing need of the people all over the world, there is still much to be desired. What is actually obtained in most developing countries is persistent water supply and sanitation crisis.

According, the World Health Organization WHO (2000), lack of funds, poverty, level of education, poor government policy, gender inequality, poor implementation strategies and natural disaster contributes to the problem hindering the provision of portable (safe) water supply and sanitation in both rural and urban areas in developing countries including Nigeria. The United Nations Children's Fund(UNICEF) in 2020 ranked Nigeria 3rd behind China and India as countries with the largest population without adequate water supply and sanitation.

The water system in Yola North Local Government Area is public sector oriented; controlled and managed by Adamawa State water board. To this end, out dated equipment is still in use for water supply. Furthermore, the existing infrastructural facilities used for water supply are not maintained regularly and there is erratic power supply to run the machinery for better supply. Consequently, Adamawa State current water supply by public utilities is grossly inadequate as most of the population still face serious water crisis. Adamawa State water board as at December, 2019 has seven water pumps (132kw) and supplies 1500 cubic metric water per hour to households in Jimeta. To cover this deficit in water provision by public authority in the state, alternative suppliers exist such as non-state water providers (NSPs) which are both formal and informal known as *pure water* producers and small scale water vendors also known as Mairuwa respectively. Historically, water vending is an old practice in Yola metropolis. Despite widespread recognition of the importance of small-scale private water vending, the phenomenon has a long history and it's still been studied both theoretically and empirically in the academic literature. Perhaps due to the hidden, unfixed, and unregulated nature of the informal economy (Bakker, 2007).

Finally, the WHO (2020) revealed that 3.4 million people die every year as a result of water borne disease globally. Also, UNICEF (2020) revealed that more than 100,000 children under five years of age die annually due to water-borne diseases in Nigeria. These water diseases include; Thyphoid, Cholera, Giardia, Dysentery, Escheria Coli and Hepatitis A.

It is against this backdrop that this research analysed household water consumption in Yola metropolis with a view to making recommendations that can help improve the current water situation in Adamawa State and Nigeria at large.

Objectives of the Study

This study is aimed at analysing household water consumption in Bekaji,, metropolis, Adamawa State-Nigeria.

The specific objectives of the study includes to:

(i) Examine the source of water for domestic use among households in the study area;
(ii) Evaluate the determinants of household water demand in the study area.

Research Questions

(i) What is the source of water supply for households in Bekaji, Yola North LGA, Adamawa State?

(ii) What are the determinants of household water demand in the study area?

II. NIGERIA POLICIES ON WATER

NAMEOF STATUES	KEY PROVISION
The water works Act of 1915	Colonial Nigeria (shortly after Amalgamation in 1914) passed the law specifically to keep water from being polluted. It prohibits the pollution of water in Nigeria by obnoxious or harmful matters.
The minerals Act of 1917	The laws vested the Head of States of Nigeria with power to make regulations for prevention of pollution of anywater course.
The public Health Act of 1917	It prohibits the functioning of water and vitiation of the atmosphere.
The oil in navigable water Act 1968	It prohibits water pollution by oil spillage.
The petroleum Act of	It covers prevention of pollution by inland waters, rivers, lakes and water course
The land use Act of 1978	Ownership of land linked to ownership of groundwater resources.
The Rivers Basin Development(RBDA) decree 25 of 1976(Revealed by No. 87 of 1979 andalso latter by the RBDA Act, decree 35 of 1987, i.e. Cap 396	In its presence from Cap 396 spells out diverse functions and objectives for these authorities to ensure a Pan- Nigerian program for water resources development.
The Environmental impact Assessment (EIA) Decree, No 86 of1992	The law seeks to protect the physical and aquaticenvironment.
Water Resource Decree, No 101 of1993	It vested the right to use control all surface waters and groundwater and of all water in any water course affecting more that one state in the Federal Government, with provisions that any person may take water without charge his domestic or livestock watering purposes (in any water course to which the public has free access).
The 1999 constitution of the FederalRepublic of Nigeria	The constitution puts in the Exclusive Legislative list (ELL) shipping and navigation on the river Niger and on any such other inland water way as many be designated by the National Assembly to be sources affecting more than one state.
National Guidelines and standard forEnvironment Nigeria (1991)	Pollution control in water course
National Effluent Regulation 1991 National Water policy Act 2020	Control of discharge of industrial waste and sewage into ater courses. Control of water by states and the Federal Government and revenue accruing from water way

Source: Mohammed (2016), FGN(2020)

III. THEORETICAL LITERATURE REVIEW

The water industry does not easily fit into conventional economic theory of competitive markets because there are significant externalities such as social costs and benefits attached to the industry. And also, because of the strategic importance of water.. The scarcity, combined with the many competing uses for water, creates complex choice over how water resources should be allocated. There are several theories applicable to water. However, This study is anchored on the game theory though other theories will be briefly discussed below.

Game Theory and Water market

Game theory known to economists, social scientists, and biologists, was given its first general mathematical formulation by John von Neuman and Oskar Morgenstern (1944). The game theory is the study of the ways in which interacting choices of economic agents produce out comes with respect to the preferences of those agents. According to Kaveh Madanii (2009) ,the conflicts over water issues are not limited to sharing of costs or benefits; a problem that have had many water scholars focused on. Conflicts also arise from social and political aspects of the design, operation and management of water projects. When analysing, operating or designing a complex water project, a decision maker must ensure that the undertaking is not only physically, environmentally, financially and economically feasible, but also socially and politically feasible. This is challenging for engineers who conventionally measure performance in economic, financial, and physical terms. Optimization techniques, such as linear or dynamic programming, can find the optimal values of the decision variables in such terms. However, if not formulated correctly, they might fail to provide insights into the strategic behaviours of the local, regional, and policy decision makers to reach an optimal outcome and the attainability of such outcome from the status quo. Game theory provides a framework for studying the strategic actions of individual decision makers to develop more broadly acceptable solutions. However, game theory is not yet well integrated into general systems analysis for water resources. Thus, game theory's value might remain unclear to the water resources community due to lack of understanding its basic concepts. As with other disciplines (e.g. economics, political science, social science, computer intelligence, etc.) water scholars will become more interested in game theory as they come to realize its novel and usefulness

The natural monopoly of water market

Prasad (2007) is of the view that water market is not competitive because of the presence of economies of scale.. To enter such an industry according to him requires enormous initial investment like lying down distribution networks such as water pipelines but the marginal cost of connecting an additional customer to the network is very low. There are high capital cost and low marginal cost in setting up a national water network..Eph and Grald (2011) also assert that the water industry is typically a network industry, regulating natural monopolies which involves irreversible environmental and public health risk changes the usual regulating schemes

in such a way that risk coverage and insurance premiums must be incorporated in the analysis.

Empirical Literature Review

Whittington *et al.* (1989), in a study of water vending in Onitsha, Nigeria, observed that most

households obtain their water supplies from well-organized water vending system that is operated by the private sector. In this city, on annual basis, households pay water vendors over twice the cost of piped water. A similar study carried out in Kaduna and Katsina, Nigeria shows that vendors charge as much as 20 times the unit rate of the respective State Water Agencies. In general, the poorest families pay more per month than some of the richest who can afford a connection to their compound or house. The amount, for a very limited volume of supply from private water vendors, can be four to ten times that of one month's continuous tap supply from the utility (Whittington *et al.*, 1989).

Akpan (2005) observed that most households in Apapa/Iganmu, Alimosho, Shomolu and Ajeromi/Ifelodun areas in Lagos depend on vended water. Specifically, in Ajeromi/Ifelodun with a population of over one million, 83 per cent of the households rely on vended water. Since it is becoming obvious that it is unlikely that water agencies will succeed in providing adequate and safe water to households; Ishaku (2010) therefore, calls for independent surveillance to ensure the safety of vended water

Ezenwanji *et al.* (2016) replicated a similar research in Enugu Metropolitan where they investigated the residential water demand and supply. The study which aimed at investigating into the water demand and supply situations in Enugu metropolitan area, Nigeria used a survey approach to collect data from 2,000 randomly selected households in the identified 41 residential wards of the urban areas within six months between April and September, 2014 by the use of questionnaire designed for the purpose.

Helen etal.,(2018) also carried out a study titled Forecasting water demand and supply in Bekaji –Adamawa State .The iteration method of R –Studio package was used under ARIMA (1,0,1) model to analyse the present and future water demand in Bekaji..According to the findings of the study, water demand in Bekaji increase with an increase in population.

Finally, Sheka et al (2020) carried out a study on the Assessment of water vending and willingness to pay for improved private water in Kano Metropolis, Kano State. The study used primary data where 731 questionnaires from households were analysed using multi-stage sanpling technique. The study found that most households (90%) in the study area relied on informal sector for water supply.

Description of the Study Area

Jimeta- Yola is situated along the bank of river Benue and is located between Latitude 9^0 and Longitude 128^0E. Bekaji is under Karewa ward in Yola north LGA, Adamawa State. Karewa ward is among the eleven wards in Yola North LGA. Bekaji is one of the oldest estate in Adamawa State built in 1991 by the Barde Administration. The majority of households in Bekaji are civil servants while many more are small business owners. Bekaji has 12 streets namely: Benin Crescent, Ghana Crescent, Niger Street, Senegal street, Mali Crescent, Tanzania Crescent, Gambia Crescent, Siera Leone Crescent, Equatorial GunIea Crescent, and Estate Circle

Source and Method of Data Collection

The data for this study was both primary and secondary data. The primary method for primary data collection was both quantitative and qualitative. The instrument for the quantitative data collection was structured questionnaires. Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) was also adopted to get more data

The secondary data was obtained from related books, journals, published and unpublished research thesis, conference papers and information from government ministries and agencies. The ministries and agencies concern is state ministry of environment and Adamawa State water board.

The sample size of the research was obtained using the recommended formula by Dillman (2007 & 2011) which is the advancement of Krejcie and Morgan (1970) as cited by Godwin(2020) is stated below as:

$$\text{Ns} = \frac{(\text{Np})(p)(1-p)}{(\text{Np}-1)(\text{B}/\text{C})2+(\text{p})(1-\rho)}$$

Where:

NS = Computed Sample size needed for the desired level of precision;

Np = Size of the population of the study;

p = proportion of population expected to be sampled;

B = acceptable amount of sampling error (in this case assume +/-5 =0.05);

C = z-statistic associated with the confidence level (in this case assume a 95% confidence level =1.96).

The above formula was used to calculate the sample size and a total of 224 was arrived at and weather from the population of the study area.

Sampling Techniques

A total number of 700 questionnaires were randomly administered to households and water vendors while 224 questionnaires were retrieved and data analysed using stratified sampling method where education level, household income and household size respectively ,were used as strata.

Model Specification

This study adopts the model for water consumption by Sheka et al.,(2020) with little modification. The linear regression model according to him is given as as:$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + u$. while the modified model for this study is given below as

$\beta_0 + \beta_1 X_{edi} + \beta_2 X_{2age} + \beta_3 X_{ini} + \beta_3 X_{p+} \beta_3 X_{ds+} \beta_3 X_{hs+} \beta_3 X_3 u$……..(1)

The above modified model (1) considered distance and wheather (seasonal variation) as determinants of water demand which was not captured in Sheka et al.,(2020) .Therefore, the above model can be interpreted as

Dw = f (P, Y, Hs, Ag, Sx, HHs, Dis,w)

Where;

Dw = demand for water

P= price of water

Hs= household size

Ag= Age of the household member

Sx= Sex

DS= Distance

Wh= wheather

Ed=Education*Apriori Expectation*

Given the nature of the model above and the variables chosen, it is expected that;

HHs (household size); demand for water is expected to increase with an increase in the household size; therefore, a positive sign is expected.

I (monthly income); monthly income of household; Households with higher income have greater ability to pay and have more water consumption. As a result, a positive sign is expected. ED (level of education). Generally, the higher the educational level of the head of a family, the higher the awareness about the benefits that could be gained from portable water. And hence educated household heads have preference for higher clean water consumption. So a positive sign is expected.

OH: (House Ownership); ownership of a house, the estimation of household wealth is difficult. However, ownership of a house is used as a proxy to the wealth of a household. The rationale for wealth is similar to that of income. A positive sign is expected.

AG: Age of household members; it is assumed that as people gets older, their per capital daily water consumption declines, so a negative sign is expected.

Dis: Distance from water source; It is known that as the distance from the water source increases, the water consumption of a household declines. So a negative sign is expected.

Wh: Weather which is also seen as seasonal variation meaning dry season and raining season is also a determinant of water demand because household consume more water during hot weather and consume less water during raining seasons because they collect and store rain water.

IV. RESULTS OF DESCRIPTIVE STATISTICS

Table 1 below provides insightful information with respect to socio-economic features of respondents.

Table 1: Descriptive Statistics on the Socio-Economic Characteristics of the Respondents.

Variable |	Obs	Mean	Std. Dev.	Min	Max
Avqwcd |	381	180.3694	139.2067	75	1875
Age |	381	43.08482	12.76665	22	75
aveincome |	381	72426.81	47558.63	15000	350000
aveexp |	381	59785.91	36095.19	15000	250000
HHsize |	381	6.760602	4.381328	3	20
expwc |	381	300.2202	8,230.18	100	7250s
edu	381	2.351573	2.260923	0	4
pmipw |	381	5.895759	2.522304	0	25

Source: Field Survey December, 2021 and Computed by the Researcher Using Stata 14

Note: **avqwcd**= Average Quantity of water Consumed per day expressed in litres, **aveincome** = Average Monthly Income of Households, **aveexp**= Average Monthly Expenditure of Household, **HHsize**= Size of Household, **expwc**= Household Expenditure on Water, **pmipw**= Percentage of Household Monthly Income Spent on Water Consumption.

Table 1 above gives a summary of basic features which established that an average household size from the field survey was estimated to be about seven (7) persons which is almost twice the national average household size of 4.5 with the smallest household having a population of three (3), while the largest having the population of twenty (15). The average water demand or consumption per household, otherwise known as household per capita water consumption was established to be 180.37 litres. It was also established that each household spends an average of three hundred naira (₦300.22k) only daily on water expenditure. That is to say, households within the study spent an average of eight thousand, two hundred and thirty naira (₦8, 230) including sachet water purchased. Additionally, it was estimated that households spent about six per cent (6%) of income on water which is twice greater than the United Nations UN, and WHO recommendation of 3%

Table 2: Summary Statistics for all the variables used in the OLS Model

Variable	Observation	Mean	Std. Dev.	Min	Max
Average Quantity of Water Consumed by HH	381	180.3694	139.2067	0	1,500
Size of Household	381	6.760602	4.381328	3	20
Present of Infant in an Household	381	.8686731	.3379888	0	1
Occupation of Head of Household	381	3.095759	1.4041	0	5
Educational Level of Household	381	2.351573	1.260923	0	4
Percentage of Household's Income Spent on Water	381	5.895759	2.52230	0	25
Quality of water supply by Vendors Utility	381	2.508222	1.321106	0	4
Average Income of Household	381	62426.81	47558.63	15000	250000
Quality of Water Supplied by Public Utility	381 .	1.402189	1.282323	0	5

Source: Field Survey December, 2021 and Estimated by the Researcher Using STATA 14.

Table 3: The OLS Regression Result

Model	OLS Model A	OLS ModelB
HHsize	.07**	0.11***
	(0.002)	(0.002)
prfant	0.09	0.000
	(0.027)	(0.028)
occup	-0.09*	-0.015*
	(0.007)	(0.007)
edul	0.14	0.07
	(0.008)	(0.008)
pmipw	0.014***	0.015***
	(0.004)	(0.004)
prfamt	0.020***	0.000***
	(0.000)	(0.000)
qwspu	-0.024***	
	(0.001)	
aveincome	0.047*	
	0	
Constant	0.842***	0.800***
	(0.040)	(0.040)
sigma		
Constant	0.232***	0.236***
	(0.006)	(0.006)
R-squared	74.04639	82.72967
N	731	731

Source: Computed by the Researcher Using STATA 14, December, 2021

Note: HHsize= Size of household sampled, prfant=presence of infant, Occup=occupation of head of household, pmipw=percentage of income spent on water consumption per month, avqwcd=average quantity of water consumed per day, qwspu=availability and quality of water supplied by public utility, and aveincome=average income earned by head of household per month.

The descriptive statistics results presented on table 2 accounts for the data collected across the sampled households on factors or determinants of water demand in which the average daily quantity of water has been used as proxy such as household size, occupation of head of households, present of infant, educational qualification of head of household, percentage of household income spent on domestic water consumption, average daily expenditure on water, quality of public water supply and average monthly income of household per month. The consideration of these factors was informed by both by the available empirical literatures and perceived water demand situation within the study area.

A total of eight (8) explanatory variables were estimated using the OLS regression analysis, out of which six variables- household size, percentage of households' income spent on water, average monthly expenditure of household on water consumption, average monthly income of head of household and quality of public water supplied- were found to have significantly influenced households demand for water within the study area. While as two (2) of the variables- presence of infants below the age of twelve (12), educational level of head of household- were found to be statistically insignificant as contained in table 3 above.

Household or Family size as conceptualized for this study refers to the total number of people in a particular house and members depend on income of the head of household for consumption expenditure. This variable was found to be significant ($p<0.01$) but is positively related to the dependent variable. This is in line with the *a priori* expectation stated in the empirical. This suggests that the demand private sector water supply increase with about 7% as household's size increases by one person.

Furthermore, the percentage of household's income spent on water consumption was also found to be statistically significant ($p<0.001$) and with a positive effect which confirms the *a priori* expectation of the mode , average monthly income of household was positively correlated and statistically significant ($p <0.05$) which conforms to the theoretical expectation of the model. By implication, if household income increased by 1 per cent, household demand for water will increase by about 4.7%. . The Wald test was used to test for normal errors and correct specification of the functional form of the heteroskedasticity The Wald test result as presented shows that there was no evidence of heteroskedasticity and the error terms are normally distributed for all the explanatory variables at p-value<0.001. This is an indication that the OLS is robust; in other words, it is

consistent, efficient and asymptotically normal estimator of the Mode

V. SUMMARY AND RECOMMENDATION

This study investigated household water consumption in Bekaji of Yola North L.G.A, Adamawa State. The importance of increasing access to clean water and safe sanitation is emphasised in the need for economic growth which will lead to poverty reduction in Nigeria.

The findings from the data analysed revealed that the determinants of water demand were positively significant to the quantity and quality of water consumed by households in the study area. These determinants are; Education, Age, Income of household head and distance to source of water. Further findings reveal that, water consumption increased with high weather temperatures

The study also found that most households in Bekaji are willing to pay for improved water supply from Adamawa State Water Corporation Agency. The water supply to households in Bekaji by Adamawa State water board is inadequate hence, the heavy patronage of informal small – scale water vendors by households. Furthermore, findings from personal interview and key informants showed that water prices per truck and jerry cans increase during hot weather periods

Finally, the study agrees with the findings of Helen et.al, (2018) which studied water demand and supply in Bekaji and found that water demand in Bekaji increase with an increase in population. And many households in Bekaji are house owners.

This study further recommends the following:

(1) Public water authorities in Adamawa State should employ more technical assistants in order to increase capacity in quality water supply and also an increase in budgetary allocation for water resources should be considered.
(2) Full privatization programme should be introduced into the water sector in Adamawa State in order to maximize efficiency.
(3) Government of Nigeria should increase its political will and also, increase funding of the water industry to meet the Sustainable Development goal (SDG) of access to improved water and poverty reduction. Finally, the public should be enlightened on how to protect water facilities and increase willingness to pay for clean water

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