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SPATIAL PATTERN OF HOUSEHOLD WATER MANAGEMENT PRACTICES IN BAYELSA STATE, NIGERIA

***OJILE, M.O. AND OKOKO, J.E.**
[1]Department of Environmental Management, Faculty of Environmental Sciences, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria
*Corresponding author: mesh.ojile@ndu.edu.ng

Abstract
Point-of-use household water treatment (HWT) has been advocated to substantially decrease the global burden of waterborne diseases and to contribute to the Sustainable Development Goals. To determine to what extent HWT has been undertaken in communities in Bayelsa State, Nigeria, we investigated the spatial pattern of household water management practices in parts of the Southern Ijaw Local Government Area. The study objectives included confirming sources of water supply, the determinants of different approaches and the underlying factors of water management practices adopted by households. Some 352 households selected randomly from three communities in a proportionate ratio were administered the structured questionnaire. Personal interviews, field observations and secondary data complemented data collection exercise. The study results revealed 84.4% of households were still reliant on surface water as principal source of domestic water supply and households with average family size of 5-7 members consume between 200 to 250 litres of water per day. Water is stored mostly in drums and jerry-cans and 42% of the households do not apply any treatment method while some 25.6% and >27% use alum and sedimentation respectively for water treatment before use. Significant variation exists amongst households with respect to water management practices and the relationship between income level and household water management practices was also found significant. Government's intervention in water provision for households to reduce and prevent incidences of water-related diseases is recommended while households must be enlightened and encouraged to adopt proper domestic water storage systems and treatment for healthy living.

Key Words*: Point of use water treatment, SDGs, Household water management practices, Water supply, Bayelsa State*

Introduction

Water is considered one of the earth's most vital and exploited natural resources and is central in every aspect of life. It is of critical importance to all forms of socio-economic development. The connections between access to safe and adequate quantity of water and health are therefore, well-established (UNDP, 2012).

Household water management practices (HWMP) are practices which ensure that the available water supply is properly treated and stored to meet the required minimum standard of quality and quantity for household consumption (United Nations World Water Development Report, 2015). These practices are to promote and enhance improvement in the water safety and protection against negative health impacts. An estimated 790 million people (11%) of the world's population are without access to an improved water supply and 2.1 billion lack access to safely manage clean drinking water at home (WHO/UNICEF, 2017; United Nations World Water Development Report (UNWWDR), 2019).

Drinking water is often extracted and treated at different spatial scales (e.g. regional, watershed, and household level), resulting in management by various stakeholders that act at each of these scales e.g. governmental, private, and household sectors (Saravanan, 2008). A clear understanding of water use patterns and the factors that affect water consumption are critical to the effective management of water supply and the effective design of related policies. Water use patterns are highly complex processes that are influenced by many factors including seasonal variability and water availability (Arouna and Debbert, 2010), household characteristics (Shove *et al.*, 2010) and attitudes and intentions regarding water conservation (Corral *et al*., 2003).

A household is considered to have access to basic services required by a family unit in Nigeria if the household has water supply and sanitation facilities which are used appropriately at all times (Federal Ministry of Water Resources (FMWR), 2005). To meet this requirement in the rural areas, various storage patterns, as well as point-of-use treatment, are adopted in many communities using different methodologies ranging from local to chemical applications. The idea focuses on improving the quality of water before it could be used by the household (Dil and Akhter, 2015).

The spatial variation in availability of household water and effects, results in spatial disparities in living standards both within and between regions and localities. The existence of disparities in living standards makes the analysis of the patterns of rural development imperative in order to identify areas of deprivation (Madu, 2007). This variation in household water management practice (HWMP) is influenced by a variety of factors, including knowledge of water treatment practices prior to distribution, perceptions of water quality at the tap and socio-demographic characteristics of the decision-makers (Fielding *et al*., 2012; Sabau and Haghiri, 2008).

Report on the World Water Day 2018 in Bayelsa State stated that the level of sustainable household water management practices in the State is poor. This was attributed to the perception and behaviour change in household water management practices (Partnership Initiative in the Niger Delta (PIND), 2018). Ensuring safe, accessible and proper household water management in rural areas is fundamental for rural development all over the world. In view of the literature and personal observations across Bayelsa State and some part of it on household water management practices amidst abundant of surface and groundwater resources, it

became imperative to investigate the spatial pattern of household water management practices in parts of Southern Ijaw Local Government Area of Bayelsa State to determine to what extent household water treatment and other management practices are undertaken. The importance of the population having access to improved water supply facilities has been identified as a veritable means of improving the human development index (Ojile, 2020).

Although Nigeria has made appreciable progress in improving households' access to safe drinking water supply, many communities and households are still without adequate safe household water supply. 3 in 10 people still lack access to safe, readily available household water (FMWR/NBS/UNICEF, 2020). Households that source water from many unhygienic sources are also without knowledge of proper household water management practices, particularly in many rural communities, and this is of serious concern. This can cause an outbreak of waterborne diseases which will further threaten the livelihood of the citizens. Fifty-nine million Nigerians or 33 percent of the population are reported to have no access to clean water (WaterAid UK/Development Initiative, 2019; World Bank, 2018), and the statistics further showed that out of this population, 51 percent resided in the rural areas.

Communities within the Bomo Clan in the Southern Ijaw Local Government Area (LGA) of Bayelsa State, Nigeria, situate in rural settings. Household water management practices are particularly problematic in such rural communities where government facilities are unavailable and may not have access to appropriate technologies to treat water locally (Hunter *et al*., 2010; Trevett *et al*., 2002). The area has witnessed some population increase in recent years but access to household water management practices have been observed to be problematic and thus need attention.

Some previous studies by researchers have examined the importance of some environmental and economic factors individually and some other studies considered the multiple drivers that can affect household water management practices (Wrisdale *et al*., 2017; Akoteyon, 2019). Doing so is important, because it identifies which factors are the most influential for household decision-making in water management practices. This knowledge can then be used to identify and target interventions that are in line with current household perceptions, which have been shown to result in a greater rate of intervention uptake and success (Jehu-Appiah *et al*., 2012).

Our study focused on the spatial pattern of household water management practices which involves investigation of household water supply sources, storage, and consumption patterns. It also investigated the impact of the management practices and the health implications from the water used, the storage types and methods of treatment adopted by the households as well as effectiveness of the water systems as regard safe availability and affordability in the area. The factors most strongly influential in the spatial pattern of household water management practices in the study area was also assessed. The study was carried out to ascertain if the household water management practices are compromised by ignorance, low level of awareness, absence of public policies or

whether there is any variation within the communities in the area.

The remaining parts of the article is structured into the following sections: the materials and methods utilized for data collection and analysis, results and discussions and then conclusions and recommendations.

Materials and Methods

The Study Area

The study was conducted in Bomo Clan in Southern Ijaw Local Government Area of Bayelsa State. Bomo Clan is one of the eight clans in Southern Ijaw Local Government Area of Bayelsa State. Southern Ijaw has homogeneous characteristics and boundaries with all other local government areas of the state. The area is located in the core Niger Delta Region of Nigeria and lies at latitude 4°48'17N to 4°07'42N and longitude 6°04'44E to 5°09'16E (Fig. 1). The area is bounded by Twon in Brass local government area to the South, Olugbobiri to the West, Onyuma to the North and Okodi community in Ogbia local government area, and Nembe local government area to the East. The communities are linearly located along the River Nun and Silver River. The study sampled communities have a total population of 23,070 as at 1991 census (National Population Commission, 1991) with the projected Figure of 43,346 at 2.9% annual growth rate as at 2017 which was used for this study.

Data Collection and Analysis

The study adopted the descriptive cross-sectional survey design which involves the administration of a set of questionnaires to households in the study area. Structured copies of the questionnaire for household data were administered to households in three purposively-selected communities of Ekowe, Peremabiri and Eniwari in Bomo Clan. Some 398 copies of the survey instrument were administered, out of which 352 copies (88.4%) were retrieved for analysis.

To complement the questionnaire data collection technique, oral interviews were conducted with selected heads of households across the study communities. Wherever household head was not available, a representative of the household was interviewed about the household water management practice.

Two hypotheses were postulated for the research work; namely, that, there was no significant difference in the spatial pattern of household and water management practices and no significant relationship between economic status of households and water management practices. The Analysis of variance (ANOVA) statistic was used to test the variation in household water management practices amongst the communities while Pearson's Product Moment Correlation Coefficient (PPMC) method was used to test the relationship between economic status and household water management practices using the income level as the independent variable for hypothesis two.

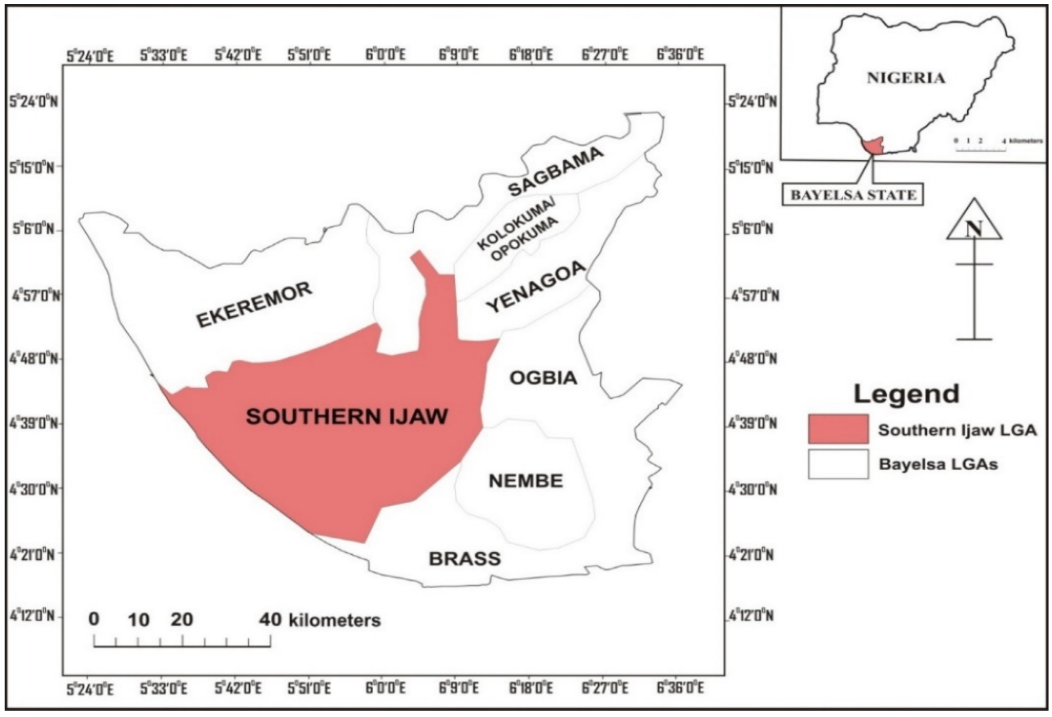

Fig. 1: Administrative Map of Bayelsa State showing Southern Ijaw LGA
Source: Extracted from the office of the Surveyor General, Bayelsa State

Results and Discussion

Socio-demographic Characteristics of Respondents

The socio-demographic characteristics of respondents are presented in Table 1. The population of the study communities was estimated to be 43,346, projected at 2.9% annual growth rate. The communities had slightly over 23,000 persons in 1991 and witnessed an average annual growth rate of 2.8% within the intervening years, indicative of rural communities (NPC, 1991; PRB, 2014). The results show that more male household heads responded in the study (i.e., 60%) compared to the female gender's 40%.

The results of household marital status also revealed high marital rate; approximately 70% of the respondents were married (69.9%). Respondents with the single marital status was the lowest (6.9%), while percentage of divorced household heads amounted to 13.8% and widowed respondents were 9.4%. These responses could be due to the administration of the instrument of which the primary target was on the heads of households that could give some information on household water management practices adopted by them.

For the family size distribution, the survey result indicated that household sizes were large with majority (29.3%) having 10 and more members in household in the area. Over one quarter of the households (28.2%) also have 7-9 members in the study communities. This also showed that the people practice more of polygamous system of marriage.

In terms of the education, research have shown that household with higher education level often have stronger intentions to conserve/store water as part of household water management (Gilg and Barr, 2006; Lam, 2006). The educational

level of the respondents revealed that greater percentage of the people ended their education at the primary school level (29.3%). It also revealed that greater proportion of the respondents are educated (77.5%) but with differential educational statuses. The average monthly income level of most of the people in the study area was found to fall within N18,000 to 50,000 (34.5%). Respondents with less than N18,000 monthly income also amounted to over one quarter (29.3%), which translated to income poverty. Low income is one of the strongest determining factors that affect proper household water management practice in the area. Higher income households have been reported to demonstrate strong intentions to install water efficient appliances (Lam, 1999). Households with higher income level have also been found to use more water than lower- income households (Bornstein *et al*., 2011; Jeffery and Gearey, 2006).

The younger age cohort of 18-25 years were least represented amongst the sampled respondents (5.1%). The findings from the survey revealed that most of the household heads fall within the average age bracket of 35-55 years with more respondents within the 46-55 years age bracket (25.8%) (Table 1). The aged (> 65 years) constituted 7.2 percent of respondents in the sampled communities, while those in the 26-35 and 56-65 age brackets constituted almost same proportions of the sampled respondents; 19.4% and 19.9% respectively. Some research findings have shown that older households consume less water (Bornstein *et al*., 2011). Fielding *et al*. (2012), however, have the opinion that it may be the stage of life rather than age that determine household water management. The findings also revealed that it could also be due to some other factors such as lack of proper knowledge, economic status, environmental conditions etc. The demographic profile of a low water-using households tends to be one with fewer people who have lower education and income. More also, the larger households consume more water.

Household Water Supply Sources and Treatment Methods

Results for the sources of household water supply indicated that the main source of water supply is the river which is most likely contaminated by faecal matters since defecation through pier toilets also takes place into the water. The majority of the respondents (84.4% on average across the communities) relied on the river (surface) water as the principal source of water supply without consideration for the quality of the water. Less than 10% of the households have access to privately piped-water in their dwellings (Table 2). In all cases, there was significant spatial variation in sources of water for the households across the 3 sampled communities.

Although several methods of household water treatment are available for adoption to make water fit for consumption at point of use, only two were found to be employed in the study environment. Sadly though, majority of the households (41.5%) do not apply any method of water treatment before use. However, over one quarter (25.6%) of the respondents use alum and another 27 percent of the households use the sedimentation method of water treatment (i.e., allowing the water to settle down) before use. Other methods occasionally adopted are, coagulation/chlorination, filtration, boiling, and use of water-guard, but very few of the households adopts these treatment methods before household water use (Table 3). The reason for the

non-treatment of the water before household use may not be unconnected to attitude, perception, and above all low-income level among other factors. Many of the respondents perceived that the river water is safe for all household use for its age-long history of use. The study used the multi-barrier approach system of treatment as the standard which is simple, convenient and less costly but majority of the respondents could not afford it, therefore such approach was hardly adopted. They are used to the traditional methods.

Table 1: Sample Demographics

Demographics	**Value**
Population	43,346 (2017)
Marital Status	% response
Single	6.9
Married	69.9
Divorced	13.8
Widowed	9.4
Gender	
Male	60
Female	40
Family Size	
1-3 persons	16.5
4-6 persons	26.1
7-9 persons	28.2
10 and above	29.3
Age bracket of Respondents	
18-25 years	5.1
26-35 years	19.4
36-45 years	22.8
46-55 years	25.8
56-65 years	19.9
> 65 years	7.0
Education	
No formal education	22.5
Primary education	29.3
Secondary education	26.7
Tertiary education	17.7
Others	3.8
Household Income (Monthly/Naira)	
<18,000	29.3
18,000- 50,000	34.6
50,000-80,000	21.0
80,000-110,000	8.9
>110,000	4.2
Occupation	
Farming	25.0
Fishing	33.5
Civil servants	14.7
Students	5.4
Trading/Business	17.4
Employed in private sector	2.0

Table: 2: Sources of Water Supply

Variables	Ekowe		Peremabiri		Eniwari		Overall Total
	No	%	No	%	No	%	
Sources of drinking water							
Surface water (river)	98	85.2	100	82.7	99	85.3	84.4
Piped private water	9	7.8	9	7.4	8	6.9	7.4
Public borehole taps	3	2.6	5	4.1	3	2.6	3.1
Public hand-dug well	3	2.6	4	3.3	3	2.6	2.8
Rain	1	0.9	1	0.8	1	0.9	0.9
Others	1	0.9	2	1.7	2	1.7	1.4
TOTAL	**115**	**100**	**121**	**100**	**116**	**100**	**100**

Table 3: Methods of Water Treatment

Variables	Ekowe		Peremabiri		Eniwari		Overall Total
	No	%	No	%	No	%	(%)
No treatment	47	40.9	50	41.3	49	42.2	41.5
Boiling	1	0.9	1	0.8	2	1.7	1.1
Addition of alum	30	26.0	30	24.8	30	25.9	25.6
Coagulation/ chlorination	3	2.6	4	3.3	2	1.7	2.6
Cloth/filtration	1	0.9	2	1.7	1	0.9	1.1
Use of water-guard	2	1.8	1	0.8	1	0.9	1.1
Sedimentation	31	26.9	33	27.3	31	26.7	27
TOTAL	**115**	**100**	**121**	**100**	**116**	**100%**	**100%**

Household Water Storage Facilities

The household water storage result for respondents showed that over a third of the households each (34.5% and 34.8%), collect and store water in small containers such as jerry cans/kegs and larger containers as the drums respectively. Approximately one quarter (24.6%) also store household water in buckets, while smaller percentage do so in other unspecified storage materials (6.1%) (Table 4). All the respondents indicated that they collect their water in small quantity and one factor contributing to this is their proximity to their major source of water supply which is the river as they are located near the river.

Table 4: Water Storage Facilities

Variables	Ekowe (%)	Permabiri (%)	Eniwari (%)	Overall average (%)
Jerry cans/kegs	34.8	34.7	34.5	34.5%
Drums	34.8	33.9	35.3	34.8%
Buckets	24.3	24.8	25.3	24.6%
Others	6.1	6.6	4.9	6.1%
TOTAL	**100**	**100**	**100**	**100%**

Households Water Consumption per Day

The highest quantity of water consumed per day by households from the study communities revealed a range of 200-250 litres; some 29.8% of the respondents reported their households consumed this much (Table 5). Close to

one quarter of the respondents (23.9%), also reported of their households consuming 150-200 litres per day, while another one fifth (20.9%) have access to 100-150 litres of water per day. When compared with the large household sizes of7-9 and even 10 members and more, it is obvious the households have access to very too little water per day. To satisfy basic needs, water must be not only safe, but also available in quantities sufficient for personal hygiene and a healthful environment. It is generally agreed that 20-40 litres per capita per day is the minimum required to assure adequate supplies for consumption, sanitation, and hygiene, although the requirement is much higher in modern industrial urban areas: 200-500l per person/day, or more (Lucas and Gilles, 1990). The World Health Organization (WHO) considers 1,000m^3 per person per year to be necessary amount of water for human health and development (WHO, 2002). On a daily basis, between 50 and 100 litres of water per person per day are needed to ensure that most basic needs are met and few health concerns arise (WHO, 2010). The findings suggest that members of households in the study communities have far less access to the required quantities of water per day for daily needs.

Table 5: Daily Water Consumption

Variables	**Ekowe**		**Peremabiri**		**Eniwari**		**Overall average Total (%)**
	No	**%**	**No**	**%**	**No**	**%**	
< 100ltrs	10	8.7	11	9.1	10	8.6	8.9
100ltrs -150ltrs	24	20.9	25	20.7	24	20.7	20.9
150ltrs - 200ltrs	28	24.3	29	24	27	23.3	23.9
200ltrs – 250ltrs	34	29.6	36	29.8	35	30.2	29.8
>250ltrs	19	16.5	20	16.5	19	16.4	16.5
TOTAL	**115**	**100**	**121**	**100**	**116**	**100**	**100**

Analysis of Spatial Pattern of household water management amongst the Communities

The results of the investigation of the spatial pattern of household water management practices showed no significant variation among the three communities (Figure 2). The spatiality observed from the findings indicated the common nature of the people's perception, behavior, approach, and belief. Low income level was identified as one of the major determining factors that influence the spatial pattern of household water management practices in the study area. Low-income levels incapacitate householders and so they cannot afford potable water in the face of inadequate water supply, hence they resort to making use of the available water source which is the river water not-minding the non-potability. All three communities were found to adopt similar methods and patterns in their household water management practices. The results are in conformity with what had earlier been reported by the Partnership Initiative in Niger Delta (PIND, 2018).

The two hypotheses postulated for verification tested for confirmation or nullity. The postulate on whether there was no significant variation in the spatial pattern of household and water management practices in the study area

was effectively tested using responses on the household water management practices at the Point-Of-Use with respect to water management parameters. The ANOVA statistic was applied and the results confirmed statistically that, there is significant variation in the mean household water management practices at the Point-Of-Use amongst the sample communities under investigation considered at 0.05% significant level. Similarly, the research was interested in finding out if there was some significant relationship between income and water management practices adopted by the households in the study communities. This hypothesis was tested using Pearson's Product Moment Correlation Coefficient statistic. To correlate the income of households with water management practices adopted, the parameter of income was grouped into two; high-income (y) variable and low-income (x) variable and the Pearson's Product Moment Correlation applied to correlate the relationship. The results showed that the critical t-value at 5% significant level was 2.05 while the calculated t-value was 5.292 greater than the critical t-value. Therefore, statistically there was a significant relationship between income and household water management practices. We therefore, rejected the null hypothesis and accepted the alternative: there is indeed a significant relationship between the incomes of householders and water management practices adopted.

In line with the study objective number 4, which sought to establish the determinants of the different practices in household water management practices, the study results, in line with Behera and Ali (2015)'s findings, affirmed, that income is the major factor which influence households' access to improved source of water supply and choice of treatment method adopted in the rural areas. The study established that, most of the households are low income earners therefore, cannot afford conventional household water management practices.

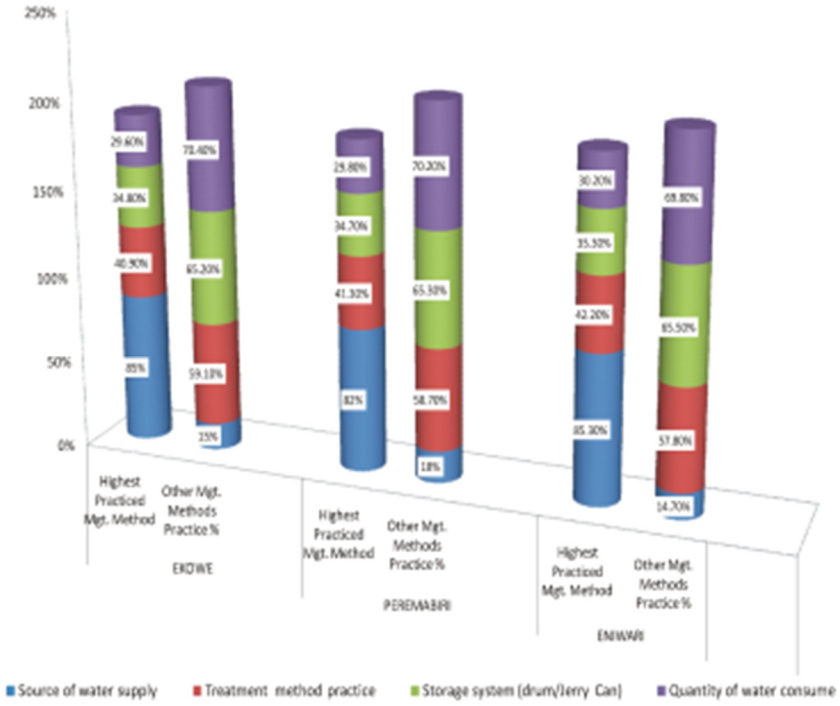

Fig. 2: Spatial pattern of household water management amongst communities

Conclusion and policy Implications of Findings

The study considered the most important components of household water management practices on a spatial scale adopting the descriptive cross-sectional survey design method for data collection. Point-of-use household water treatment and management (PoU-HWT) is practiced directly and indirectly by people living in both urban and rural areas at different scales. Findings of the study conducted in 3 different communities in the Southern Ijaw LGA in Bayelsa State, Nigeria, looking at four major components of household water management practices of source of water supply, treatment, storage and quantity consumed per day revealed that, most of the households use surface (river) water as the principal source of water supply in the area. For water treatment practice, households use more of traditional methods of sedimentation and alum, while households store water in drums and jerry cans/kegs more than others. The level of household water consumption is low compared to WHO and other international requirements.

The research shows that socio-demographic and infrastructural variables have roles to play in determining the spatial pattern of household water management practices in rural areas. Putting aside factors such as household size, and income, which are out of control in policy making; the findings suggest the importance of the policy makers to promote the culture of water management practices that could persist even when the environmental contact changes. The study underlined the failure on the part of the government in not providing potable water for its citizens particularly the rural areas which would have saved the people

from the problem of using unimproved water sources that could jeopardize their health.

In view of the study findings, the following points are put forth for policy consideration on household water management, which if implemented will play an important role in improving household water management practices amongst communities in the rural areas. Firstly, the government at the local and state levels and even federal should make concerted efforts in providing water infrastructures for its citizens and particularly those in the rural areas in line with the avowed SDG, No.6. Secondly, until when water provisioning infrastructures are made available, the rural dwellers should be encouraged to engage in the practice of improved household water management practices, to alleviate the risk of ill-health associated with use of contaminated water. Rural households' involvement in self-help projects so as to improve the source of household water supply through the adoption of good point-of use (POU) water treatment methods and use of improved storage facilities that are cost effective should also be encouraged.

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