ACHIEVING SUSTAINABLE WATER SUPPLY IN THE RURAL AREAS USING WATER POVERTY INDEX (WPI): A CASE OF RURAL COMMUNITIES IN OYO STATE, NIGERIA

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ABSTRACT

The understanding of water supply situation at various levels calls for a comprehensive investigation into the components that affect the supply of this resource if sustainable access will be realized. The investigation carried out applies Water Poverty index method to analyze the status of water supply situation in the rural areas of Oyo State, Nigeria. WPI revealed that both surface and subsurface water resources are generally available and reliable with scores ranging from 2.72 in Itesiwaju LGA and 15.93 in Akinyele LGA. However, access component ranges from 2.72 in Itesiwaju LGA and 14.29 in Atisbo LGA; Capacity component scores ranges between 1.33 in Surulere LGA and 6.47 in Ogo-Oluwa LGA; Water Use Component ranges between 0.80 in Surulere LGA and 7.94 in Atisbo LGA and Environment Component score ranges between 0.00 in both Oyo East and Lagelu LGAs and, 3.18 in Atisbo LGA, all out of the highest obtainable score of 20 for each component. The overall Index ranges between 1.29 in Itesiwaju LGA and 47.89 in Atisbo LGA. This implies a generally water poor situation despite the evidence of resource availability. WPI tool revealed those areas that need prompt attention in order to achieve a sustainable water supply.

KEY WORDS: *Water Poverty Index; Rural Areas; Sustainability; Water Resources; Oyo State*

INTRODUCTION

Water is essential to human survival. Thus, every effort is always made to ensure that its availability, accessibility and quality are not jeopardized in time and space to ensure the survival of life. Attempts to solving water related problems include the development of several indices especially for timely and accurate information about its availability. Amongst such indices include water poverty index developed by Sullivan et al. (2003). This index has been applied by many authors to

determine water availability situation in different areas of study. Ifabiyi and Ogunbode (2014) applied WPI to determine the status of water resource availability in the rural areas of Oyo State, Nigeria. In the study, the results revealed that there is poor water supply in Oyo State despite the abundant supply of water in the State: abundant surface and subsurface water resources and annually replenished by eight months of abundant rainfall. Even though there are evidences to show that there is inadequate supply of water in Oyo State such as conflicts at water points, long queues at available water points, prevalent water-related diseases and death, loss of economic time to water winching, searching for water over long distances among others. However, all these proves are still minimal when compared with what Sullivan et al (2002) enumerated and which are incorporated in the application of water poverty index. This scenario poses the challenge of the adequacy of WPI to solving water scarcity in Nigeria and even in Africa. Are all the WPI subcomponents valid for application? This work is aimed at appraising the application of WPI in solving water scarcity in the rural communities of Oyo State, Nigeria.

People can be water poor as they are 'income poor'. Water could be available but the affordability may not be there for them in term of paying for it (Lawrence, et al. 2003). According to them, the idea of a Water Poverty Index is to combine measures of water availability and access with measures of people's capacity to access water. The application of Water Poverty Index in measuring water accessibility goes beyond mere physical presence of the resource and the quantity available in time and space. According to van der Vyer (2013), the index aims to target political and financial attention towards those in need. It also considers that man's good access to potable water should reflect in diverse areas of living including his health, livestock keeping, economic viability, environmental health and subduing disasters among others.

The use of indicators to measure progress in environmental management, water resources inclusive, is not new in literature (see for example Falkenmark, 1989, Gleick, 1996 and Salameh, 2000). However, Lawrence, et al. (2003) noted that none of these applications recognised the unique importance of water to all forms of life. On this note, Sullivan (2002) and, Sullivan & Meigh (2003) emphasised that without adequate and efficient water supplies, that is, where there is 'water poverty,' any measures to reduce income poverty are unlikely to be successful. It has become imperative to quantify water poverty in a universally accepted way, through the derivation of a 'Water Poverty Index'. According to Sullivanet al. (2002) this index will enable progress toward development targets to be monitored, and water projects to be better targetted to meet the needs of the current generation, while securing water availability for the needs of future generation. Apart from WPI, there are other indicators already developed like water stress index (see Gleick, 2002), the water scarcity index (Asheesh, 2004). However, Heidecke (2006) remarked that these indicators did not provide sufficient details especially when working on a smaller scale. It was emphasised that a high level detail is required to allow targeting of resources to adress specific problems (see also Feitelson & Chenoweth, 2002; Moll & Mollinga, 2003). In furtherance, Water Poverty Index was adjudged to be easy to calculate, easy to implement based mostly on existing data, and also a mechanism to prioritise water needs (van der Vyer (2013). Several attempts have been made to apply WPI for instance, Ginéand Pérez-Foguet (2008b) and Guppy (2010). Guppy (2010) discovered that

the WPI values of Vietnam is higher than that of Cambodia which is less developed. It was discovered that there was a significant difference in use and capacity component while Vietnam had 62 percent and 63.2 percent in the survey, Cambodia got 28percent and 38.5 percent in water use and capacity components . This implied that the Vietnam have a greater level of water use and also higher capacity to understand and manage their own water sources and to improve their own water resources at a local level. However, the lower scores in other components as discovered for Vietnam by Guppy (2010) implied that all-round success has not been attained across water-related components.

Olotu, et al (2009) in their study in Ondo State, Nigeria concluded that Component approach is preferred to Simple Analysis approach used. This is due to the fact that the latter cannot link complex multidimensional aspects of water management together as incorporated in the former.

There are several methods of calculating WPI. These include Composite Index approach, Time-Analysis approach, A 'Gap' approach, Jarman Index, Use of pentagram, econometric (logit/probit) approach. However, the most frequent ones in literature are Composite Index and Time-Analysis approach. The use of pentagram has been developed and often applied with any of the approaches as it enhances visualisation of the results obtained from any method used (see Sullivan, and Meigh & Fediw, 2002). However, each of these approaches is not without different hiccups.

The problem of unconmensurability of some subcomponent data is found to be associated with Component Index Approach. For instance, data on child mortality and income factor are not of the same unit. This, however has been solved through the conversion of such data to index value. Also, the method could lead to the compression of extremes in some data since components and subcomponents are combined together by averaging. This could mislead on the impression of greater homogeneity between sites. Another problem is that comparisons may be difficult especially when some data are missing or flawed. Also collection of dataset for macrolevel WPI calculation often make some variable values unreliable from some sources. Another notable problem with this method is that it is not obvious which direction some of the components should go. For example increasing water use is good, but after a certain point, it becomes wasteful, and therefore bad.

On the other hand, Sullivan, et al., (2002) noted that even though the Time-Analysis Approach is simple, requires less data, it does not reflect sufficient complexity of the situation. The approach does not incorporate the relevance of such components like water quality and environmental factors in water availability were not taken into consideration. However, the fortunate report is that the WPI from this method correlates quite well with the more comprehensive Composite Index Approach. The Time-Analysis approach only considers time factor in accessing water for domestic use. It can equally be noted that Component Index method requires existing data for its use. Thus, its use in calculating WPI may be prone to errors especially in developing nations where data collection and storage are not taken with all seriousness. Time Analysis approch is time-saving, fast and so its results can be quickly made available to correct an abnormal situation of water poverty (see Olotu, et al., 2009). It was however noted that the use of Time-Analysis combined with GIS would improve the results generated.

Method of Study

Study area

Oyo state, located on latitude 07°N to 09°N and longitude 02.80°E and 4.50°E, has its headquarters at Ibadan. It is bounded in the North by Kwara State, in the east by Osun State, in the South by Ogun State and in the West partly by the Republic of Benin (Fig. 2).

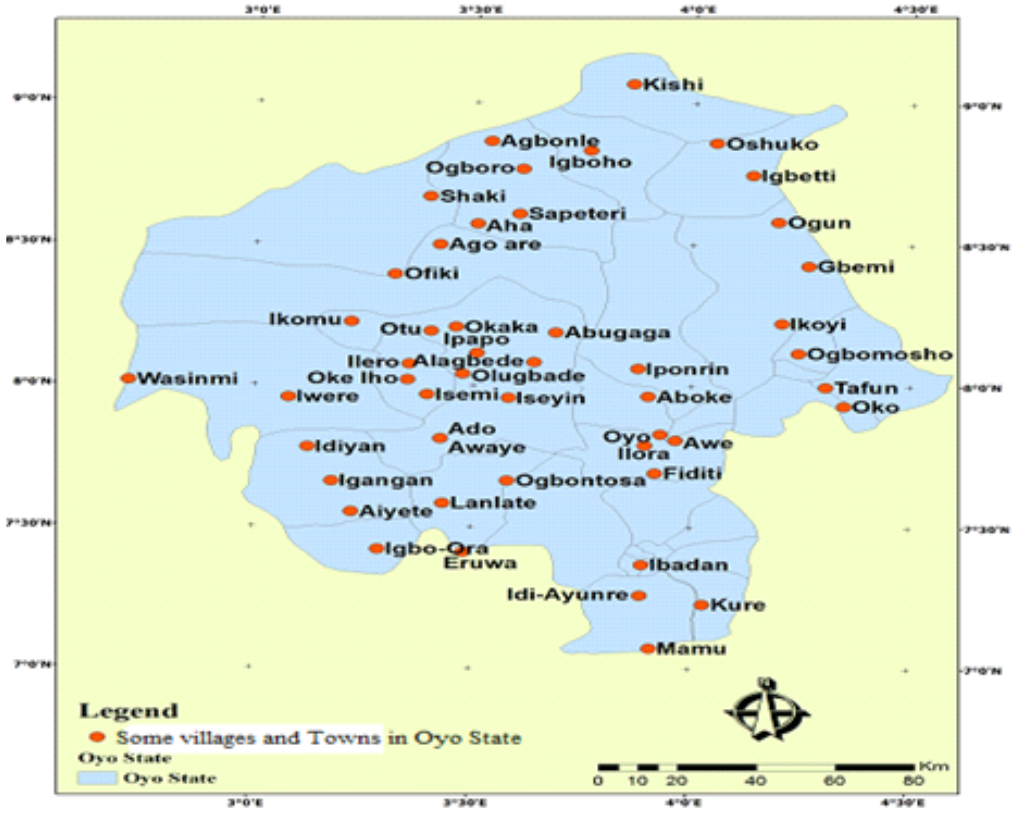

Fig. 2: Map of Oyo State showing some of the rural communities investigated

Oyo State covers approximately an area of 28,454km^2 and is ranked fourteenth by size in the country. It has thirty-three (33) Local Goverernment Areas (LGAs). The total population as at 2006 census was 5,591,589 (National Population Commission (NPC), 2006). Some of the major urban centres includeIbadan, Ogbomoso, Oyo, Iseyin, Saki, Okeho among others.

The State is endowed with two seasons namely dry and wet seasons. Dry season starts from November to March while wet season starts from March and ends in October. Rainfall amount varies from an average of 1200mm around Igbeti in the northern part of the State to 1800mm in Igbo-Ora and Ibarapa zone in the southern part. Water supply situation in Oyo state according to Kehinde and Longe (2003) is below any acceptable standard. The records from the Water Corporation, as revealed in the work, indicated that 233,485m^3 is generated daily by all water supply schemes in the state out of which about 55,080m^3 is actually supplied daily. The record further revealed that only 17.45% of households have piped water supply, but in Ibadan municipality 55% of households are linked to piped water supply. Thus over 56% of households in Oyo State have to obtain their water from unreliable sources. A report by National Bureau of Statistics (NBS, 2009) showed that preventable diseases are common. For example, schistosomiasis increased from 25 reported cases in 2003 to 1107 in 2005, cholera

increased from 157 in 2004 to 2768 in 2005 and typhoid from 484 in 2003 to 10,432 in 2005. Due to the susceptibility of surface water resources to contaminants (Ogunbode et al, 2016), inhabitants in the rural areas who are hardly connected to pipe borne water networks often, as an alternative, resorted to subsurface sources through digging of wells and boreholes. It is worth noted that despite fair and better status of underground sources, cases of total abandonment of some wells or segrigation of some wells for certain purposes, according to Ogunbode (2015), have been observed, the scenario being attributed to the physical, chemical and biological constituents of such underground sources.

Method of Data collection and analysis

Questionnaire was administered to generate data for the analysis of water poverty in the study area. Five rural communities were selected from each of the selected twentyfive LGAs as shown in Figure 1 out of thirty-three LGAs in Oyo State. Composite Index Approach as developed by Sullivan (2003) was used in the determination of Water Poverty Index WPI)(equation 1).

$$WPI = w_rR + w_aA + w_cC + w_uU + w_eE \quad w_r + w_a + w_c + w_u + w_e \text{ (equation 1)}$$

The above expression is the weighted average w_r, w_a, w_c, w_u and w_e of the five components namely Resources (R), Access (A), Capacity (C), Water Use (U), and Environment (E) respectively. Each of these components is first standardised so that it falls in the range 0 to 100. The resulting WPI value is between 0 and 100. A score of zero indicates water-stressed situation while 100 score shows water-advantaged situation.

Table 1: The Components' and the Water Poverty Index Values in the Study Area

S/No Local Govt	Resource (20)	Access (20)	Capacity (20)	Water Use	Environment (20)	WPI (100%)
Afijio	10.17	9.67	4.71	7.57	0.87	33.90
Akinyele	15.93	3.93	4.47	1.94	0.08	26.35
Egbeda	15.69	5.62	4.61	2.06	0.11	28.09
Atisbo	15.66	14.29	6.82	7.94	3.18	47.89
Ibarapa Central	11.67	4.61	3.44	2.49	0.10	22.31
Ibarapa East	9.80	2.97	3.38	1.35	0.02	18.95
Ibarapa North	6.34	6.90	2.45	3.23	0.03	17.52
Ido	8.58	8.71	3.28	4.47	0.24	25.28
Irepo	10.66	5.23	3.54	2.62	0.18	22.23
Iseyin	9.13	4.26	2.68	2.29	0.50	18.86
Itesiwaju	2.72	2.72	4.27	1.56	0.02	11.29
Iwajowa	10.69	4.24	3.62	1.67	0.37	20.59
Kajola	11.00	10.69	5.91	6.47	0.49	34.56
Lagelu	14.09	3.20	2.11	1.61	0.00	21.01

Ogo-Oluwa	12.67	8.06	6.47	3.70	3.80	34.70
Olorunsogo	11.39	3.79	3.74	5.12	1.06	25.10
Oluyole	14.54	7.16	4.74	2.45	0.03	28.92
Ona-Ara	13.95	3.04	3.36	1.06	0.00	21.40
Orelope	14.56	4.34	2.81	1.98	0.37	24.06
Oriire	12.14	4.08	2.31	1.79	0.28	20.60
Oyo East	11.42	6.04	4.13	3.05	0.00	24.64
Oyo West	13.66	4.35	4.53	1.62	0.02	24.18
Shaki East	13.73	3.33	3.53	1.59	0.08	22.26
Shaki West	11.44	3.80	3.38	1.67	0.11	20.40
Surulere	8.98	3.83	1.33	0.80	0.32	15.26

(Source: Author's fieldwork), 2015

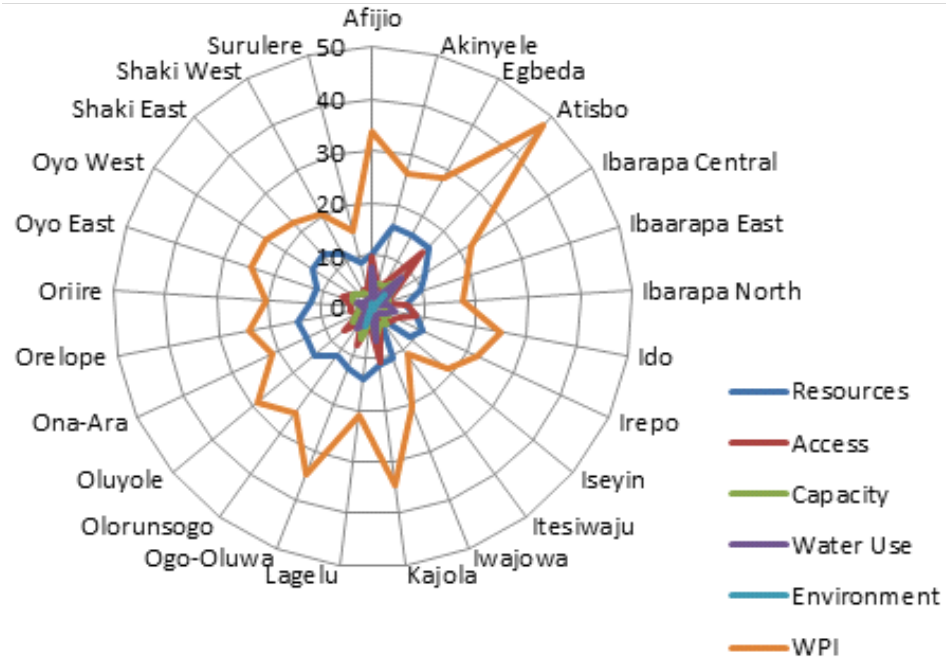

Figure 2: WPIs and the Subcomponent Values in the Study Area
(Source: Author's fieldwork, 2012)

RESULTS AND DISCUSSION

WATER RESOURCE COMPONENT

The result indicated that 24% of the entire Local Government Area investigated had less than 50% in the highest obtainable of 20 in the availability of resources while 70% had 50% and above. The implication of this result is that most LGAs are endowed with water resources including surface and subsurface resources. It further showed that the water sources are accessible, reliable and of good quality. Ogunbode (2015), however, discovered that water sources in Oyo state, especially the ground water are of acceptable quality, though,

he recommended some form of treatment for some LGAs. The reliability of the sources indicates that the water sources are readily accessible all the year round and over seasons. Ogunbode (2015) further corroborated this finding when it was asserted that both surface and subsurface sources are readily replenished through eight months of rainfall (March-October). Apart from this, Ogunbode and Ifabiyi (2019) had revealed that rainfall incidence in Oyo state is on increasing trend, thus, allaying the fear of inadequate rainfall for replenishment in the study area. This result was further corroborated by Akinbile et al., (2019). The availability, accessibility. reliability and the quality status of both surface and subsurface water resources noted were further supported by other scholars including Lade and Oloke (2015), Ogunbode and Akinola (2019), Ogunbode et al. (2015) and Ogunbode et al., (2016). However, the extremely poor results found in Itesiwaju LGA (2.72) and Ibarapa North (6.34) for water resource component was found to be attributed to the completion of the questionnaire by the newly settled inhabitants in the areas investigated in the LGA. Thus, the respondents here were not of full knowledge of the water resource endowment in the area. Also, the fairly appreciable results in LGAs such as Ido (8.58), Surulere (8.98) and Ibarapa East (9.80) were also attributed to some of the inexperienced respondents engaged as a result of the inavailability of most of more experienced inhabitants in the affected rural communities during the course of the survey.

II. ACCESSIBILITY OF WATER RESOURCES

Household having access to water

Apart from Atisbo and Kajola that had 14.29 and 10.69 out of 20 obtainable from this com ponent, all other LGAs have extremely poor score. For instance, Itesiwaju has 2.72, Ibarapa 2.97, Akinyele 3.93, Iseyin (4.26), Iwajowa (4.24), Shaki East, Shaki West and Surulere had 3.33, 3.80 and 3.83 respectively, Ona-Ara (3.04) and so on.The implication of this result is that all LGAs studied are well endowed with water resources in abundance and believed that it is accessible to the respondents. It implies that access to piped water is poor, there are conflicts at water points, women had to travel to fetch water for home use, access to toilet facility is poor, inadequate storage facilities and also, enormous time is spent in fetching water. Ogunbode and Ifabiyi (2016) corroborated this observation when it was noted that water use is dictated by several factors including storage facilities, education level and so on despite the availability of the resource.

The reason for poor access was probably attributed to the following:

a. Water resource is available but not fully exploited to meet up with the demand for household use (see also Lade and Oloke, 2015; Ogunbode et al., 2015; Ogunbode and Ifabiyi, 2019);

b. The developed groundwater resources are not well protected from pollutants, thus, limiting itsuse (Ogunbode et al., 2016; Ogunbode and Akinola, 2019);

c. Polluted surface sources (Ogunbode et al., 2016; Ogunbode and Akinola, 2019);

d. Existence of hard water which may make surface sources preferable for certain uses like washing and bathing (Ogunbode and Ifabiyi, 2017);

e. Possibility of shoddy contract in the provision of groundwater outlets, especially by political class (Awoduni and

Akeasa, 2017; Ogunbode and Ifabiyi, 2017);

f. Vandalized water-related equipment (Obeita, 2017)

g. Time taken to draw water from the well may discourage rural people from exploiting it in favor of surface, if far (Ogunbode and Ifabiyi, 2017b);

h. Shallowness of groundwater sources may result in its dryness/poor yield during dry season and also its quality deterioration (Ifabiyi, 2008);

I. Inadequate fund to maintain water-related projects (Coker and Sridha, 2002);

j. Poor power supply Ogunbode and Ifabiyi, 2017); Popoola and Magidimisha, 2019);

k. Corruption (Coker and Sridha, 2002; Okoro et al., 2015);

l. Inappropriate citing of groundwater sources outlets (Adetunji and Odetokun, 2011; Ogunbode et al, 2017; Akanbi, 2018).

III. CAPACITY COMPONENT

This component explains how communities are capable to ensure sustainable water access and availability. The results of the analysis showed that the LGAs investigated were grossly incapacitated in ensuring sustainable water access and availability. This fact is evident in the scores which ranges from 1.33 in Surulere LGA and 6.82 in Atisbo LGA out of 20 obtainable for capacity component. This is extremely poor. Thus, the results implied the following:

Firstly, that most underground source was mostly provided by philanthropists, NGOs and government agencies. The average cost of constructing a well as at 2003, according to Kehinde and Longe (2003), was 40USD (N14, 400.00 at N360.00/USD as atJanuary 9, 2020) which may be not be realistic by the present day economic dictates. Thus, the cost may be too high for rural dwellers to carry out with their peasantry level. Thus, there is no sole authority/control on the outlets available in their domain except for communal control. This implies that the maintenance of such outlets rest with any of these providers who may not be readily available for its maintenance or may be difficult to reach.

Secondly, that poor score in this component also implies that there is high death rate due to water quality. Rural dwellers obtain water from any source without reference to its quality. For instance, since the supply or provision of water is believed to rest with the government or any of its agencies or any NGO, the maintenance is equally their responsibility as far as rural life is concerned. According to Oluwafemi and Oluwole (2012) cases of water-borne diseases were recorded in Ibadan after a devastating flood in August, 2011 as a result consuming water of poor quality. In the same vein, Adeyemo and Omonona, in 2017, discovered that lack of access to portable water supply and sanitation correlated with the incidence of four water-related diseases in rural Nigeria. In addition, in view of discovering that some water constituents exceeded standard recommendation, Ogunbode et al., (2017) suggested that water from the underground source in Ogbomoso zone of Oyo State should be given treatment before consumption.

Level of education.

It is not surprising that the result of capacity component across the LGAs investigated is extremely poor as the level of education is poor. Most rural dwellers, who mostly engage in subsistence farming, are either without formal education (Olawuyi and Adetunji (2013). Thus,

the awareness on the significance of timely and spatially access to water of good quality is extremely low. Furthermore, as a result of low level of education, utilization of water for other uses other than regular domestic purposes is extremely low. In theirdifferent observations,Ayoade and Adeola (2012) and, Olawuyi and Adetunji (2013) revealed thatlack of formal education in rural areas contributed to the poverty level of rural dwellers. Thus, place the rural dwellers incapacitated in water resource unhindered accessibility.

a. Membership of Water Use Association.

The field observation and the survey carried out in the areas of investigation showed that water-based Associations are nil. However, water-related matters are often discussed at Landlords' Association which is commonly found in urban centers and may not be relevant in the rural areas. The only forum for discussing about water in the rural areas is usually at community/village meetings whose decisions at times are implemented only when government or its agencies and NGOs are involved, due to the high level of poverty. According to Takeshima et al., (2010), the only water-user-related association that exist in rural areas is Fadama User Association which only exists to enable the members to collectively obtain irrigation equipment and other inputs at subsidized rates and also to serve as a forum for training of the members in the areas of irrigation farming.

b. Economic buoyancy of Rural Households

Economic status of households correlates with household infrastructural possessions. Thus, households that are economically vibrant have high possibility to acquire facilities like cars, refrigerators, toilet facilities among others, which are water-consuming. Apart from these, it has been established that the higher the income, the more the likelihood to possess modern household facilities (Ayoade and Adeola, 2012) and so disadvantaged in modern live hood that enhances the use of water. Ayoade and Adeola (2012) and, Olarinde and Kuponiyi (2017) had noted that the poverty level of households low standard of living, low income level and low level of life expectancy. It is in view of the poor economic status, that domestic uses dominate water utilization in the rural areas of Oyo state. It was further suggested that government or any of its relevant agencies and other stakeholders should develop agriculture as a way of improving the rural dwellers' economic base (Omoregbee and Edeoghon, 2006; Ayoade and Adeola, 2012;Olarinde and Kuponiyi; 2017)) to increase their urges for water need.

IV. WATER USES COMPONENT

Despite the evidence of abundant availability of water resources in the study area as indicated in Table 1, investigation showed that water use component recorded other poor results. The results range between 0.80 in Surulere LGA 7.94 in Atisbo LGA. The water use component has the following subcomponent namely; Quantity of water used, Proportion of land under irrigation, Extent of livestock water need and other uses of water apart from domestic and agricultural uses.

a. Quantity of water used

The results obtained for this component implied that the areas investigated did not meet up with the minimum water need for adults of 20 liters/day as recommended by the United Nations (UN). The fact that the major water uses in the LGAs are domestic and agriculture showedare agrarian economy where industrial and aesthetic water uses are almost nil. Even, domestic water uses are mainly for cooking, drinking and bathing. According to Ifabiyi et al., (2012), Shan et al., (2015) and Istifanus et al., (2019) the volume of water used correlates with

the status of households such as the level of education, household economy and so on. On this basis, Ifabiyi et al., (2012) and Ogunbode and Ifabiyi (2015) in supporting this finding stated that water use in the rural areas could be improved by enhancing their livelihood through modern agricultural practices, encouraging small scale and medium scale industries in the rural areas and also educating rural dwellers on mixed farming (raising crops and animal husbandry).

b. Proportion of land under irrigation

Irrigation farming entails artificial supply of water at the appropriate level for the use of plants. The results obtained in this study showed that crop production in the study area mostly rain-fed. Thus, for most part of the year (about eight months), irrigation farming is handicapped. However, during the dry season, it was found that some farmers engage in Fadama farming where river beds and banks, and moistened wetlands are cleared to raise some crops like vegetables, cereals, among others. The land available for this practice is, however, limited and short-lived since its only practicable within two to four months of the year (November to February). In their submission, Adefalu et al., (2013) revealed that dry season farming is limited in coverage due to the shortness of the season. Thus, the yields from this practice are grossly limited. Apart from this, Tsoho and Salau (2012) revealed that land available for dry season farming is too small and at times could be costly to clear for average farmers. Thus, it was suggested that incentives should be made to the farmers to encourage them to increase production. Such incentives include soft loan, equipment lease, and improved yields and so on.

c. Extent of water need for livestock

The poor score of water use component as show in Table 1 is an indication that water use for livestock is poor. It has been suggested that appropriate stakeholders (NGOs, Government and its Agencies) should take it as a matter of policy to enlighten rural dwellers on mixed farming to boost their economic status and eventual livelihood. Mixed farming is a practice that combines crop farming with livestock farming. From field observation, only few farmers that engage in this practice only keep few tools and some scavenging animals which are kept for home consumption. Thus, water need for livestock farming is almost at zero level.

d. Other uses of water apart from domestic and agricultural uses

The poor result of water use component is due to the living standard of the rural dwellers. The income of these rural dwellers is grossly low ranging between 5000 Naira and 25,000 Naira per annum as their production is at subsistence level. Most of these people do not only have access to modern toilet facilities, cars, lawns, washing machine, power supply, swimming pools and so on. All these infrastructures, if possessed by rural households, will have positive impact on water use. Appropriate agencies can boost the standard of living of rural dwellers through access roads, regular power supply, soft collateral-free loans, to boost their agricultural production, price stabilization (Oyakhilomen and Zibal, 2014; Downie, 2017; Ojong and Anam, 2018) , among others. This is expected to boost water use among rural dwellers. Moreover, Amin et al., (2018) and Akoteyon (2019) emphasized that the higher the household's living standard and the higher the household's water use.

V. ENVIRONMENT

The result in Table 1 shows that scores obtained across the LGAs ranges between 0.00 in Kajola

and Oyo East LGAs and 3.80in Ogo-Oluwa LGA out of the 20 highest obtainable. The implication of these results is that the study area was ravaged with crop loss during the period of investigation, poor access to natural resources, especially land resources, incidence of flooding and erosion.

a. Report of crop loss in the last five years

The results showed that the rural dwellers investigated experienced crop loss in their domain. This incidence could be traced to the possibility of inappropriate management of water resources. For instance, an incidence of excessive rainfall which ought to have been utilized to boost their production could have led to crop loss. Okeleye et al., (2016)and Ayanwuyi et al., (2010) corroborated this finding in their report on agricultural production in Oyo state. In the same vein, Adeola (2014) revealed that the production of maize in Oyo State was affected by change in climatic variability such as in rainfall and temperature. Thus, there is need for effective water resource management to cater for remedies to excessive rainfall and shortage of it to sustain agricultural production.

b. Access to natural resources

The poor results recorded for the Environment component also implied that the study area is bedeviled with access to natural resources such as land and water. The noted poor access to land, which is the principal factor to agricultural practice, could be attributed to prevailing land tenure system. Land ownership or heritance issue could jeopardize the efficiency and effective utilization of the natural environment especially in terms of agricultural practice which could prove image of water or water availability. According to Kassali et al., (2009) land tenure has rendered immeasurable discouragement to farmland expansion as a result of land ownership crisis in Oyo state as farmers have to travel up to 6 kilometers (see also Kassali et al., (2012) from their respective bases and their farmland. In the same vein, impeded access to the use of wetland and water bed, especially in the dry season has been a challenge to the production of vegetables in Oyo state. The restricted access is attributable to ignorance and inappropriate use of this resource (Oyedele and Olorunfemi, 2019). In view of this, it was suggested that there is need to strengthen the existing laws and policies on wetland use, management and protection. Furthermore, such laws could be updated and made appropriate to match the current realities.

Incidence of flooding and erosion

Flooding is a concept that describes a situation when rivers overflow their banks as a result of excessive supply of water, usually from rainfall. The results in Table 1 indicates that the study area experienced flood disaster and this has impacted on their livelihood, especially agricultural production water resource management inclusive(Winsemius, et al., 2013; Onifade et al, 2014; Okeleye, et al., 2016). Okeleye et al., (2016) further stated that the areas that agricultural production have been greatly and negatively affected by flood disasters in Oke-Ogun zone of Oyo state with losses attributed to the disaster running to millions of naira across the zone. Sangotegbe et al., (2012) reported that farmers in Oke-Ogun area lose hectares of cultivated land with maize, yam, soy bean and so on as a result of flood disaster. Apart from this, Ewetola, et al., (2015) had reported that drastic measures need to be taken to combat soil erosion in the five LGAs in Ogbomoso zone of Oyo state. They further reiterated that erosion has been ravaging the LGAs and seriously impeding sustainable agricultural production. The ability to subdue these environmental problems by appropriate authorities is only an evidence to show

efficiency use of water resources with respect to WPI analysis.

Water Poverty Index in Oyo State

The results of WPI across the 25 LGAs in Oyo state showed that it ranges between 11.29 in Itesiwaju LGA and 47.89 in Atisbo LGA at 100 maximum obtainable. The accumulated results of the components gave the summary. Thus, it can be asserted that, though, rural areas are endowed with water resources, both surface and subsurface, but

I. Accessibility to it is poor (See also WHO, UNICEF, 2015; Ezenwaji, et al., 2016),;

ii. Rural dwellers are poorly incapacitated to develop or manage the resources (see Olawuyi and Adetunji, 2013);

iii. Water use is poor- Water use in the study area is dominantly for domestic and agricultural purposes indicating an agrarian economy (see also Ifabiyi and Ogunbode, 2017; Ogunbode and Ifabiyi, 2017);

iv. Water resources, though available, its management is poor. The resource has not been fully tapped to enhance the living standard of the people (see also Gbadegesin and Olorunfemi, 2011; International Bank for Reconstruction and Development/World Bank, 2017).

Thus, it is recommended that;

I. Relevant stakeholders should develop the resource to improve the accessibility to the resource. Mini water works can be constructed across rivers to provide water to many villages through networking. Apart from this, motorized boreholes, hand-dry wells should be constructed and be evenly distributed to boost access to the resources (see also, Coker and Sridhar (2002);

ii. Stakeholders in water resource development should intensify effort in educating rural dwellers in the following;

   a. Modern agriculture to boost their production;
   b. Entrepreneurship in other small and medium scale businesses to enhance their living standard;
   c. Encourage co-operative associations so that farm inputs can be purchased in bulk, thereby, bringing down the unit prices of such items; and also sell their products together as a way of stabilizing their prices;
   d. Government or its agencies and other NGOs can give out soft loans to farmers in the rural areas to expand their agricultural outputs;
   e. Leasing out farm equipment to farmers will also enhance the capacity of the rural dwellers;
   f. Provision of good access road network, modern health facilities, recreation centers, among others, are relevant to improving the capacity of rural dwellers.

iii) a. Water resources in the rural areas should be developed and tapped to boost dry season farming. Mini-dam can be constructed to make water available during the dry season for irrigation farming;

Eight-month rainfall should be tapped to boost agriculture in the rural areas. Accurate weather forecast report as it affects agriculture should be carried out to eliminate or minimize crop loss due to either poor and erratic rainfall or excessive rain water. Such forecasts should be at local farmers' language for ease of comprehension and application.

Government should oversee allocation of land for farming purposes and/or prevail over

landlords to make access to land easy to enhance agricultural expansion.
Rural dwellers should be given relevant education on how best to control water erosion in their local setting.

Conclusion

The application of WPI in assessing water availability and accessibility in the rural areas of Oyo state, Nigeria, was investigated. WPI will be a great tool in water resources development, if applied at local, national or international level. It will enhance spatial and temporal evaluation and monitoring of water availability and accessibility. The index could reveal where problem lies in the provision of water for use and so could engender action for its resolution among other benefits.

Data Availability Statement

Some or all data set, models that support the findings of the study are available from the corresponding author upon reasonable request.

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