Original Research Article

Application of Water Poverty Index (WPI) in assessing water accessibility in the rural suburbs of Ogbomoso zone of Oyo state, Nigeria

Abstract

Unrestricted access to potable water is required for a healthy living but access to the resource in Nigeria is about 42%. Thus a research to assess accessibility to potable water in the rural areas of Ogbomoso zone of Oyo State Nigeria was conducted using water poverty index combined with field observations. One hundred and fifty questionnaires were conducted across fifty randomly selected households in each of the three LGAs (Ogo-Oluwa, Oriire and Surulere LGAs). The results showed that Ogo-Oluwa has 34.70, Oriire, 20.60 and Surulere, 15.26 out of 100 obtainable, which implies that the study area is water poor. Among the causes of this status include peasantry living of the respondents, high level of illiteracy, ignorance of record keeping, poor maintenance of water facilities, erratic power supply among others. To check the problem of poor water accessibility, government and non-governmental agencies should encourage small and medium scale businesses, irrigation farming among others in order to boost the economic status of the rural dwellers. Further investigation into water scarcity scenario in the rural areas is required to establish models for checkmating the water poverty in the rural areas.

Keywords: Water Poverty Index, Oyo State, Ogbomoso zone, Water accessibility, Water scarcity indicators

Introduction

Water is essential to human survival. Thus, every effort is made to ensure that its availability, accessibility and quality are not jeopardized in time and space to ensure the survival of life. It has been revealed that access to potable water is 42% in Nigeria despite its relevance to human livelihood (Pacific Institute, 2007). Attempts to solving water related problems include the development of several indices especially for timely and accurate information about its availability status. Amongst such indices include water poverty index developed by Sullivan (2002), the Livelihood Vulnerability Index (Hahn et al., 2009), the Water Economy, Investment and Learning Assessment Indicator (Cohen and Sullivan, 2010) and the Modified Water Poverty Index (Ty et al., 2010). The use of indicators to measure progress in environmental management, water resources inclusive, is not new in literature (see for example Falkenmark, 1989, Anderson, 1991, Gleick, 1996 & Salameh, 2000). However, Wilk and Jonsson (2013) observed that the earlier water accounting tools mainly addressed availability and quality of the resource. In addition to this, Lawrence, et al., (2002) noted that none of the previous applications recognised the

unique importance of water to all forms of life. In relation to these observations, Sullivan (2002) and, Sullivan & Meigh (2003) remarked 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. 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, Meigh & Sullivan, 2002). Thus, water poverty index was developed to bridge the highlighted gaps. According to Lawrence et al. (2002), 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 among others.

According to Sullivan (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, Awojobi, 2014). 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, Giné and Pérez-Foguet (2008b) and Guppy (2010), Olotu et al (2009) and, Ifabiyi and Ogunbode (2014). 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% and 63.2% in

the survey, Cambodia got 28% and 38.5% 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. Similar results were obtained by Olotu et al. (2009) and Ifabiyi and Ogunbode (2014) in their respective areas of study in Nigeria.

This research aims to apply WPI to determine water availability situation in the suburbs of Ogbomoso zone of Oyo State comprising three local government areas with the application of WPI. The specific objectives are as follows: (i) to evaluate the availability of of water resources in the study area; (ii) to determine the accessibility of the resource in the rural suburbs of Ogbomoso zone using WPI; and (iii) to identify factors that contribute to the results obtained from the analysis.

MATERIALS AND METHODS

Study Area

The study area comprises of Ogo-Oluwa, Oriire and Surulere Local Government Areas which form part of the five local government areas (LGAs) in Ogbomoso Zone of Oyo State, Nigeria. The remaining two, Ogbomoso North and South LGAs are within Ogbomoso metropolis. The three LGAs, their headquarters, coordinate axis and the villages selected in each for the purpose of this study are shown in Table 1.

Comment [AAG1]: This information should be in introduction not in materials and methods!!

Comment [AAG2]: Here you need a good map, not a table!!

Table 1: LGA, their Headquarters, Coordinates and the Selected Villages of Study

S/No	Name of LGA	Headquarters	Latitudinal Location	Longitudinal Location	Names of Villages selected
1.	Oriire	Ikoyi	8.16°N	4.10°E	Olorunda, Aitete, Budo-Ode, Alaidan and Saamo
2.	Ogo-Oluwa	Ajaawa	7.56°N	4.07°E	Opete, Iwata, Ladanu, Lagbedu and Pontela
3.	Surulere	Iresaadu	8.05°N	4.24°E	Igbo-Ile, Idi-Ayin, Eleeru, Kueke and Onnipanu

Source: Author's compilation, 2012

The three LGAs were carved out from the former Ogbomoso LGA together with the other two LGAs located within the city of Ogbomoso (i.e. Ogbomoso North with its headquarters in Kinira-Ogbomoso and Ogbomoso South LGAs with its headquarters at Arowomole-Ogbomoso). Oriire LGA adjudged to be the

biggest in Oyo State with a land area of 2,116 km^2 has a total population of 150,628, Ogo-Oluwa LGA with an area of coverage of 369 km^2 has a population of 65,184 and Surulere LGA has a total population of 166,034 according to the census record of 2006.

Figure 1: Map of Nigeria showing Oyo State (Source: Google maps)

Comment [AAG3]: This figure is not cited in the text. This figure is of very poor quality.

One of the major peculiarities of these LGAs is that they consist of rural communities with farming as the dominant occupation. Farm settlements of varying sizes are found within these areas. Apart from farming, the inhabitants in the zone engage in small business activities such as trading, livestock keeping, lumbering among others. The prevailing climatic condition is tropical with distinct wet season (March-October) and dry season (November-February). According to Gbadegesin & Olorunfemi (2007), the sources of water in the study area are both surface and groundwater apart from seasonal rainfall. Groundwater source is reached through digging of wells/boreholes which were either provided by government at different levels through its agencies, international agencies such as UNDP, community and religious groups and private individual donors. Despite the availability of water resources in this area, there are still evidences of water scarcity. These include early morning and late evening searching for water by women and children, rationing the available water in homes, water reuse, queues and occasional conflicts at well and borehole points, skipping baths, rotation of water fetching among the dwellers.

Data collection

Questionnaire administration was conducted across the five rural communities selected in each of the three Local Government Areas in order to generate data for water poverty analysis. Five rural communities were selected from each of the LGAs out of which ten (10) households were also selected from each of the communities. Thus, fifty (50) households were selected from each of the villages [and one hundred and fifty (150) households in all the three LGAs] for the purpose of questionnaire administration. The questionnaires were conducted either early in the morning before the dwellers depart for their various farms, markets and other businesses or late in the evening on returning back from their day's businesses.

Data analysis

Composite Index Approach as developed by Sullivan (2003) was used in the determination of Water Poverty Index WPI)(eqn 1).

$$WPI = \frac{w_r R + w_a A + w_c C + w_u U + w_e E}{w_r + w_a + w_c + w_u + w_e} \qquad \text{(eqn 1)}$$

where the weighted average w_r, w_a, w_c, w_u and w_e are the five components respectively, Resources (R), Access (A), Capacity (C), Use (U), and Environment (E) respectively. Each of these components is first standardised so that it falls in the range of 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. The procedure of analysis was done according to Ogunbode (2015). Pentagrams were used to show the spread of the subcomponent values in each of the LGAs. However, in view of the abundance of water resources in the zone, it is hypothetically expected that there is unlimited access to water resources. Thus, the investigation is carried out on the hypothesis stated below:

H_o: That is unrestricted accessibility to water resources in the rural suburbs of Ogbomoso zone

H_1: that accessibility to water resources in the rural suburbs of Ogbomoso zone is poor.

Results and Discussion

The summarized results of the analyses is presented in Table 2. The results showed that Surulere LGA has the least index of 15.26 while Oriire LGA has 20.60 and Ogo-Oluwa LGA has 34.70 out of 100 maximum obtainable.

Table 2: Values of Components and the Water Poverty Index in the Study Area

S/No	Local Govt	Resources (20)	Access (20)	Capacity (20)	Water Use (20)	Environment (20)	WPI (100%)
1.	Ogo-Oluwa	12.67	8.06	6.47	3.70	3.80	**34.70**
2.	Oriire	12.14	4.08	2.31	1.79	0.28	**20.60**
3.	Surulere	8.98	3.83	1.33	0.80	0.32	**15.26**

(Source: Author's fieldwork, 2012)

I. Ogo-Oluwa Local Government Area

The result in Table 2 showed that Ogo-Oluwa LGA had WPI of 34.70. The subcomponent values as revealed from the Table and depicted in Figure 2 indicated that resource components is 12.67; access, 8.06; capacity, 6.47; water use, 3.70 and environment, 3.80. The result of poor access in Ogo-Oluwa was traceable to absence of pipe borne water network, report of conflict at water points, low percentage of water carried by women, absence of toilet facilities, time spent in fetching water and absence of irrigation facilities. Poor attitude to the protection of most wells also have effect on their potability thus contributing to the resource inaccessibility. In addition, it was discovered that power supply had influence on the accessibility to water in some of the villages. At Iwata people had to go to surface source, which is about two kilometres to the village due to power failure that hindered the use of pumping machine that was provided. Peasantry economic base of the dwellers also in addition contributed to the inability of the inhabitants to contribute for the purchase of fuel.

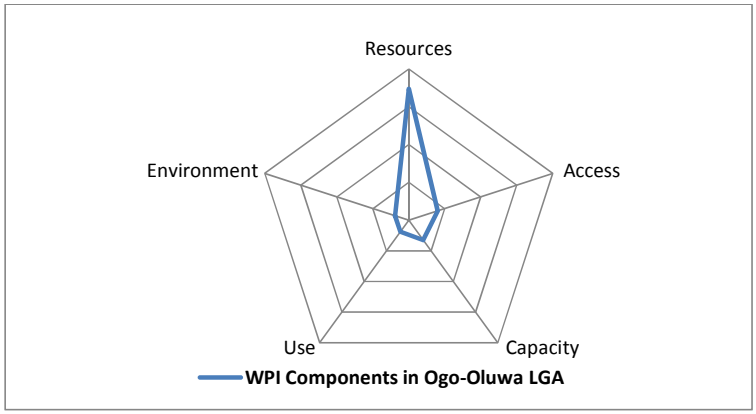

Figure 2: Components of WPI in Ogo-Oluwa LGA

Comment [AAG4]: This figure is not cited in the text.

II Oriire Local Government Area

The result in Table 2 shows that WPI in Oriire LGA was 20.60 out of 100. The values of subcomponents indicated that the resource is 12.14, access is 2.31; water use was 1.79 and environment, 0.28 as depicted in Figure 3. Though the results showed that water resources were present in this local government, accessibility was poor However, the results obtained for accessibility subcomponent indicated household's accessibility to pipe water was non-existing, and that conflicts prevail at water points and that farming was predominantly rainfed. The accessibility could have been affected by low yields of wells, which led to the abandonment of such wells especially at Budo-Ode. Similar observation was made at Saamo, Aitete,~~,~~ Olorunda and Alaidan. The results further revealed that the percentage of water carried by women is low and that modern toilet facilities are lacking. The relatively poor WPI value in this local government was also due to illiteracy level. This impeded record keeping of their farm holdings and also non-existence of water use association to fight the course of water accessibility. In term of water use, the result showed that there was no other appreciable use of water outside agriculture and domestic activities. The result of environment subcomponent was dominantly explained by crop loss in the last five years due to late and erratic rain incidence.

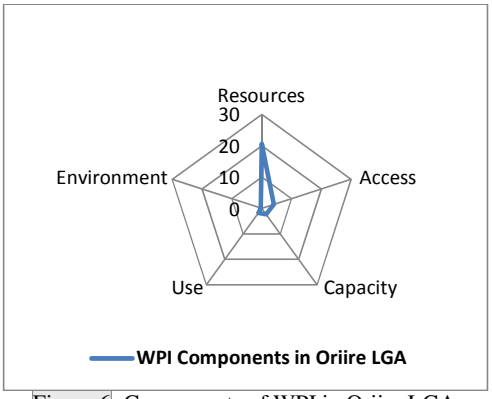

Figure 6: Components of WPI in Oriire LGA
(Source: Author's fieldwork, 2012)

Comment [AAG5]: This figure is not cited in the text. Where are the other figures? (figures 3, 4 and 5?)

III Surulere Local Government Area

Table 2 showed that the WPI in Surulere local government area was 15.26, the poorest of the three. The values of other subcomponents as presented in Figure 4 showed that resource availability was 8.98, access, 3.83; capacity, 1.33; water use, 0.80 and environment, 0.32. The result in Surulere was the poorest in the area of study. In addition, the poor results were evident from the response and what was observed from the field. For instance, many respondents claimed that the resource was not available because the resource is not reliable and the quality made the available source points restricted. There were many hand-dug wells in Idi-Ayin and Onipanu but none of them yields water all-round the year leading to their abandonment. The poor access was also compounded by poor quality as some of these hand-dug wells, which were not protected and also dilapidated especially in Kueke. The only better and reliable source of water in Onipanu is the solar-powered borehole provided by the Ogun/Oshun River Basin Authority. Also, the response of the respondents revealed high level of illiteracy, ignorance about record keeping and poor income level noted from the respondents. All these could have compounded the problem of water scarcity in the study area. In addition, it was reported that the dominant uses of water was for agriculture and domestic activities. Crop loss due to late rains was also reported showing evidence of water poverty.

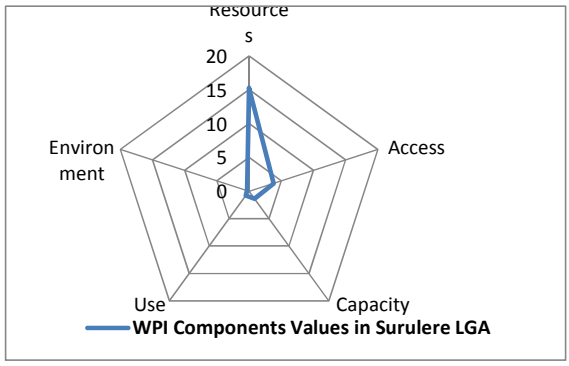

Figure 8: Components of WPI in Surulere LGA
(Source: Author's fieldwork, 2012)

Comment [AAG6]: This figure is not cited in the text. Where is figure 7?

The WPI obtained in this investigation generally showed that there is poor accessibility to water in the rural suburb of the zone. Thus the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted and then concluded that accessibility to water in the rural suburb of Ogbomoso zone is poor. The results of the analysis revealed that the WPI is effective in revealing the water availability status of the study area. The contributed factors to water scarcity include power instability, poor maintenance of water facilities, poor attitude of the end-users (rural dwellers) to the facilities, inadequate knowledge of the benefits of water association, poor economic base, ignorance on record keeping among others. This suggests that the government at all levels and other stakeholders need to put more efforts in order to remedy the situation. Remedial solutions could be through the involvement of community-based associations and public-private partnership in water provision. Government needs to encourage and boost small and medium scale businesses in the rural areas to encourage water prosperity. Water consumption level as revealed in the use of WPI could be seen as evidence of good and healthy living.

Conclusion

An investigation into the accessibility to water resources in the rural suburb of Ogbomoso zone in Oyo State, Nigeria using WPI has been carried out. The results of the analysis revealed that water resource (surface and subsurface and also eight months of rainfall) is abundant in the zone. However, the investigation showed that there is poor access to water in the zone. Of the three LGAs, Ogo-Oluwa

seemed to be fair in accessibility with an index of 34.70 while Oriire LGA has 20.60 and Surulere has an index of 15.26 out of 100 maximum obtainable. Some of the factors that contribute to the poor access to water in the zone include peasantry living of the respondents, high level of illiteracy, ignorance of record keeping, poor maintenance of water facilities, erratic power supply, poor yields of wells among others. It is therefore recommended that government and non-governmental agencies should encourage small and medium scale businesses, irrigation farming among others in order to boost the economic status of the rural dwellers. This is expected to improve the economy of the rural dwellers which, invariably, could have impact on their quests for water use. Further investigation into water scarcity scenario in the rural areas is required to establish models for checkmating water poverty in the rural areas.

References

Anderson, V. (1991) *Alternative Economic Indicators*. London and New York: Routledge

Asheesh, Q.K. (2004) *Allocating the gaps of shared water responses (the scarcity index). Case study of Palestine Isreal*. Finnish Institute of Technology, Kotkantie, Oulu, Finland.

Awojobi, O.N. (2014) Water Poverty Index: An Apparatus for integrated water management in Nigeria. *Int. J. Innovation and Applied Studies,* 8(2): 591-599.

Cohen A and Sullivan, C. A (2010) Water and poverty in rural China: Developing an instrument to assess the multiple dimensions of water and poverty. *Ecol Econ* 69:999-1009

Falkenmark, M. (1989) The massive water scarcity threatening Africa. *Ambio* 18(2):112- 118.

Feitelson, E. & Chenoweth, J. (2002) Water poverty: Towards a meaningful indicator. *Water Policy*, 4:263-281.

Gbadegesin, N. & Olorunfemi, F. (2007) Assessment of rural water supply management in selected rural areas of Oyo State, Nigeria. *African Technology Policy Studies Network (ATPS) Working Paper Series No. 49.*

Giné, R. & Pérez-Foguet, A. (2008b) Enhancing the water poverty index: Towards a meaningful indicator**.** *Proceedings of IV Congress Universitat i Cooperacio al Desenvolupament, Bellaterra, Espanya.*

Gleick, P.H. (1996) Basic water requirements for human activities: Meeting basic needs. *Water International, (IWRA)* 21: 83-92.

Guppy, L. (2010) Comparative water poverty in Rural Cambodia and Viet Nam.Paper Presentedfor SEAGA, Hanoi, 23-26 November, 2010. Online Proceedings

Hahn, M. B, Riederer, A. M, and Foster, S. O (2009) The Livelihood Vulnerability Index: a pragmatic approach to assessing risks from climate variability and change – a case study in Mozambique. *Global Environ Change* 19:74-88

Heidecke, C. (2006) Development and evaluation of a regional water poverty index for Benin. *EPT Discussion Paper 145, International Food Policy Research Institute, Environment and Production Technology Division, Washington DC.*

Lawrence, P., Meigh, J. & Sullivan, C. (2002) The Water Poverty Index: An international comparison. *In developing and testing the water poverty index: Phase 1 Final Report, eds. Sullivan, C.A., Meigh, J.R. and Fediw, T. (eds) Report to Dept for International Development. Wallingford, UK, Centre for Ecology and Hydrology.*

Ifabiyi P. I. and Ogunbode, T. O. (2014) The use of Composite Water Poverty Index in Assessing water scarcity in the rural areas of Oyo State, Nigeria. *International Journal of Science and Technology,* 3(2), S/No 7: 51-65.

Lawrence, P., Meigh, J. & Sullivan, C. (2003) The Water Poverty Index, An international comparison, *Keele Economic Research Papers, Keele***.** www.keele.ac.uk/depts/ee/kerp

Molle, F. & Mollinga, P. (2003) Water poverty Indicators: Conceptual problems and policy issues. *Water Policy*, 5: 529-544.

Olotu, Y., Akinro, A.O., Mogaji, K.O. & Ologunagba, B. (2009) Evaluation of poverty index in Ondo State, Nigeria. *ARPN Journal of Engineering and Applied Sciences*,:4(10)

Ogunbode, T.O. (2015) *Domestic water Utilisation and Management in selected rural areas of Oyo State, Nigeria.* An Unpublished PhD. Thesis, Department of Geography, University of Ilorin, Ilorin, Nigeria. 287pp.

Pacific Institute (2007) *Total Renewable Freshwater Supply by Country*. 6pp

Salameh, E. (2000). Redefining the water poverty index. *Water International,* 25 (3), 469–473.

Sullivan, C.A (2002) Calculating a water poverty index, *World Development*, vol. 30, no. 7, pp. 1195-1210.

Sullivan, C. & Meigh, J. (2003) Considering the water poverty index in the context of poverty alleviation. *Water Policy* 5: 513-528.

Sullivan, C. & Meigh, J. R. & Fediw, T.S. (2002) *Derivation and Testing of the Water Poverty Index Phase 1. Final Report***.** Volume 1- Overview

Sullivan C.A., Meigh, J.R. & Lawrence, P. (2005) Application of the water poverty index at different scales: A cautionary tale. *Agriculture, Ecosystems and the Environment*. Special Issue.

Wilk, J. Jonsson, A. (2013) From Water poverty and water Prosperity- A more Participatory approach to studying local water resources management. *Water Resources Management*, 27(3): 695-713.

van der Vyver,C. (2010) *Water poverty mapping and its management applications* knowledge management and innovation: A business competitive edge perspective.

--- (2011b) The application of water poverty mapping in water management. *The Journal for Trandisciplinary Research in Southern Africa*. 8(1): 95-120.

van der Vyer, C. (2013) Water poverty index calculation: additive or multiplicative function? *Journal of South African Business Research,* Vol.2013, Article ID 615770. DOI: 10.5171/2013. 615770.

Ty T.V, Sunada K, Ichikawa Y, Oishi S (2010) Evaluation of the state of water resources using modified water poverty index: a case study in the Srepok river basin, Vietnam-Cambodia *Int J River Basin Manag* 8(3-4):305-317

Table A1. Questionnaire on Water Poverty Analysis

S/N	**Component/Subcomponents**	**Index**					
		0/5	**1/5**	**2/5**	**3/5**	**4/5**	**5/5**
	RESOURCES						
1	Assessment of surface water						
2.	Assessment of groundwater						
3.	Is water available and accessible						
4.	Is the source reliable						
5.	Is it of good quality						
	ACCESSIBILITY						
1.	percent of household having access to piped water						
2.	percent of household having conflict at water point						
3.	.percent of water carried by women						
4.	Access to sanitation (access to toilet facility)						
5.	Time spent in fetching water (min)						
6.	Access to irrigation						
	CAPACITY						
1.	Land ownership with size of acreage						
2.	Mortality rate of children under five						
3.	Level of education						
4.	Membership of water use association (fadama)						
5.	percent households with reported water related illnesses						
6.	percenthousehold receiving salary, pension or remittance						
	WATER USES						
1.	Amount						
2.	Proportion of farmland under irrigation						
3.	Extent of livestock water need						
4.	Uses of water outside agriculture and domestic uses						

	ENVIRONMENT						
1	Report of crop loss over the last 5 years						
2.	Access to natural resources eg. Water, land etc						
3	percent household affected by flood						
4.	percent Household affected by erosion						