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Household Water Stress, Adaptation and Resilience in Some Selected Peri-urban and Rural Communities of Oyo State, Nigeria

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Household Water Stress, Adaptation and Resilience in Some Selected Peri-urban and Rural Communities of Oyo State, Nigeria

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Abstract. The condition of water infrastructure in selected village communities along peri-urban and rural corridors of Oyo State can be said to be in a state of colossal infrastructural waste and communal neglect. Using a mixed approach, the study examines household water stress and adaptation. Evidence shows that peri-urban villages and rural areas in Oyo State buy water and that water facility maintenance is limited by the high cost of repairs and limited inter-community cooperation. It was also revealed that many households are vulnerable to water-borne diseases owing to a lack of a potable water source. It was revealed 50.4% of the households travel less than 30m to fetch potable water, 17.1% travel between 31 to 60m, while the remaining 32.5% travel over 100m to fetch water. The study suggests that the strategic location of the capital city and LGAs' headquarters must be considered as this often influences water infrastructure access and availability. The strategic location of infrastructure is considered relevant in the transformation of the selected communities towards sustainability environment and improved liveability.

Keywords: Rural Household, Water, Stress, Survival, Adaptation.

1. Introduction

Global discourse on the importance of water cannot be downplayed. Upton et al. [16] was of the view that water security is one of the most pressing risks facing the world. The relevance of water for human survival and other livelihood activities has constantly been identified. Its relevance as a crop growth agent, food production ingredient, for domestic activity use and industrial raw materials cannot be under-emphasized. In fact, [20, 8] identified that water plays a significant role in the human settlement sustainability agenda and livelihood capacity drive. Attesting to the relevance of water, institutions such as UNICEF and the WHO are continuously geared towards reducing the exposure of over 800million rural dwellers without access to potable water across the globe [10, 22]. Aligning with the global relevance, [7] mentioned that water resources play a pivot role in improving the livelihood and food security conditions of people and most especially Ghanaians.

Narrating the threat to water resources, the complexity of water across settlements has ranged from water quality, shortage, availability and supply, and increasing population [18]. In fact, rapid urbanisation is one of the four factors identified by [5] to have led to the continuous demand for freshwater in Middle East and Northern Africa. The study further reported that despite the increasing water demand in this region of Africa, water scarcity, quality and availability remains a less considered issue in the formulation of policies. One of the arguments of this paper is that investigating water security experience of village dwellers in peri-urban and rural areas of Nigeria is imperative to achieving the Sustainable Development Goal 6- Clean Water and Sanitation. Expressing this, [13] iterates the relevance of water security to sustainable development.

Despite the aforementioned, there exists a dichotomy in access to portable water between rural and urban areas [1]. In Nigeria, modernization and urbanization which is often characterized by an inequality in space between the rural and urban centres often generates rural neglect, livelihood limitations and out-migration, which is caused by the unavailability of basic amenities such as water in rural communities [14]. A vast majority of over 50 million Nigerians has been reported to lack access to potable water sources with rural and urban village dwellers among the most water poor and vulnerable [23].

In Nigeria, [12], provided a holistic generalization of the water resources condition. It was opined that increasing global water scarcity, is due to poor water management and resource insufficiency, increasing populations, rapid urbanization, industrialization and deforestation, as well as the effects of climate change, all of which are having impacts on environmental migration. In Africa, water insecurity remains domicile and more acute in rural and surrounding peri-urban agricultural regions [9]. Furthermore, [3] narrated that why a general water scarcity is experienced across Nigeria, rural and peri-urban villagers are the most exposed owing to their increasing dependent on open sources of water as water supply service remain below par.

The condition of the rural water infrastructure in Oyo State can be said to be in state of colossal infrastructural waste and communal neglect. Inequitable access to potable water has compelled rural dwellers to use unclean water sources, with heavy dependence on rain and open streams as their water sources, thus increasing their exposure to diseases. If this then is to go by, the question asked by the researcher is how rural dwellers and villagers along the urban corridors been able to adapt and respond to the water insecurity conditions in Oyo state. Against this background, this study attempts to examine peri-urban village dwellers and rural households' water stress, resilience and adaptation experiences.

2. Study Settings and Methods

South-West geopolitical zone of Nigeria which is majorly a Yoruba speaking region of the country has six states. These states are Oyo, Ogun, Ekiti, Lagos, Ondo and Osun. Oyo is in the South-west of Nigeria. Oyo state is the home of the Yoruba ethnic group whose main form of occupation is farming with the preference of living within the highly populated areas of the city [2]. The study was carried out in Oyo State, Nigeria (see Figure 1).

Owing to the study been a household survey, the total population of the nine sampled Local Government Area (LGA) was 298,609 household units according to the National Population Commission Census data of 2006. Taking into consideration and spatial configuration of the sampled communities along with [6] sample size calculation formula, a sample size of 384 (0.128 per cent) of sampled household population was recommended. The study now considered the argument of [24] that, a large population sample requires a small sample size representation. Thus for increase sample credibility so as to capture the heterogeneity of the sample space, a sample size for 500 household units (0.1674 out of the total 298,609 households in the 9 sampled LGAs) was adopted for this study. After data sorting, it was discovered that only 472 out of the sampled 500 household questionnaire could be use. Another study [11], aver that a 60% response rate is a reliable and valid for the results of

a study. Thus, the response rate used in the study analysis was 472 sampled peri-urban and rural household.

The study employed a mixed-methods research design through a cross-sectional survey approach to facilitate the collection of data from primary and secondary sources. The study made use of primary data through questionnaires and interviews gathered from 472 household heads in nine sampled LGAs. The households were selected randomly from the purposively selected 11 villages within the nine LGAs. Interviews were conducted with rural traditional leaders (village heads), private and government officials.

The study adopted some settlements classified as poor and vulnerable during the National Cash Transfer Policy for the rural poor in Nigeria by the Federal government of the nation. Selection of these villages and communities was based on the outlook, nature of activities and mental perception of the officials of the Department of Agriculture who are the main actor in rural and peri-urban areas. It is from the settlements (wards) that the household sample will be considered. The settlement selected for sampling study within the LGAs were selected using cluster sampling technique following preliminary survey with the Department of Agriculture at each of the LGAs during the Federal Government Cash Transfer.

A total of eleven (11) rural and peri-urban villages distributed across the nine selected local government areas were visited and administered households' questionnaire (see Table 1). However, since the study is a household survey, then the unit of analysis is based on the household data for each of the local government areas selected using cluster sampling. To minimize the effects of this evident challenge of rural terrain and building arrangement, the classification was done using the senatorial district and the LGA. For the easy identification and to eliminate bias, the household questionnaire was administered conveniently according to each identified households. Thus, respondents will be household representative and not just the entire peri-urban-rural population. The household head or the oldest adult in such household was the sampled respondents for the households' selected for interview.

For the study, SPSS was used to analyse the questionnaires and content analysis was done for the transcribed interview data and discussions were done thematically, with pictorial evidence complemented by field observations obtained during the field survey. Coordinate of water infrastructure within the sampled areas was obtained using open data kits (ODK) and with ArcGIS 10.2 software. For this study, potable water was conceptualized as boreholes and ringed wells.

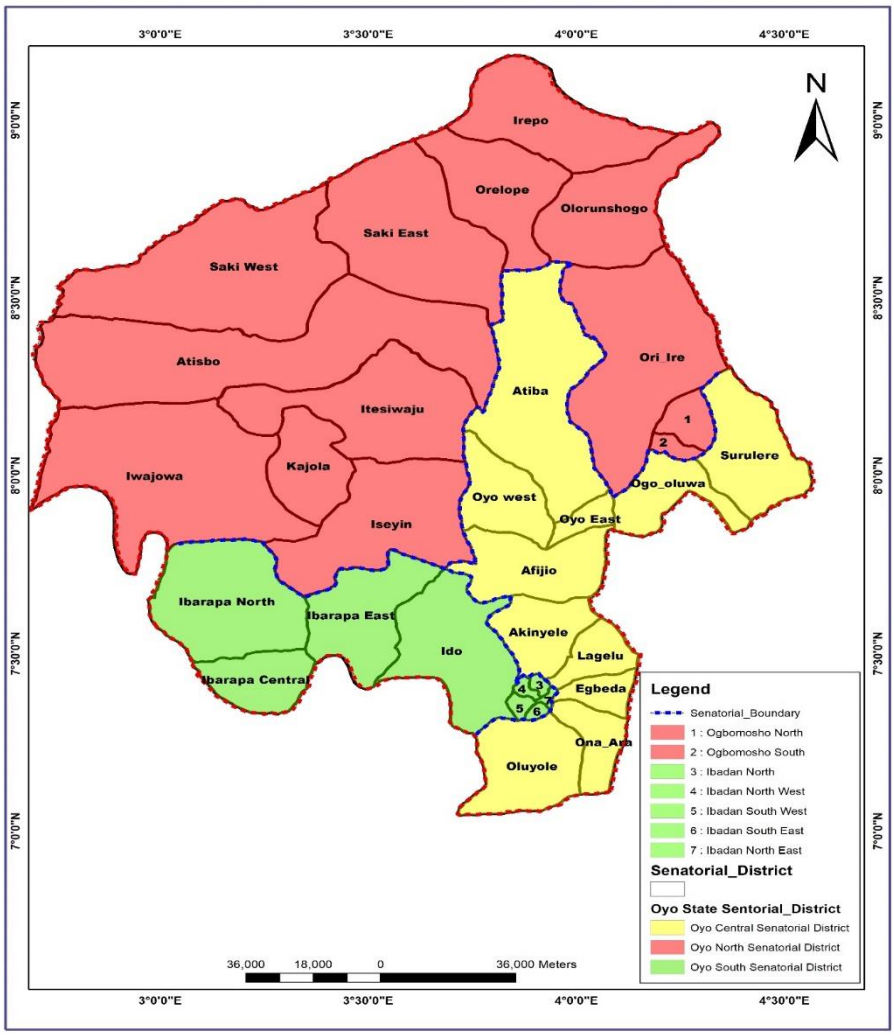

Figure 1: **Oyo state LGAs within the Senatorial district context.**
Source: Authors' Mapping (2019).

Table 1. Sample Frame and Size in each LGA.

LGA	Village classification (Urban, peri-urban or Rural)	Number of households in the LGA.	Household Sample size of 0.1674% across the LGAs.	Number of village (s) sampled
Ibarapa Central	Rural	22372	38	2 villages
Ibarapa North	Rural	22513	38	1 village
Ido	Peri-urban/Rural	25776	43	1 village
Irepo	Rural	24709	41	1 village
Iseyin	Lesser city/Rural	55034	92	2 villages
Olorunsogo	Rural	17372	29	1 village
Oyo East	Lesser city/ Rural	28652	48	1 village
Atiba	Rural	35379	59	1 village
Egbeda	Peri-urban/Rural	66802	112	1 village

Source: NPC 2006 and Authors' Compilation 2019

Interviews were conducted with rural traditional leaders (village heads), private and government officials. Coordinate of water infrastructure within the sampled areas was obtained using open data kits (ODK) and with ArcGIS 10.2 software. For this study, potable water was conceptualized as boreholes and ringed wells.

3. Results

Water stress and shock in rural areas was measured in both availability, accessibility and functionality. Using data captured from the households' survey, water infrastructure accessibility and condition (see Table 2), shows that 59.3% of the households claimed that there was water infrastructure, while the remaining 40.7% stated there was none. Of the 472 respondents, 61.4% claimed that facility is functional while the remaining 38.6% claimed the facility is not functional. Table 2 further presents that 16.1% said the water facility is good, 36.9% said it was fair and the remaining 1.7% felt it was in a bad condition.

Table 2. Rural Villages and Rural Water Infrastructure (Public well and Borehole)

LGA	Water Facility (Public Well and Borehole) Condition Across the Sampled Villages in the LGAs						
	Good (No & % of 472 sample size)		Fair (No & % of 472 sample size)		Poor (No & % of 472 sample size)		Total
	No.	%	No.	%	No.	%	
Atiba	23	4.9%	16	3.4%	20	14.4%	59
Egbeda	19	4.0%	41	8.7%	32	4.2%	92
Ibarapa Central	0	.0%	2	.4%	29	6.8%	31
Ibarapa North	1	.2%	5	1.1%	33	6.1%	39
Ido	9	1.9%	23	4.9%	11	7.0%	43
Irepo	1	.2%	5	1.1%	35	2.3%	41
Iseyin	9	1.9%	57	12.1%	25	7.4%	91
Olorunsogo	0	.0%	0	.0%	29	5.3%	29
Oyo East	14	3.0%	25	5.3%	8	6.1%	47
Total	76	16.1%	174	36.9%	222	1.7%	472

	Availability of Water Facility in Sampled villages in the LGAs (Response & % of 472 sample size)				
LGA	YES	% within LGA	NO	% within LGA	TOTAL
Atiba	45	16.1%	14	7.3%	59
Egbeda	92	32.9%	0	.0%	92
Ibarapa Central	11	3.9%	20	10.4%	31
Ibarapa North	37	13.2%	2	1.0%	39
Ido	43	15.4%	0	.0%	43
Irepo	1	0.4%	40	20.8%	41
Iseyin	15	5.4%	76	39.6%	91
Olorunsogo	0	.0%	29	15.1%	29
Oyo East	36	12.9%	11	5.7%	47
Total	280	59.3%	192	40.7%	472

	Water Facility Functionality Level in the Sampled village (Response & % of 472 sample size)				
LGA	Functional	% within LGA	Non-functional	% within LGA	TOTAL

Atiba	48	16.6%	11	6.0%	59
Egbeda	86	29.7%	6	3.3%	92
Ibarapa Central	30	10.3%	1	0.5%	31
Ibarapa North	25	8.6%	14	7.7%	39
Ido	40	13.8%	3	1.6%	43
Irepo	0	.0%	41	22.5%	41
Iseyin	25	8.6%	66	36.3%	91
Olorunsogo	1	0.3%	28	15.4%	29
Oyo East	35	12.1%	12	6.6%	47
Total	290	61.4%	182	38.6%	472

Figure 2 shows that 231 (50.4%) households travel less than 30m to fetch potable water, 78 (17.1%) households travel between 31 to 60m, while the remaining 149 (32.5%) household respondents travel over 100m to fetch water.

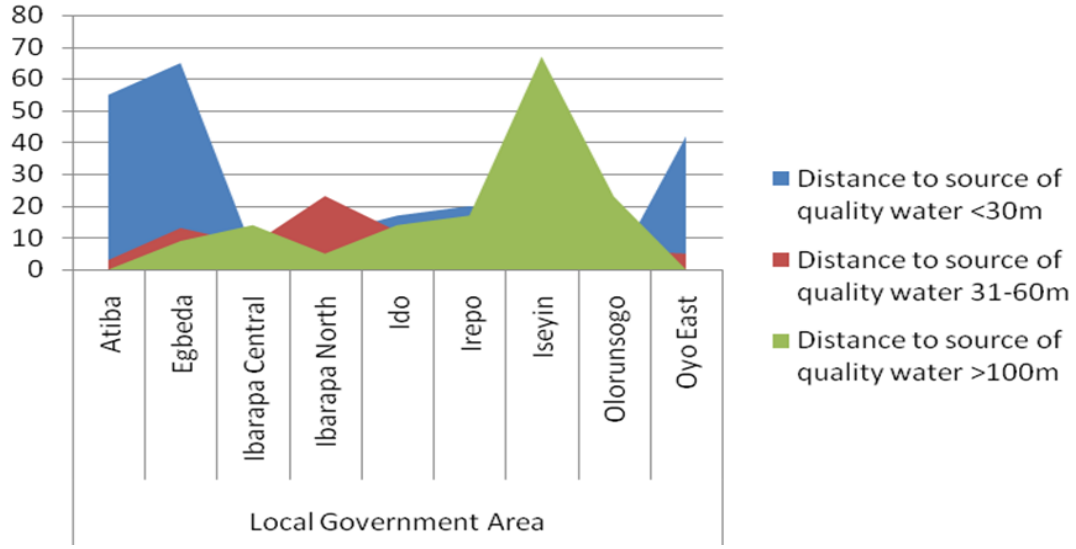

Figure 2: Distance to source of potable water

Despite the differences in water need, travel distance, Figure 3 shows that the distance varies across the sampled areas. Household analysis in Figure 3 shows that many (221 households) of the sampled respondents consider the water source to be highly reliable, 134 households consider it to be slightly reliable, while the remaining 109 responding households opine that the water source in their community is unreliable. The conceptualisation of reliability in the context of this study is the ability of a household to gain access and ability to get water at the nearest potable water source any time of the day. In a way, that delays such water infrastructure lock, resource queues and well seasonality (see Plates 1, 2, 4 and 9) is prevented.

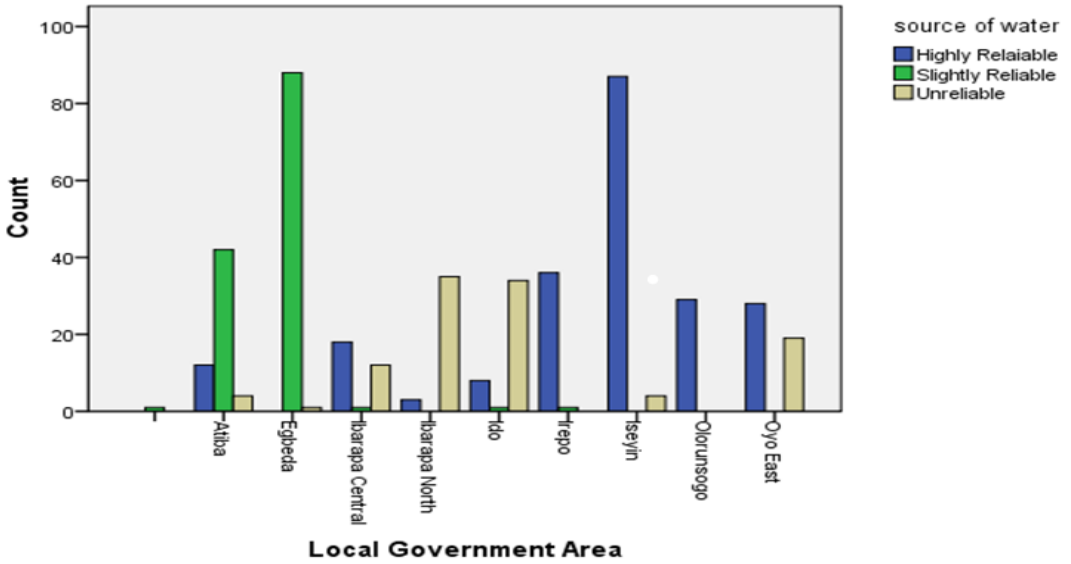

Figure 3: Perception of reliability of water source

4. Discussion: Water Stress and Resilience

The condition of urban villages and rural water infrastructure in Oyo state can be said to be in state of colossal infrastructure waste and communal neglect. Based on the reported condition of infrastructure by the household respondents and field observation, it is understood that water infrastructure livelihood in peri-urban villages and rural areas of Oyo State are a reflection of survival and adaptation with the available infrastructure, as against the infrastructure needs for a sustainable livelihood. Households have over the years adapted to the limited water infrastructure, live a life of resilience, and hope for good governance of water infrastructure provision.

Whilst there is an array of water survival strategies (such as fetching from streams, un-ringed wells, ringed wells, private-religious boreholes and government-owned boreholes) amongst the rural dwellers, the perception of reliability of the water source differs from the quality of the water source itself. For example, the source of potable water in Akodudu community in Atiba LGA is less than 30meters away from the village centre (cluster of houses) prior to the time that the solar-powered borehole was functioning (see Plate 1 and Figure 4).

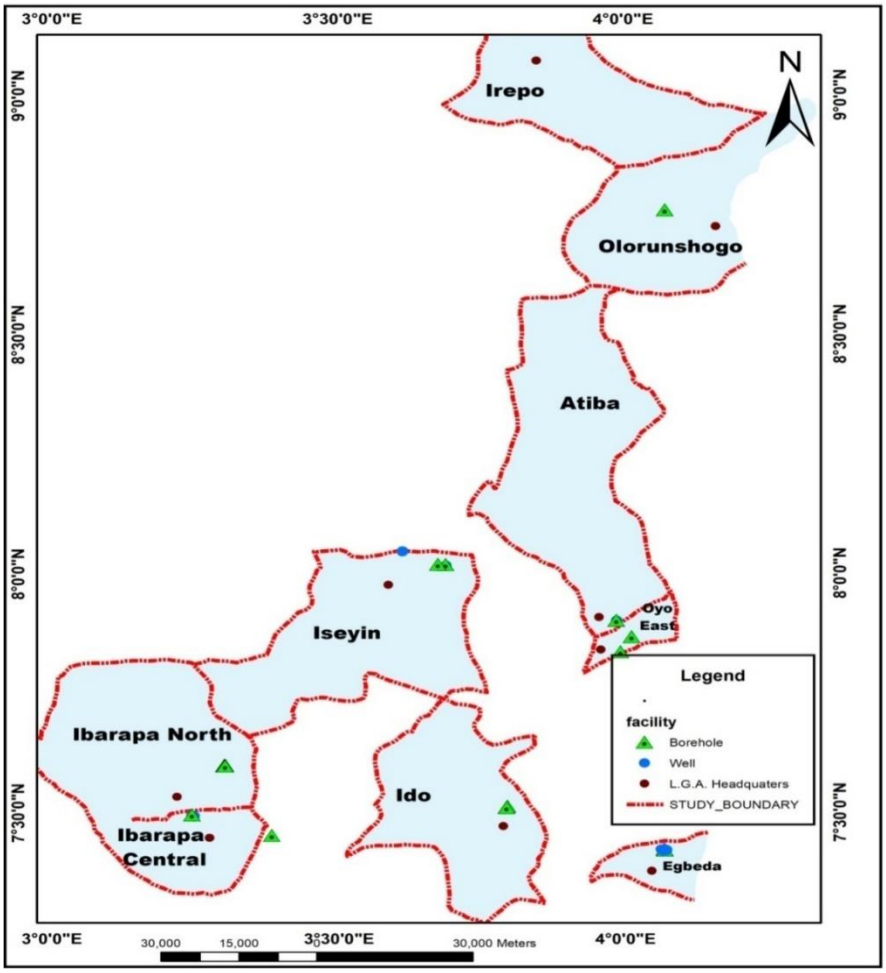

Figure 4: Distribution of public potable water points within the sampled villages
Source: Researchers' Mapping (2019)

The on-site evidence shows households now depends on well closest to them water survival (see Plate 1); many of which are usually under lock and key owing to higher water demand that the supply within the villages or choices defined by individual well household owner. Although the spatial location of the source of potable public water (ringed-well or borehole) may be far from some households.

Plate 1: Well depended upon by Akodudu community (Atiba LGA)

The study queries the condition of the solar-powered borehole, as the community leader stated that the borehole engine is the only thing that needs to be replaced. The high cost of repair (₦350000) and lack of inter-community coordination was identified to have limited its repair and servicing. Investigating the relevance of the water to the community and the roles played by the community in getting the borehole repaired, the community Baale (traditional elder) summarized thus:

> *"…There are but no positive result. Some of the reasons been that it is not only those that stayed in the community that make use of this water some even travel over 2hrs to make use of this water, the effort to contribute money for repair is usually futile, they* (other neighbouring communities) *kept saying that it is government property and government property belongs to everyone so if it is repaired everyone will still be benefiting without contributing to the repair and they cannot be stopped and also based on inquiry the price of the pump is extremely high about ₦350000 and how much are we making from our farm produce..."* **Community Leader, Akodudu Village, Atiba LGA**

This response points to the lack of community interaction and community engagement in getting the borehole fixed. In Alabi village at Ibarapa North LGA, "*water suffering*" is also evident and but with a level of community engagement in the form of payment to fetch water. A woman household head said "…*There is only one borehole left working here* (see Plate 2) *and the handle is now stiff and one can only fetch two basins*(owing to communal demand) *because we have to struggle with a lot of fights because of the number of those that want to fetch. We are really suffering regarding this water issue and roads is another area that is disturbing us, but water is critical…One container* (25 litres keg or bowl) *of water from the borehole is ₦30 if you cannot pump but if you can pump it is ₦10, but as an old person there is no strength to pump so I pay₦30 and it is not always available to fetch…*" This was what [19, 15] identified as weak institutional and organizational support in water infrastructure deficiencies. The argument posed in their study was that the inadequate water infrastructures often limit rural and urban village household livelihood sustainability and escape from poverty. The relationship to poverty in this study is as a result of increasing expenses on access to water, purchase of water and continuous expenses on the repair of damaged water infrastructures.

Plate 2: The only functioning borehole at Alabi village

Interview questions were asked on the condition of the remaining identified water infrastructure, a woman responded that:

> *"…One of the boreholes sunk by the State government has no handle to pump. We (Alabi village residents) dug this borehole ourselves, the one government did has is no water. All the boreholes dug by government are malfunctioning and we still buy water at 10 naira per container. One of the borehole has not been working for about 5years* (see Plate 3)*, the other one 8 years this one also has stopped working since last year but after it was repaired it stopped again. It is just useless. How will one survive if there is no food and water…"* **Village Dweller, Alabi, Ibarapa North LGA**

Plate 3: One of the non-functioning government sunk borehole at Alabi village

Water-stress owing to lack of access to electricity and generators was also reported in Idere village of Ibarapa North LGA. A dweller was asked of her household water availability and access experience, she narrated that despite the infrastructure deficit faced by the residents in Idere village, water remains the main difficulty and most needed resource. She said:

> *"When it (electricity powered-borehole) was brought, there was generator but the challenge was that the pump was small and it takes longer time before it gets filled with a gallon (5litres) of fuel but now it is no longer working because the hole collapsed (owing to poor drilling). The other manual borehole is what we (Idere village dwellers and environ) are depending on now and more so it can be easily repaired when it gets spoiled and repairing it is easier as the money (₦5- ₦10) paid for fetching water a depending on the borehole type and bucket size which is collected but the community committee members is used in repairing and managing the facility when needs arises".*

The vulnerability of the sampled rural households to water borne diseases owing to the lack of access to potable sources of water cannot be ignored. Figure 1 shows that many of the households sampled in Irepo, IDO, Iseyin, Olorunsogo and Ibarapa North LGA travel well over 100 meters to sources of potable water. Study reports by [21, 17] suggested that distances travelled to water should be a maximum of 100m to the dwelling unit. Evidence from site visit Alabi village a commercial village in Ibarapa North, indicated that it has only one functioning borehole water facility, while Alagogo, Gbokoyi and Olatutu villages in Iseyin LGA is without no functioning borehole to access potable water contribute to increasing travel distance to source of potable water. In Olatutu village, there exist a seasonal well and an unsustainable borehole sunk by the local and state government respectively. The village leader stated that the well (see Plate 4) which was sunk over 20 years ago, has reached the

rock and it does not produce enough water for the village during the dry season. He reported that the community has attempted to solve the well difficulties. He indicated that the well-rings (seven in number) provided by a politician during the election period limited the option of blasting the rock deposit inside the well surface, as this would result in the ring sinking into the well, making unusable.

Plate 4: Seasonal ringed well Olatutu village, Iseyin LGA

Furthermore, a Kruskal-Wallis rank sum test was conducted to assess if there were significant differences in distance travelled to quality water sources between the selected Local Government Areas. The results of the Kruskal-Wallis test were significant based on an alpha value of 0.05, $\chi 2$ (8) = 202.211, p< .001, indicating that the mean rank of distance travelled to the source of quality water source are not the same between the LGA's. The study argues that why there exists a variation in distance travel to the source of potable water, the rural-peri-urban water access experience is stressful. Thus limiting the ability of households to be water secure. This was further explained in an interview with a woman who states that stress from increasing (seasonally defined) distance to the source of potable water has a negative effect on women's health and the holistic health conditions of the household. She argued increasing exposure to potable water source during dry season.

Summarizing the dilemma of a village, the leader reported that the sustainable borehole sunk in the village is a colossal waste and a debt burden owing to continuous repairs by the villagers. A question was asked as to the role of the community in improving the water demand condition of the village and the steps taken towards the repair of the borehole. The village leader had this to say:

> "…*After the installation of the borehole the government has given us the mandate of repairing and maintenance. The materials that were used are notof standard quality so all needed to be replaced* (see Plate 5)...*The first time it got spoiled it was reported at the secretariat but nobody yielded to our request, after which we contributed and repaired it…. This is the third repair and for your information we (the community) still owe some debt based on the last repair which cost over ₦100000* (after seven months of waiting)*, yet we can't fetch water every time as it cannot provide for the entire community*…" **Village Leader, Olatutu village, Iseyin LGA**

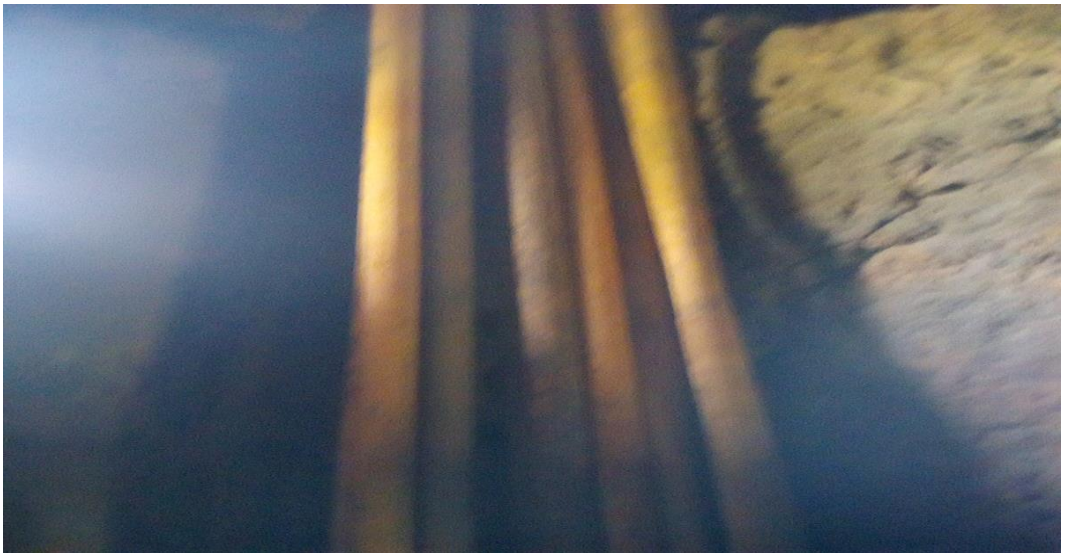

Plate 5: Replaced borehole fittings at Olatutu village, Iseyin LGA

Identifying the adaptation strategy towards the water shock in Irepo LGA, a household mother said*"…we drink water from open streams* (used by nomadic farmers) *or the well which is muddy* (see Plate 6) *during the dry season. She stated that it is only during the rainy season that the community has access to averagely clean water from rainfall…*" The dwellers at Iya-Yooyi reported that sometimes residents have to queue to fetch the high lead and iron concentrated open stream water for use as the nearest source of potable water is a 20 minutes' drive on a motorcycle and an average walking distance of 35minutes based on participant observation. This dependence on unclean water was what [4] reported that weak institutional capacity of the state institutions (local governments, rural water and sanitation agency and department of works) is responsible for poor state of the environment and dwellers exposure. The preposition put forward was a change in the citizens attitude (drinking of unclean water from poor sources), improved environmental management and strengthening of agencies towards improved settlement liveability.

Plate 6: Open stream source of water at Iya-Yooyi village

From the sampled 9 LGAs for the study, Oyo North senatorial district which comprises Iseyin, Irepo and Olorunsogo LGAs travels the longest distance of over 100m to sources of potable water, followed by Oyo Central Senatorial district (Atiba, Oyo East and Egbeda LGAs) and then Oyo South Senatorial district (Ibarapa Central, Ibarapa North and Ido LGAs). This study classifies potable source of water

as ringed well and borehole water sources. This finding points that as travel distance to the capital city increases, households' access to sources of potable water decreases. This assertion can be attributed to the poor government commitment to water infrastructure provision, incompletion, collapse and the unsustainability of water infrastructure projects (see Plate 7); poor maintenance; sparse and geographical locations of villages; and the morphological (clay soil or rocky terrain) composition (see Plate 8).

Plate 7: Uncompleted borehole water project by FADAMA in Gaa-sidi, Olorunsogo LGA

Plate 8: Unproductive well owing to clayey and rocky terrain at Alagogo, Iseyin LGA

From the data analysis, it was established that there exists a high level of uncertainty in getting potable water from the water sources in Ibarapa Central, Ibarapa North and Ido LGAs (Oyo South Senatorial district) when compared to other LGAs or Senatorial districts. Reasons for the uncertainty include high water demand for the borehole supply (see Plate 9); an inability to pay to fetch water; damaged solar panels that power the borehole; poor community cooperation to buy fuel for the generator to pump water; wells and boreholes being under lock and key; and animals (cattle) to have polluted the stream water.

Plate 9: Queues of water containers at borehole point at Alabi village in Ibarapa North LGA

The reality of the water shock was evidently reported by a rural private geophysical survey expert and a consultant with the LDS charity (a religious NGO supporting rural water infrastructure provision across Nigeria) stated that "...*They* (rural dwellers) *get their water majorly from streams and the situation is terrible*…" Further narrating the water infrastructure dearth, as the consultant has this to say:

> "...*Most of the rural areas I have been going to had nothing like water infrastructure. They* (rural dwellers) *get their water majorly from streams and the situation is terrible. By providing them with borehole one can combat water borne diseases. In some case where we have the enlightened ones we have the well. When we get there we provided them with infrastructure* (borehole or ringed well)…" **Private Geophysicist/LDS Charity consultant**

Field observation and mapping as presented in Figure 5 revealed that this water shock and struggle for survive in many instances are a reflection of poor maintenance or dilapidated water sources. The poor conditions of the water infrastructure negatively influence the negative exposure of the households' water poverty and insecurity. This is evident in increased water cost, increasing maintenance, dependence on open streams and water purchase

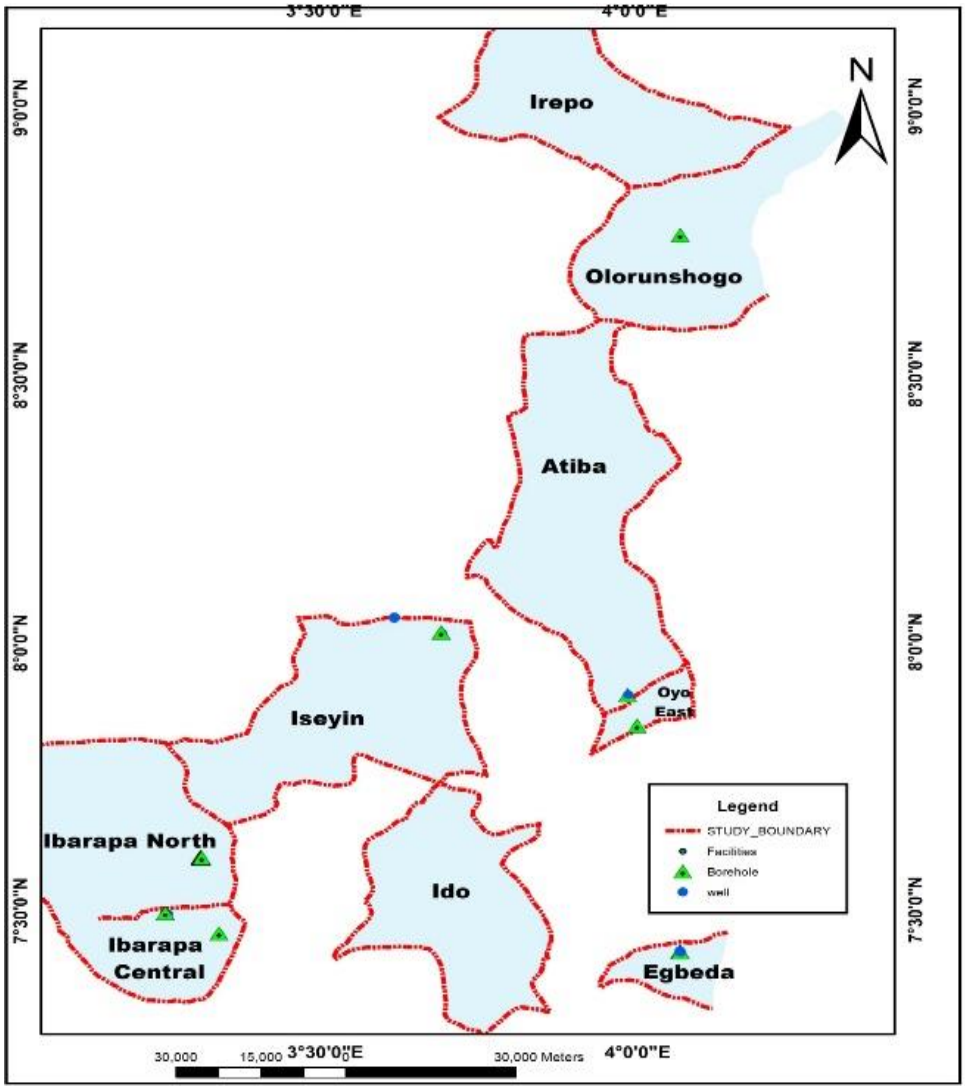

Figure 5: Some faulty public water points within the sampled communities

5. Conclusion

This study concludes that potable water infrastructure accessibility, availability and functionality varies across rural Oyo State and its availability and functionality is often defined by distance from the capital city. It was also identified that rural areas are at high risk of exposure to water-borne disease owing to limited access to potable water (boreholes or ringed wells). The study identifies increased household expenses in the purchase of potable water, which is one of the adaptation methods by rural dwellers to the increasing water demand that is higher than the supply.

It was also identified that queuing for water is often not a choice for households that need potable water. The study recommends that there is a need for increased cooperation towards the maintenance of water facilities among communities. Likewise, the strategic location of the capital city and LGAs to promote access to governance must be considered as this often influences infrastructure access and availability. This is suggested, as it will bring about increased and improved government investment in social amenities in the geographically isolated villages sampled.

The study reveals that why some of the limitations to water infrastructure can be natural many are traced poor governance process which reflected in corrupt laced construction process and materials used in the water facilities in such village. Thus, the study advocates for improved project

management that eliminate unnecessary maintenance costs from faulty water infrastructures in rural areas

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