◆ Research paper

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Analysis of Water Poverty and Vulnerability to Water Scarcity in Selected Local Government Areas of Ebonyi State Using Water Poverty and Vulnerability Index

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Abstract: The study was carried out in selected Local Government Areas in Ebonyi State, purposely to examine vulnerability to water scarcity in the area using the vulnerability index. The study made use of Abakiliki, Ohaukwu, Ishelu, ikwo, Ohaozara, and Onicha Local Government areas as the study L.G. A's, This study adopted the Vulnerability Index (VI) methodology to determine the vulnerability to water scarcity, after Kusumartono and Rizal (2019) in the determination of water scarcity vulnerability in some small Islands in Indonesia. The result of the study indicates that the explanations of the water poverty index (WPI) are consistent with the Vulnerability Index determination. Both indices showed that the state is vulnerable to water scarcity with an overall VI score of 0.495, indicating a mid-level vulnerability, and a WPI score of 47.11, indicating an unsafe water poverty status. The study however concludes that the state's vulnerability index is ranked at mid-level vulnerability and therefore recommends that Community leaders and household heads should make deliberate efforts to engage Government and Non-Government representatives for support in capacity building on training of skilled manpower to support the operation and maintenance of water supply facilities, water preservation, treatment, and conservation techniques within the study area to empower households to ensure effective management of water resources.

Keywords: Vulnerability, Water, Scarcity, Ebonyi State, Vulnerability Index

Introduction

Water is a precious resource. Being vulnerable to water scarcity is a major challenge to any living organism. According to the United Nations, water usage increased at twice the growth rate in the world population and could result in global water shortages by 2025. The concept of vulnerability has been variedly defined by different bodies concerning their interest in the management of risk. Such disciplines as disaster management, geography, sustainable livelihood, and development among others (Alwang et al, 2001 as cited in Shitangsu 2013).

Vulnerability has been defined as the extent to which a system in whole or part may react adversely during the occurrence of a hazardous event (Proag, 2014). It is a concept that implies a measure of risk associated with the physical, social, and economic aspects and implications resulting from the system's ability to cope with the resulting event (Proag, 2014). In agreement with the above definition, Cardona 2003; Enrich, and Culter 2011 cited in Shitangsu 2013, define vulnerability as an inherent risk factor of the system that is exposure to a hazard and its ability to be affected by the hazard. Examining the mathematical approach to vulnerability, White et al 2005 cited in Villagran De Leon (2006) formulated that vulnerability is a combination of exposure, susceptibility, and coping capacity in the expression;

$$Vulnerability = \frac{exposure \times susceptibility}{coping\ capacity}$$

Vulnerability is exposure, susceptibility to hazards, and resilience or coping capacity. It can be defined as the tendency to suffer damage due to external stressors events. Therefore, when an individual or a group of people begin to experience a diminishing capacity to cope or resist a hazard, the risk of being affected by the hazard increases, leading to greater or sustained suffering.

However, when there are available resources to individuals or groups to cope with a given threat or hazard in an organized manner, the impact of the hazard on such individuals

or people is greatly reduced, leading to improved livelihood and sustained development. Counteracting vulnerability requires identifying the several indicators that lead to vulnerability to a particular threat like water scarcity. It requires reducing the impact of the hazard through mitigation, preparedness, or total elimination. It also requires building capacities across the various communities to withstand and cope with the hazards and tackle the underlying causes of the vulnerability.

Physical, social, economic, and political factors determine to a great extent the people's level of vulnerability and their ability to cope and recover from a threat or hazard. The use of indicators for vulnerability seeks to examine the physical, and socio-economic determinants of vulnerability rather than to measure vulnerability. The indicator approach establishes vulnerability that is not easy to quantify directly. However, there are indicators of vulnerability to water resources that could be determined statistically or mathematically. Based on research by several authors, indexes like the water poverty index (Sullivan 2002), the water resources vulnerability index Raskin et al (1997), and Falkenmark et al (1989) water stress indicator are among notable ones.

Vulnerability indicators include Physical: geography, environment, infrastructure, hazardous industries, etc. Emergency management: plans, equipment, trained people, etc. Demographic: numbers, density, structure, minorities. Health: patterns of disease and services, disabilities. Economic: income, production & productivity, insurance, employment. Communications: public education, information & warning systems, media. Psychological: experience, stress, acceptance. Societal/cultural: coping strategies, cohesion, language, leaders, beliefs. Organizational: Government & NGO services, logistics, policies, laws. These indicators have underlying causes or factors that will result in someone being vulnerable to a particular situation. These factors may include; Poverty, limited access to power structures, resources, information, illness & disabilities lack of local institutions, education, training, appropriate skills, local investments, local markets, services, freedom of information, population expansion, urbanization, environmental degradation, fragile physical environment, dangerous locations, dangerous buildings, fragile local economy, low levels of

income and precarious livelihoods.

Methodology

This study therefore adopted the cross-sectional. The choice of the cross-sectional research design is because it describes situations, attitudes, views, and behaviors of individuals or a group of persons just the way they are at a point in time. The study made use of Abakiliki, Ohaukwu, Ishelu, ikwo, Ohaozara, and Onicha Local Government areas as the study L.G.A's.

The study area for this research is Ebonyi State, which is one of the states in the South-Eastern zone of Nigeria. Abakaliki is the capital of Ebonyi State. The state was created from former Enugu state and Abia state on October 1, 1996. The state which got its name from the Ebonyi River is bordered by Abia state in the south, Benue state in the north, Cross River state in the east, and Enugu state in the west. The southern zone is the geopolitical zone of Ebonyi state. Ebonyi state consists of thirteen Local Government Areas (LGA) with Abakaliki, Ohaukwu, Ebonyi, and Izzi LGAs in the North senatorial zone. Ikwo, Ishielu, Ezza North, and Ezza South are in the central senatorial zone while Onicha, Ohaozara, Ivo, Afikpo North, and Afikpo South are in the southern senatorial zone. According to the National Population Commission (NPC 2006), Ebonyi state's estimated population is 2,176,947 million people with an estimated projected population of 3,091,265 in 2021 at a 2.8% annual growth rate. 5,935 square kilometers is the total land area of the state. The State lies approximately within latitudes 5°40'0'' and 6°45'0''N and Longitudes 7°28'0'' and 8°32'0''E (NPC 2006). See Fig 3.1 and 3.2 below.

The predominant tribe in Ebonyi state is the Igbo tribe. The non-Igbo speaking population is found in the state which includes the Okpotos and Ntezis who are in Ishielu LGA. The study area is drained by the Ebonyi river tributaries according to (Awoke and Okorji, 2004). Though a major source of water all year round, anthropogenic activities contribute greatly to the pollution of surface bodies in the study area, contributing to the water scarcity challenges.

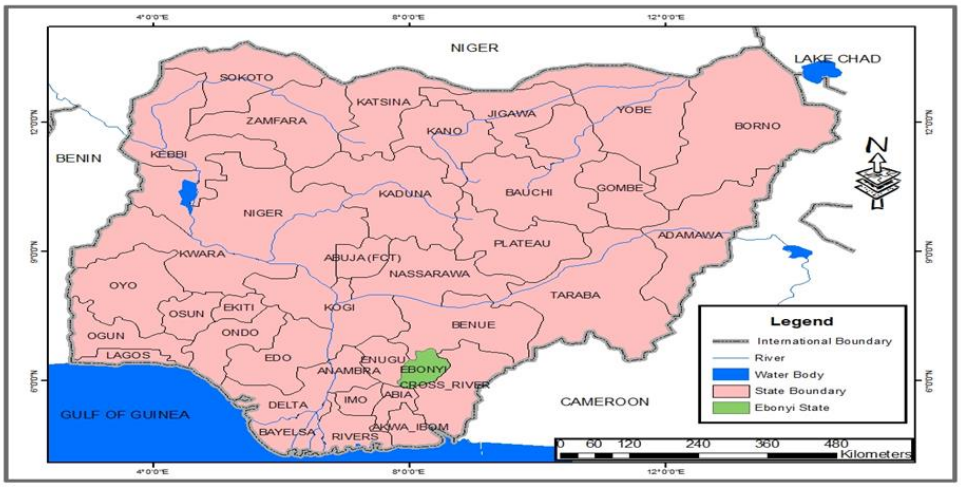

Figure 1 Nigeria Showing Ebonyi State

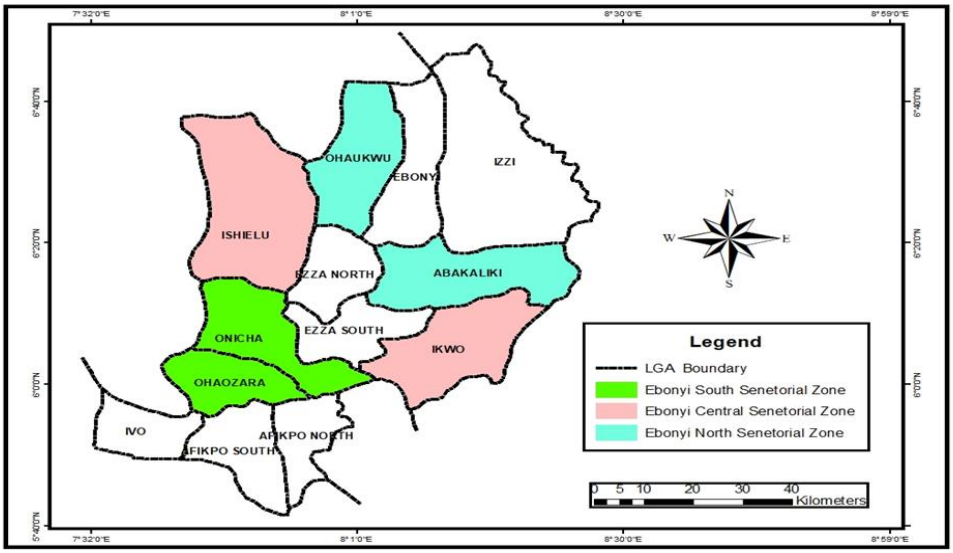

Figure 2 Ebonyi State showing sampled Local Government Areas

This study adopted the Vulnerability Index (VI) methodology to determine the vulnerability to water scarcity. The VI was used by Kusumartono and Rizal (2019) in the determination of water scarcity vulnerability in some small Islands in Indonesia in the study titled "An integrated assessment of vulnerability to water scarcity measurement in small islands of Indonesia". The study adopted the vulnerability concept with the three dimensions of adaptive capacity, sensitivity, and exposure. Indicators of the vulnerabilities were identified

in line with the dimensions and integrated into the questionnaire design. Data were analyzed and normalized for the vulnerability score to range between 0 and 1 with 1 as the highest vulnerability score. Equal weighting was adopted for the indicators thereby equating them to unity or 1. The mathematical equation for the vulnerability index calculation is shown below in equation 1.

$$WPI = \frac{\sum_1^N w_i X_i}{\sum_1^N w_i} \qquad i = 1 \tag{1}$$

Where W is the weighted average of the dimension indicators, X is the Dimensions indicators.

The results are in Table 1.

Table 1 Water Poverty Index in the Study Area

Senatorial Zone	LGAs	Resources	Access	Capacity	Use	Environment	WPI
North	**Ohaukwu**	62.17	41.08	41.07	46.65	40.53	**46.30**
	Abakaliki	71.07	62.75	53.30	28.30	58.85	**54.85**
Central	**Ishielu**	58.87	37.17	37.73	53.30	33.30	**44.07**
	Ikwo	57.73	37.18	35.53	49.95	22.23	**40.52**
South	**Ohaozara**	61.07	48.32	46.63	44.95	43.30	**48.85**
	Onicha	63.30	46.62	51.07	38.30	41.10	**48.08**
Overall WPI Score							**47.11**

Table 1 shows the water poverty index of the study area, Ohaukwu LGA scored 62.17 for the resource's component of the WPI. The LGA also scored 41.08 for access, 41.07 for capacity, 46.65 for use, and 40.53 for environment components. Ohaukwu therefore scored 46.30 as the overall WPI for the LGA. Abakaliki LGA scored 71.07 for the resources component, 62.75 for the access component, 53.30 for capacity, 28.30 for use, and 58.85 for the environment component. The overall WPI for Abakaliki LGA is 54.85.

The resources component score for Ishielu LGA is 58.87. The access score is 37.17, capacity is 37.73, use is 53.30, and 33.30 for the environment component. The overall WPI score for Ishielu LGA is 44.07. Ikwo LGA scored 57.73 for the resources component of the WPI. Other scores include access; 37.18, capacity; 35.53, use; 49.95 and environment; 22.23. The

overall WPI score for Ikwo LGA is 40.52. Ohaozara LGA resources score is 61.07. The access component score is 48.32. The capacity score is 46.63. The use score is 44.95 while the environment score is 43.30. The overall WPI score for Ohaozara LGA is 48.85. Onicha LGA resources component score of the WPI is 63.30. The access score is 46.62. The capacity score is 51.07. The use score is 38.30 and the environment score is 41.10. The overall WPI score for Onicha LGA is 48.08.

Table 2 Water Poverty Status of the Study Area

Senatorial Zone	LGAs	WPI	Water Poverty Status
North	Ohaukwu	46.30	Unsafe
	Abakaliki	54.85	Low Safe
Central	Ishielu	44.07	Unsafe
	Ikwo	40.52	Unsafe
South	Ohaozara	48.85	Low Safe
	Onicha	48.08	Low Safe
Overall WPI Status		**47.11**	**Unsafe**

Table 2 shows the water poverty status of the selected local governments in the study area. In the north senatorial zone of Ebonyi state, Ohaukwu LGA's overall WPI score is 46.30 which translates to a water poverty status of unsafe. Abakaliki LGA's overall WPI score is 54.85, having a water poverty status of low safe.

In the central senatorial zone, Ishielu LGA's overall WPI score is 44.07 with a water poverty status of unsafe. The Ikwo LGA overall WPI score is 40.52, having a water poverty status of unsafe.

In the southern senatorial zone, Ohaozara LGA's overall WPI score is 48.85 which translates to a water poverty status of low safe. Onicha LGA's overall WPI score is 48.08 with a water poverty status of low safe. The overall WPI of the selected local government areas of Ebonyi state is 47.11 with an overall water poverty status of unsafe.

Vulnerability to water scarcity was also determined using the vulnerability Index (VI). It is made up of three dimensions adaptive capacity, sensitivity, and exposure. The indicators

were integrated into the questionnaires presented to the respondents in the study area and the vulnerability was determined by normalizing the scores to range between 0 and 1 with 1 as the highest vulnerability. The data were analyzed, and the results are presented in Table 3.

Table 3 Vulnerability Index Determination

Dimension	Indicators	Abakiliki	Ohaukwu	Ishelu	Ikwo	Ohaozara	Onicha
Adaptive Capacity	income level	0.467	0.667	0.7	0.7	0.6	0.534
	educational level	0.3	0.334	0.334	0.367	0.267	0.234
	poor water quality illness	0.634	0.767	0.834	0.867	0.734	0.7
	water affordability	0.6	0.7	0.734	0.767	0.6	0.534
	gender equity in water access	0.3	0.434	0.434	0.467	0.367	0.434
Sensitivity	below 25L usage requirement	0.834	0.5	0.4	0.434	0.534	0.7
	proximity of the water source	0. 234	0.567	0.6	0.534	0.467	0.5
	good water quality	0.334	0.467	0.467	0.534	0.534	0.467
	available natural water source	0.167	0.134	0.167	0.167	0.134	0.134
Exposure	Building withstanding heavy storm	0.267	0.267	0.533	0.733	0.4	0.4
	erosion on lands	0.334	0.667	0.634	0.7	0.4	0.7
	living in risk zones	0.367	0.667	0.533	0.7	0.634	0.5
Vulnerability Index		**0.3837**	**0.5143**	**0.5308**	**0.5808**	**0.4726**	**0.4864**
Vulnerability Ranking		**6**	**3**	**2**	**1**	**5**	**4**
Overall Vulnerability index		**0.495**					

The table shows the vulnerability index (VI) of the selected local governments in the study area. In the north senatorial zone of Ebonyi state, Ohaukwu LGA VI score is 0.5143 with a vulnerability ranking of 3 among the selected LGAs. Abakaliki LGA scored 0.3837, with the least rank and indicating the least vulnerable LGA. In the central senatorial zone, Ishielu LGA's overall VI score is 0.5308 with a vulnerability ranking of 2. This is following Ikwo LGA with a VI score of 0.5808, having the highest vulnerability among the LGAs with a rank of 1. In the southern senatorial zone, Ohaozara LGA VI score is 0,4726 which translates to a rank of 5, while Onicha LGA score is 0.4864 with a rank of 4. The overall VI of the selected local government areas of Ebonyi state is 0.495, indicating a mid-level vulnerability.

Discussions

The study showed the vulnerability index (VI) of the selected local governments in the

study area. The explanations of the WPI are consistent with the Vulnerability Index determination. Both indices showed that the state is vulnerable to water scarcity with an overall VI score of 0.495, indicating a mid-level vulnerability, and a WPI score of 47.11, indicating an unsafe water poverty status. This finding agrees with Vyver (2016), in the study titled "A Comparison of the Water Poverty and Water Vulnerability Indices" where the findings revealed that the two indices led to similar conclusions when the overall score is considered. This also agrees with the study by Plummer, Loe, and Armitage (2012), where both indices were listed as water vulnerability assessment tools. This therefore gave credence and further supports the use of the water poverty index in the determination of vulnerability. The VI result further showed that Abakaliki LGA with a 0.3837 VI score is the least vulnerable. This can be attributed to the urban status of the area being the state capital. Ikwo LGA was observed to be the most vulnerable LGA with a VI score of 0.5808.

Conclusions and Recommendations

The study however concludes that the state's vulnerability index is ranked at mid-level vulnerability and therefore recommends that Community leaders and household heads should make deliberate efforts to engage Government and Non-Government representatives for support in capacity building on training of skilled manpower to support the operation and maintenance of water supply facilities, water preservation, treatment, and conservation techniques within the study area to empower households to ensure effective management of water resources.

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