INFORMAL WATER VENDING IN YENAGOA, BAYELSA STATE , NIGERIA

ODAFIVWOTU. OHWO

Abstract

The aim of this study was to examine the pattern of informal water vending in Yenagoa metropolis. The study adopted the survey design, which involved field observation and the administration of two sets of 100 and 400 questionnaires, which were administered to water vendors and households respectively, in ten randomly selected communities, using the systematic sampling technique. The data were analyzed using descriptive statistics. The findings revealed that 61.30% of households depended on informal water vendors for their water supply, as 59.48% of households do not have water connection. However, the activities of the informal vendors were not well appreciated and regulated by government. This also influenced households' poor rating of their services. The water vending business was more prominent in areas that were occupied by the less privileged, which lack public water utility, thus validating the underclass hypothesis. It is recommended that government should integrate informal water vendors into the mainstream of water provision in the town by establishing a legal regulatory framework, which would help to achieve safe and affordable water supply to the inhabitants.

Keywords: *Informal water vending, fixed point vendors, mobile vendors, households, underclass, Yenagoa*

Introduction

Adequate water provision in Nigerian cities appears to be decreasing and deteriorating (Ohwo, 2016) due to the high rate of urban expansion and population growth which had far outstripped the level of public water provision. Unfortunately, studies have shown that the poor in urban areas are the worst affected by poor public water services, which has compelled many poor households to end up buying water from vendors at great expense (Ohwo & Abotutu, 2014; Lagos Water Corporation, 2013; Onyenechere, Eleazu, Azuwike, Osuji & Igwe, 2012; United Nations Development Programme, 2011), in some cases more than ten times higher than the cost of public water provision, due to uneven spatial distribution of pipe borne water in urban centres.

Urban studies have revealed that the spatial distribution of public services, which water provision is an important part, is unevenly distributed (Swyngedouw, 2006) in favour of a few privileged (who can afford higher cost of water) to the disadvantage of the less privileged in the society, who have poor income (Olajuyigbe, Rotowa and Adewumi, 2012). This statement encapsulates the concept of the underclass, hence its adoption as the conceptual framework for the study. Although this concept has been defined in several ways by deferent authorities, however most of the definitions focused on a group of people who have been deprived, marginalized and generally concentrated in parts of a city where infrastructural facilities are lacking or poorly provided, due to discrimination by public authorities. The underclass in Nigerian urban centres relies heavily on the urban informal sector for survival because it

provides ample opportunities to support their livelihoods (Onyenechere, 2011). This group of people constitute majority of those involved in informal activities (including water vending) in an urban area. Informal water vending is usually undertaken by vendors, who are unregistered and unauthorized small independent providers, who obtain water from several sources (protected or unprotected) and deliver small quantities of water to households for domestic use in a variety of ways, ranging from the use of carts and wheelbarrows, to tanker trucks (Pangare & Pangare, 2008).

This group of water providers has assisted to bridge the gap in the shortfalls of pipe water supply in urban centres. Areas where informal water vending is most prevalent in an urban centre are probably areas occupied by the underclass, where informal economic activities predominate with limited public services. To a large extent, the prevalence of informal water vending in a city or a section of it goes to show the pattern of public water distribution network or its efficient level of operations. This submission is substantiated by the United Nations Development Programme (2011) that the informal water vendors are major players in the water sector, who have helped to fill service gaps left by the deficits of the formal water system. Thus, the informal water vendors help to extend the distribution chain to areas not serviced directly by the water utilities.

The inadequate and uneven provision of public water utilities in most urban centres in Nigeria has made informal water vending an important component of the water distribution chain. Hence, this study was aimed at examining the pattern of informal water vending in Yenagoa metropolis. To achieve this aim the study seeks to provide answers to the following research questions: Who are the water vendors? What are the water vendors' business characteristics? Who are the major customers of the vendors and their water supply characteristics? How do the customers rate the water vending business in Yenagoa?

Study Area

Yenagoa metropolis is geographically located within latitudes $4^{\circ} 55'$ and $5^{\circ} 02'$ North of the Equator and about longitudes $6^{\circ} 15'$ and $6^{\circ} 25'$ East of the Greenwich meridian (Figure 1). It is the capital of Bayelsa State, Nigeria. Yenagoa lies generally on a coastal plain, with a mean height of about 15 metres above sea level (Ohwo, 2014). Its major drainages are the Ekole and Epie creeks. Yenagoa assumes a linear settlement pattern, which is characterized with poor urban planning that has made the provision of infrastructural facilities quite challenging. Although the town is surrounded by surface water bodies with adequate stock of groundwater, access to potable water is a great challenge (Ohwo & Abotutu, 2014) due to the inability of the government to harness these abundant water resources to the benefit of the people. This situation has led to the proliferation of informal water vendors, who supply households' demands for basic water needs in the town.

Figure 1: Yenagoa Local Government Area Showing the Study Area

Source: Adapted from Koinyan, Nwankwoala and Eludoyin (2013)

Method of Study

This study was designed to examine the pattern of informal water vending in Yenagoa metropolis. To achieve this aim, the study adopted the survey research method which involved the use of questionnaires, and direct field observation. The population for the study is the entire households' and informal water vendors in Yenagoa, from which a sample of 400 households and 100 water vendors were selected for the study. In order to have an adequate representation of the population, Yenagoa was structured according to the twenty major communities (quarters) that make up the town, from which ten communities (quarters) were randomly selected for the

study (Figure 1). The 400 households and 100 water vendors were systematically selected for the study from the sampled communities, which represented 40 households and 10 vendors respectively from each quarter. These figures were considered adequate for the study, using the Krejcie and Morgan (1970) table for determining sample size from a given population.

Data for the study were obtained with the aid of two sets of structured questionnaires. The first set of questionnaire was administered to the 100 sampled water vendors; while the second set was administered to the 400 sampled household heads. Both sets of questionnaires addressed vended water demand and supply issues. The water vendor questionnaire focused on the structure of water vending business and the demographic characteristics of the vendors; while the household questionnaire focused on households' demographic and water supply characteristics, and the rating of informal water vending in Yenagoa town. The obtained data for the study were analyzed using descriptive statistics.

Results and Discussion

The Water Vendors

Out of the 100 structured questionnaires administered to water vendors, 98 (98%) were returned and analyzed. The demographic characteristics of water vendors presented in Table 1 revealed that males are the dominant players as 71.43% are males, while only 28.57% are females. This was not surprising because mobile water vending is labour intensive. Majority of the vendors (41.84%) are 25 - 40 years old; while 31.63% are within the age range of 41 – 65 years, and other groups of 20.41% and 6.12% are below 25 years and above 65 years, respectively. This shows that the major players fall within the working class group of 21 – 65 years. The educational qualifications of vendors revealed that majority (47.96%) had secondary education, while 29.59% and 22.45% had tertiary and no formal/primary education, respectively. This shows that a reasonable number of them are not well equipped to fit into the formal urban sector of the economy which is a major feature of the underclass. However, they are easily absorbed by the informal sector because it is characterized by low entry barriers, reliance on indigenous/local resources, low level of education and skills, labour intensive and simple organizational structure and irregular working hours (UNECA/AAPAM, 1992). This explains why the underclass dominates informal water vending activities in urban areas.

Table 1: Demographic Characteristics of Water Vendors

Questionnaire Variable	Response Variable	Respondents	Percentage
Sex	Male	70	71.43
	Female	28	28.57
Age	Below 25 years	20	20.41
	25-40 years	41	41.84
	41—65years	31	31.63
	Above 65 years	6	6.12
Educational Qualification	No formal/Primary	22	22.45
	Secondary	47	47.96
	Tertiary	29	29.59

Source: Author's fieldwork, 2016

This work is licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](https://creativecommons.org/licenses/by-sa/4.0/)

Water Vendors Business Characteristics

Table 2 showed the data on water vendors' business characteristics. From the table, 57.14% of the vendors are into fixed point water vending, while 42.86% are engaged in mobile water vending. The female water vendors are majorly into the fixed point vending, while the males entirely dominated the mobile vending, which requires so much energy and manual labour to fetch and transport the water to customers on foot/chart or vehicle/tankers. The major water source for both fixed point and mobile vendors was borehole (87.76%), while sources such as pipe borne water, river/stream and other sources had 4.08% each. Almost all the fixed point operators sunk their individual boreholes through which water is pumped from the ground to overhead tanks where sales are made directly to consumers. Some of the fixed point operators are patronized by mobile vendors, who buy in larger quantities in jerry-cans and resell in smaller quantities to households. In a similar study by Olajuyigbe *et al* (2012) 66% of the informal vendors obtained their water from unprotected wells and only 4.2% obtain theirs from boreholes.

The major means of water transportation by the vendors was through pipe (45.92%), which was mainly indicated by the fixed point vendors, who sell directly to customers through their installed piped water network. Other means of water transportation such as cart/foot (42.82%) and vehicle/tankers (11.22%) were used by mobile water vendors. In Festac Town, Lagos, 66% of informal water vendors deliver water to their customers through the use of carts and shoulder held cans (Olajuyigbe *et al*, 2012). The major customer base of informal water vendors are households (56.12%), business enterprises (40.82%) and institutions (3.06%). Since most of the households do not have water connection, they rely on water vendors to meet their water needs. The quantity of water sold per day by 47.96% of water vendors range from 300 – 600 litres. Another group of 9.18%, 23.47% and 19.39%, respectively sold below 300 litres, 601 – 900 litres and above 900 litres. Similar figures were also reported by Onyenechere *et al* (2012). Based on the quantity sold, 40.82% of both fixed point and mobile water vendors are unable to satisfy their customers' daily water demand. The major reasons given for this situation by fixed point operators was the epileptic public power supply and high cost of fuel needed to power their pumping machines. On the other hand, the mobile vendors complain of the labour involved in the transportation of water and poor accessibility of some areas, which is a major feature in areas inhabited by the underclass.

The cost of vended water in Yenagoa varies among vendors. The major factors that influence the cost of water are its perceived quality and distance of customers from the supply source, which is majorly considered by mobile vendors. This explains the variation of the cost of 20 litres of water from below N30 – to above N50. Majority of the vendors (80.61%) sold a 20 litre jerry-can below N30, while 13.27% and 6.12% of other vendors sell between N30 –N50 and above N50 respectively. Onyenechere *et al* (2012) also reported similar cost for a 20 litre jerry-can in their study in Enugu Local Government Area. The monthly income of water vendors was determined mainly by the selling price and quantity of water sold daily. Hence, 77.55% of the water vendors earned a monthly income of below N50, 000; other groups that accounted for 18.37% and 4.08% respectively, earned between N50, 000- N100, 000 and above N100, 000. Most of the vendors that earned above N100, 000 are fixed point operators, who sell in large

quantities to both households and mobile vendors. The incomes of most of the water vendors show that they belong to the underclass and operate within their neighbourhoods where public services are lacking or in short supply.

In spite of the role that water vendors' play in water provision in Yenagoa, their activities are not well appreciated and regulated by government, as attested to by 72.45% of the operators. This situation is not peculiar to Yenagoa, as Kjellen and Mcgranaham (2006) observed that in many cities, water vending was actively discouraged by government officials. This negligence was also responsible for the loss of valuable tax income from these vendors to government, as indicated by 46.94% of operators who indicated that they do not pay any form of tax to government. Water vending in Yenagoa is a competitive business as indicated by 63.27% of the operators who stated that they faced competition from fellow operators. This explains why vendors do not freely increase the price of water to their customers as indicated by 63.27% of the operators.

Table 2: Water Vendors Business Characteristics

Questionnaire Variable	Response Variable	Respondents	Percentage
Type of water vending	Mobile vending	42	42.86
	Fixed point vending	56	57.14
Major source of water supply	Borehole	86	87.76
	Pipe borne water	4	4.08
	River/stream	4	4.08
	Others	4	4.08
Mode of water transportation	Pipe	45	45.92
	Vehicle/tankers	11	11.22
	Cart/foot	42	42.86
Major customer base	Households	55	56.12
	Business enterprises	40	40.82
	Institutions	3	3.06
Quantity of water sold per day	Below 300 litres	9	9.18
	300-600 litres	47	47.96
	601-900 litres	23	23.47
	Above 900 litres	19	19.39
Daily satisfaction of customers demand	Yes	58	59.18
	No	40	40.82
Cost of 20 litres of water	Below N30	79	80.61
	N30-N50	13	13.27
	Above N50	6	6.12
Income per month	Below N50, 000	76	77.55
	N50, 000-N100, 000	18	18.37
	Above N100, 000	4	4.08
Government appreciation and regulation	Yes	27	27.55
	No	71	72.45

Payment of tax to government	Yes	52	53.06
	No	46	46.94
Competition from fellow water vendors	Yes	62	63.27
	No	36	36.73
Freely increase cost of water to customers	Yes	25	25.51
	No	73	74.49

Source: Author's fieldwork, 2016

Vendors' Major Customers and their Water Supply Characteristics

Households are the major customers of water vendors as the underclass inhabits areas in urban centres with poor or lack of public services. To obtain data on demographic and water supply characteristics of households, a set of 400 structured questionnaire was administered to sampled household heads, out of which 385 (96.25%) were retrieved and analyzed as presented in Table 3. The sex distribution from the table revealed that 185 (48.05%) are males, while 200 (51.95%) are females, which is a good representation of both sexes. The age group with the highest percentage respondents of 56.36% was 25-40 years, while above 65 years group had the lowest with 3.12%. Respondents educational qualifications showed that majority of them are literate enough to provide reasonable responses to the questionnaire as 36.62% and 43.64% had secondary and tertiary education, respectively; while only 19.74% had either primary education or no formal education. Majority of the respondents are either self-employed (34.81%) or into business/private enterprises (34.29%); while the public service accounted for 21.04% and another group of 9.87% belongs to other occupational categories, which shows that a significant percentage of the household heads are engaged in the urban informal sector.

Responses to household size showed that 47.01% and 32.21% respectively, indicated 1-3 and 4-6 persons, while 7-9 persons and above 9 persons were indicated by 12.99% and 7.79%, respectively. The monthly income revealed that majority of the respondents are either low or medium income earners as 67.80% and 25.97% earned below N50, 000 and between N50, 000 – N150, 000, while only 6.23% earned above N150, 000. The income distribution explains why a significant number of respondents indicated vendors as their major water supplier, as the low income earners lived in areas with poor or no water connections in their homes and had to depend on water vendors for their daily water needs.

Households' water connection promotes good sanitation and hygiene practices. However, in Yenagoa, most households (59.48%) do not have water connection, hence, majority of the households (61.30%) relied on water vendors as major suppliers of both domestic and drinking water for their respective households. In spite of the reliance of most households on water vendors, 43.64% of households are not aware of their vendor's major source of water. This scenario is unhealthy as vendors are known to obtain water from varied sources including unprotected wells and streams (Onyenechere *et al*, 2012), which quality may not be guaranteed (Ohwo & Abotutu, 2014). This could lead to the contraction of infectious diseases, since the water supplied is used for drinking and domestic activities by some households.

The cost of a 20 litre jerry-can ranged from N30-N50. The price variability corresponds to varying demand and cost profiles of vendors, which was mainly influenced by the distance travelled between the water source and the point of delivery. Similar reason for the price

variability of vended water was also advanced by water vendors in a study by the United Nations Development Programme (2011) in Dar es Salaam. The price variability of vended water coupled with variation in the quantity of water demanded by households influenced the daily amount spent by households for water provision. For example, 52.47% of households spent a minimum of N100-N200 per day for the purchase of water, which translates to a monthly bill of between N3, 000 –N6, 000, on a national minimum wage of N18, 000. A study by Ohwo and Abotutu (2014) reported a monthly bill of N4, 500 for the purchase of vended water by households. Unfortunately, most of the households that spent this amount were households that earn limited income through their informal economic activities.

Table 3: Demographic and Water Supply Characteristics of Households

Questionnaire Variable	Response Variable	Respondents	Percentage
Sex	Male	185	48.05
	Female	200	51.95
Age	Below 25 years	60	15.58
	25-40 years	217	56.36
	41—65years	96	24.94
	Above 65 years	12	3.12
Educational Qualification	No formal/Primary	76	19.74
	Secondary	141	36.62
	Tertiary	168	43.64
Occupation	Self employed	134	34.81
	Public service	81	21.04
	Private/Business	132	34.29
	Others	38	9.87
Household Size	1-3	181	47.01
	4-6	124	32.21
	7-9	50	12.99
	Above 9	30	7.79
Monthly Income	Below N50, 000	261	67.80
	N50, 000 – N150, 000	100	25.97
	Above N150, 000	24	6.23
Households' water connection	Yes	156	40.52
	No	229	59.48
Vendors as major supplier of domestic and drinking water	Yes	236	61.30
	No	149	38.70
Awareness of vendor's major water source	Yes	217	56.36
	No	168	43.64
Household water cost per day	Below N100	183	47.53
	N100-N200	98	25.46
	Above N200	104	27.01

Source: Author's fieldwork, 2016

Water Vending Business Rating by Customers

Households' rating of informal water vending in Yenagoa was determined based on five major variables as presented in Table 4. Regarding the first variable, cost of water sold by vendors, 55.84% households indicated either unsatisfactory or very unsatisfactory because of the amount of the household's budget that is spent in the purchase of water. Responses to vendors' major source of water supply revealed that 49.35% of the respondents considered it as either very satisfactory or satisfactory, while 50.65% considered it as unsatisfactory or very unsatisfactory.

This work is licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](https://creativecommons.org/licenses/by-sa/4.0/)

This response pattern was because of the various sources of vendors' water supply, which are both protected and unprotected. Similarly, majority of the respondents (55.59%) are unsatisfied with vendors' mode of water handling and transportation, which is dominated by 20 litres jerry-cans and transported by carts/foot and vehicles by mobile vendors. Hence, 52.98% of respondents are unsatisfied with the quality of water supplied by vendors, while only 47.02% are satisfied. In the same vein, 47.28% of respondents are satisfied, while 52.72% are unsatisfied with the quality of service and flexibility in the quantity of water sold by vendors. This is not unconnected with the fact that 40.82% of water vendors are unable to satisfy the daily water demands of their customers (see Table 2). Similar household rating of water vendors was also reported by Olajuyigbe *et al* (2012) where 58.6% of respondents were unsatisfied with the limited capacity of vendors in meeting their households' water needs.

Table 4: Households' Rating of Informal Water Vending in Yenagoa

Variable	Very satisfactory	Satisfactory	Unsatisfactory	Very unsatisfactory
	Response (%)	Response (%)	Response (%)	Response (%)
Cost of water sold by vendors	61 (15.84)	109 (28.31)	139 (36.10)	76 (19.74)
Vendors major source of water supply	63 (16.36)	127 (32.99)	145 (37.66)	50 (12.99)
Mode of water handling and transportation by vendors	47 (12.21)	124 (32.21)	171 (44.42)	43 (11.17)
Quality of water supplied by vendors	59 (15.32)	122 (31.69)	145 (37.66)	59 (15.32)
Quality of service and flexibility in the quantity of water sold by vendors	58 (15.06)	124 (32.21)	140 (36.36)	63 (16.36)

Source: Author's fieldwork, 2016

Conclusion

Informal water vending plays a significant role in water provision in Yenagoa, as 59.48% of households do not have water connection. Hence, 61.30% of sampled households depended on water vendors for both domestic and drinking water supply. However, households rated informal water vending in Yenagoa below average as none of the five rating parameters (cost of vended water; vendors' major source of water supply; quality of water supplied by vendors; mode of water handling and transportation by vendors; and quality of service and flexibility in the quantity of water sold by vendors) had a satisfactory rating of up to 50% due to concerns on water quality, vendors' major sources of water supply and price consideration.

Water vending is a business and some of the operators (fixed point vendors) earned reasonable income from it; however, water vendors' role in water provision in Yenagoa is not

well appreciated and regulated by government as attested to by 72.45% of the operators. This is because the water vendors belong to the urban informal sector that is poorly regulated and operate in areas mostly inhabited by the underclass, where public facilities are lacking. This clearly validates the underclass hypothesis which posits that the poor are discriminated against by public officials in the provision of public facilities. In order to achieve improved and sustainable water supply in Yenagoa, deliberate efforts must be made by government to integrate this group of water providers into the mainstream of the water supply network in the town by establishing a legal regulatory framework, which would help to achieve safe and affordable water supply to the inhabitants that live in areas that are lacking or having poor public water utility. In addition, government should enhance the capacity and efficiency of the public water utility so that more households, business enterprises and institutions can be connected.

References

- Kjellen, M and Mcgranaham, G (2006) Informal Water Vendors and the Urban Poor, Human Settlements Discussion Paper Series, Theme: Water-3, International Institute for Environment and Development (IIED)
- Koinyan, A. A., Nwankwoala, H. O. and Eludoyin, O. S. (2013) Water Resources Utilization in Yenagoa, Central Niger Delta: Environmental and Health Implications, *International Journal of Water Resources and Environmental Engineering* Vol.5 (4):177-186, [Online] <http://www.academicjournals.org/journal/IJWREE/article-full-text-pdf/0B227F73306> [Accessed July13, 2015]
- Krejcie, R. V and Morgan, D. W (1970) Determining Sample Size for Research Activities, *Educational and Psychological Measurement*, 30: 607-610 [Online] http://home.kku.ac.th/sompong/guest_speaker/KrejcieandMorgan_article.pdf [Accessed July13, 2015]
- Lagos Water Corporation (2013) Stakeholders/CSO Interaction with LSWC [Online] www.Lagoswater.org/news.php?page=51 [Accessed October 12, 2014]
- Ohwo, O (2014) Housing Quality in Yenagoa, Bayelsa, State, Nigeria, *Nigeria Geographical Journal, New Series*, Vol. 10 (1): 53-67.
- Ohwo, O (2016) Challenges of Public Water Provision in Nigerian Cities: A Review, *Journal of Water, Sanitation and Hygiene for Development*, 06.1, 1-12
- Ohwo, O and Abotutu, A (2014) Access to Potable Water Supply in Nigerian Cities Evidence from Yenagoa Metropolis, *American Journal of Water Resources*, Vol. 2, No. 2: 31-36. doi: 10.12691/ajwr-2-2-1
- Olajuyigbe, A. E; Rotowa, O. O and Adewumi, I. J (2012) Water Vending in Nigeria - A Case Study of Festac Town, Lagos, Nigeria, *Mediterranean Journal of Social Sciences* Vol.3 (1): 229-239, Doi: 10.5901/mjss.2012.03.01.229

- Onyenechere, E. C. (2011) The Informal Sector and the Environment in Nigerian Towns: What We know and what we still need to know, *Research Journal of Environmental and Earth Sciences* 3(1): 61-69
- Onyenechere, E. C; Eleazu, E.I; Azuwike, O. D; Osuji, S and Igwe, C. F (2012) The Dynamics of Domestic Water Vending in Enugu North L.G.A. of Enugu State, Nigeria, *Journal of Water Resource and Protection*, 4, 224-230 <http://dx.doi.org/10.4236/jwarp.2012.44025>
- Pangare, G and Pangare, V (2008) Informal Water Vendors and Service Providers in Uganda: The Ground Reality, The Water Dialogues [Online] www.waterdialogues.org/.../InformalWaterVendorsandServiceProvidersinUganda.pdf [Accessed July 10, 2016]
- Swyngedouw, E (2006) Power, Water and Money: Exploring the Nexus, Human Development Report Office Occasional Paper, United Nations Development Programme
- UNECA/AAPAM, (1992). Mobilizing the Informal Sector and NGOs for African Economic Recovery and Development: Policy and Management Issues, Report of 12th AAPAM Conference, Abuja.
- United Nations Development Programme (2011) Services and Supply Chains: The Role of the Domestic Private Sector in Water Service Delivery in Tanzania, Bureau for Development Policy, UNDP [Online] www.undp.org/content/dam/undp/.../Inclusive%20development/Tanzania-Water.pdf [Accessed October 8, 2016]

Author's Profile

Dr Odafivwotu Ohwo is a lecturer in the Department of Geography and Environmental Management, Niger Delta University, Wilberforce Island. He teaches courses and supervises research projects at both the postgraduate and undergraduate levels. His research interest is in Environmental Management, with bias in water resource management, sanitation and hygiene and climate change. He has published extensively in these areas in both international and national journals, such as the *America Journal of Water Resources*; *Journal of Water, Sanitation and Hygiene for Development*, published by the *International Water Association*; *British Journal of Applied Science and Technology*; *Nigerian Geographical Journal* amongst others. He has also peer reviewed research papers for *British Journal of Applied Science and Technology*. He was a visiting senior research consultant for Domino Information Coy, Lagos, from 2007-2012. He is currently the departmental coordinator of postgraduate programmes and undergraduate fieldwork studies. He is a member of learned professional societies such as the Association of Nigerian Geographers; Nigerian Cartographic Association, and Nigerian Environmental Society.