Evaluation of Household Water, Sanitation, and Hygiene Management in a Nigerian Rural Community

Ojima Zechariah Wada¹², David Bamidele Olawade²*, Omotayo Asogbon², Fiyinfoluwa Taiwo Makinde³ and Ismaeel Adebayo⁴

¹Division of Sustainable Development, College of Science and Engineering, Hamad Bin Khalifa University, Doha, Qatar.
²Department of Environmental Health Science, University of Ibadan, Ibadan, Nigeria.
³Department of Biomedical Science, De Montfort University, Leicester, United Kingdom.
⁴Department of Chemical Engineering, Nanjing University of Science and Technology, China.

Authors’ contributions

This work was carried out in collaboration among all authors. Author OZW designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Authors DBO and OA managed the analyses of the study and wrote the protocol. Authors FTM and IA managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJTDH/2021/v42i530455

Editor(s):
(1) Dr. Cihad Dundar, Ondokuz Mayis University, Turkey.

Reviewers:
(1) Muhibul Haque Bhuyan, Southeast University, Bangladesh.
(2) Alyaa Jabbar Hamid, Al-Furat Al-Awsat Technical University, Iraq.

Complete Peer review History: http://www.sciarticle4.com/review-history/67466

Received 08 February 2021
Accepted 16 April 2021
Published 20 April 2021

ORIGINAL RESEARCH ARTICLE

ABSTRACT

The Water, Sanitation, and Hygiene (WASH) disparities between the rural and urban areas have hindered the Sustainable Development Goal 6. Recent data is required in our bid to tackle this menace effectively. This study aimed to provide data on the status of household WASH facilities in a remote village in Southwestern Nigeria. The survey was cross-sectional in design, and total sampling was used to select 70 household respondents. Data were obtained via observational checklists, questionnaire, and key informant interview guide. Data was entered and analyzed using SPSS 20. Descriptive statistics like measures of frequency and proportions were used. The respondents had a mean age of 43.1 ± 16.4 years, only 2.9% had tertiary education. The village had two handpump boreholes provided by the Water Supply and Sanitation Sector Reform Programme (WSSSRP)-II. All the respondents reported that the boreholes were their primary

*Corresponding author: Email: olawadedavid@gmail.com;
drinking water source, and water was available all through the year. In over 80% of households, females were assigned the duty to fetch water, while most households had the boreholes within 30 minutes from their houses. The sanitation facilities were also provided via the WSSSRP-II. The majority (90%) of the respondents owned pit latrine with slab, of which only 10% shared their facilities with other households. Most (95.7%) of the respondents still practised open defecation at instances they could not access their household latrines. All the toilets had water for handwashing, and the soap commonly used by community members was palm kernel ash. The condition of water and sanitation in the village was quite progressive. However, subsequent interventions should ensure toilet facilities are available in non-household settings like farms and markets.

Keywords: Sustainable development goal 6; water; sanitation and hygiene; water supply.

1. INTRODUCTION

Sustainable Development Goal (SDG) 6 aims to ‘Ensure availability and sustainable management of water and sanitation for all’ and comprises WASH-related indicators such as population-open defecation practice and household accessibility to basic WASH services. So far, the achievement of this global goal has been marred with disparities. As of 2017, it was estimated that 758 million people were without access to safely managed drinking water services. Around 3.5 billion people lacked access to safely managed sanitation services, while 3 billion people had no access to essential handwash services at home [1].

The disparities between low-income and high-income countries and between urban and rural regions have been clearly revealed. Based on a WASH Watch report [2] in 2017, around 94% of the population in Northern America and Europe had access to safely managed drinking water. Only around 24% of the population in Sub-Saharan Africa (SSA) had such access. The SSA region has been estimated to have the highest number of people without access to safe water [3]. Furthermore, a report by the United Nations Children’s Fund and World Health Organization (WHO) revealed that nine from every ten persons that lacked access to basic water services resided in rural areas. Also, nine out of every ten open defecators resided in the rural area [1].

Narrowing the situation to Nigeria, the situation seems despicable. In September 2018, the Nigeria Government declared Emergency in the WASH sector due to the deplorable state of her Water, Sanitation, and Hygiene services. The relatively poor progress the country has made can be seen from the fact that only 27% of the Nigerian population used improved drinking water sources and sanitation facilities, while 23.5% of her citizens practised open defecation, making Nigeria the global capital of open defecation [4-6]. Around 64,000 under-5 children in Nigeria have been estimated to die yearly due to the lack of access to safe water, sanitation, and poor hygiene practices [7]. The vulnerable groups have also been identified as those living in low-income and rural areas [8]. Studies recently conducted among rural schools in Southwestern Nigeria reported a paucity of WASH facilities. Only 15% of the available school sanitation facilities provided basic sanitation service, while none of the hand wash facilities provided basic hygiene service. Also, the open defecation rate among students in the community was over 35%, while only 10% of the schools were open defecation free [9,10].

Another study that assessed WASH facilities in 5 communities in Northern Nigeria reported that over half of the respondents’ major drinking water source was surface water, while over 75% used pit latrines. The open defecation rate in the communities was estimated to be around 41% [11].

Furthermore, an exploratory survey recently conducted to assess WASH inequalities in Sub-Saharan Africa revealed that the disparities between rural and urban communities in the region are still widespread, thereby impeding the ability of the region to attain the related SDGs [12].

When considering the progression in global WASH from 2000 to 2017, rapid improvement had been recorded. The global urban coverage of basic water services increased from 95% to 97%, while that of the rural areas increased from 69% to 81%. The global rate of open defecation dropped from 21% to 9%, shifting from 1.3 billion people to 673 million people [1]. However, the WASH situation in the world’s largest black nation, Nigeria, seems to be peculiar. A recent report by the World Bank revealed that the country is significantly lagging in the WASH sector, and recommended proactive measures should be taken to ensure rural areas have access to basic WASH facilities [13].
Hence, this study was conducted to assess the state of WASH services in a distant rural community in Southwestern Nigeria to provide recent and relevant data about the potential WASH inadequacies and inequalities in some areas today.

2. MATERIALS AND METHODS

2.1 Study Area

The survey was conducted in Abimbola, a rural village located in Ayedaade Local Government Area, Osun State. It has an area of 1,113 km² and a population of 150,392 at the last Nigerian census. It is located at coordinate 7°19'N 21'E. The Local Government Area (LGA) shares its boundaries with Isokan, Irewole, and Aiyedire LGA to the East and Ife North to the West. It consists of over 50 districts and villages, including Abimbola. Abimbola village is an agrarian community; prominently known to produce palm oil. There are about 500 villagers and around 70 households in the area.

2.2 Study Design and Sampling Procedure

The study was cross-sectional in design. The study population consisted of members of the Abimbola rural village. Purposive sampling was used to select a household member from each of the household presents. A total of 70 respondents were selected.

2.3 Inclusion Criteria

1. The respondents selected were not less than 15 years
2. The respondent must be a member of a household in the community
3. The respondents must have lived in the community for at least 1 year

2.4 Exclusion Criteria

1. Respondents less than 18 years, whose parents did not permit to participate were excluded.
2. Community members that were not permanent residents in the village were exempted.

2.5 Data Collection Procedure

An instrument for data collection

1. Observational Checklist: This was used to assess the status of WASH facilities available to the households in the community.

2. Interviewer administered questionnaire: This was used to collect data about the management of the WASH services accessible to the villagers. One household member was selected from each home. The questionnaire was divided into four sections: A. Socio-demographic Characteristics B. Household Water Supply Management C. Household Sanitation Management D. Hand Hygiene Practices

3. Key Informant Interview: This was used to collect information pertaining to the Government’s involvement in the Local Government’s WASH sector. The LGA Sanitary Inspector Officer was engaged in the interview. Due to the possibility of a response bias, data obtained from the other instruments was used to verify some of the inspector’s information.

2.6 Community Entry

A United Kingdom registered humanitarian NGO: Livingstone Explorer Initiative conducted a health outreach in the distant community. Resource persons in the NGO had met with the community leaders and other key members to inform them about the survey. The community members welcomed the research team warmly as they were aware that such research would help maintain and improve their health and put their distant community in the global atmosphere.

2.7 Data Collection

An interviewer-administered questionnaire was administered to 70 community members, each from a different household within the village. The researcher assistants or fellow villagers did not coerce the respondents into filling the questionnaire. The researcher assistants ensured the entire questionnaire was adequately and correctly filled. The observational checklist was also used to assess the status of the WASH facilities available to the villagers.

2.8 Data management and Analysis

There was a 100% response rate. The data were properly cleaned for inconsistencies, then entered into SPSS version 20. The files were safely kept ensuring the confidentiality of data. Only descriptive statistics were used for analysis since total sampling was used, and only little
variations existed between the responses. Descriptive statistics were used to determine the measures of frequencies and proportions of WASH facilities, while graphs and charts were used to reveal the different types of services provided by the facilities. The WASH facilities available were classified based on the JMP ladders into safely managed basic, limited, and no service.

3. RESULTS

3.1 Sociodemographic Characteristics

The mean age of the respondents was 43.1 ± 16.4; details of their sociodemographic characteristics can be found in Table 1.

3.2 Status of Water Facilities

The village had two handpump boreholes within their vicinity. These boreholes were near all the households within the village. The boreholes were constructed by collaboration between the Government of Nigeria, the European Union, and UNICEF under the Water Supply and Sanitation Sector Reform Programme (WSSSRP)-II. This was boldly displayed on a billboard behind the pumps. The boreholes were in functional condition and were in use during the survey. An electricity pump borehole was also present in the village, another organization constructed this. However, this facility was not functional during the survey as the community had limited access to power. Pictures of the boreholes can be seen in Plate 1.

3.3 Status of Sanitation Facilities

A majority (90%) of the households had pit latrines as their toilet facilities, while the remaining 10% had no facility available at the time due to the unavailability of funds. The sanitation facilities owed by all the households were similar. They were all located outside their homes but nearby. They were all built with materials like wood, palm front, and roofing sheets. All the facilities were without a covering (roof), and privacy could not be guaranteed as the structures were in the open and with a height of less than 2 meters. All the facilities visited had water available. However, during community surveillance, it was observed that there were no toilets in the farms and palm oil processing centres. Pictures of some of the facilities are shown in Plates 2 and 3.

| Table 1. Sociodemographic characteristics of respondents |
|----------------------------------------------------------|
| Characteristics                                           | Frequency (N=70) | Percentage (%) |
| Gender of respondent                                      |                |                |
| Male                                                      | 24              | 34             |
| Female                                                    | 46              | 66             |
| Age of Respondent                                         |                |                |
| 15 years to 35 years                                      | 23              | 33             |
| 36 years to 55 years                                      | 29              | 41             |
| 56 years to 75 years                                      | 18              | 26             |
| Marital Status                                            |                |                |
| Married                                                   | 57              | 81             |
| Single                                                    | 13              | 19             |
| Level of Education                                        |                |                |
| No Formal Education                                       | 16              | 23             |
| Primary Education                                         | 11              | 16             |
| Secondary Education                                       | 41              | 59             |
| Tertiary Education                                        | 2               | 3              |
| Ethnic Group                                              |                |                |
| Yoruba                                                    | 66              | 95             |
| Igbo                                                      | 3               | 4              |
| Hausa                                                     | 1               | 1              |
| Religion                                                  |                |                |
| Christianity                                              | 42              | 60             |
| Islam                                                     | 28              | 40             |
| Occupation                                                |                |                |
| Farmer                                                    | 27              | 39             |
| Trader (farm produce)                                     | 29              | 41             |
| Civil servant, lumber, self-employed                      | 14              | 20             |
The Sanitation Inspector for the Local Government shed more light on the water and sanitation project. Here were some of his comments:

Question (Q): When did the water and toilet projects start?

Response (R): "about 8 years ago (2011) as they (Government and donor agencies) made 2 to 3 manual borehole facilities available in each community and ensured that a household is entitled to one toilet facility which is the covered pit latrine across the thirteen (13) villages in the Local Government. Representatives from the agencies and ministry of the environment from the State come around for inspection and maintenance."
Q: How often do they come for inspection?

R: “Once in a month for inspection and health education.”

Q: Did the agencies sponsor the building of all toilet facilities?

R: “every household dug the toilet pits but the agencies helped to seal and cover it as supposed.”

3.4 Status of Handwash Facilities

There were no conventional handwash stations present in any of the households. The conventional handwash containers present were kettle and open buckets. The soap commonly owned by community members was palm kernel ash, a byproduct of one of their significant farming activities. Plate 4 shows of palm kernel ash byproducts at a palm oil processing plant within the village.
3.5 Water Supply Management

All the respondents reported that their main source of drinking water was the community boreholes; they all also affirmed that water from the borehole is available all through the year. Details of the respondents' responses can be found in Table 2. The Local Government Sanitary Inspector corroborated the respondents' collective responses about the conditions of the water provided. Here are his responses when asked the following relevant questions:

Q: What was the source of water in the villages before the intervention of the water scheme?
R: “we use the river and rain harvesting which we do not use again since the availability of the facilities.”

Q: Have there been times when there was no water from the pump?
R: “No, water is always available both in rainy and dry season except when the pump is faulty.”

Q: How often does the water pump have issues and how soon do you get a response to fix it from those concerned?
R: “The water pumps do not really have issues frequently, but when we make a complaint, they come around to fix it in about three days after we reach them.”

Q: Have there been any outbreaks or prevalence of any water-borne disease?
R: “Not recently. There was an outbreak of guinea worm infections and Cholera sometimes ago but that was before the water facilities were made available.”

Q: Like how many years ago?
R: “About 16 years ago. Since the intervention, when we observe any abnormalities in the physical status of the water like colour, odour, insects in the water, we send a notice to the agencies as they come around to treat the water.”

Q: How often do they come around?
R: “Monthly as a treat with chlorine powder and other things.”

Q: Is it the same set of people that come for water management inspection that does toilet sanitary and hygiene inspection?
R: “No. For water inspection, representatives come from the state once in a month as they check the facilities. They service and repair the pumps when necessary as they also make available their phone numbers if we have any complaint afterwards.”

Table 2. Water Supply Management

| Variables                              | Frequency (N=70) | Proportion (%) |
|----------------------------------------|------------------|----------------|
| Main Source of Drinking Water          |                  |                |
| Borehole                               | 70               | 100            |
| Availability of Water all through the year |                |                |
| Yes                                    | 70               | 100            |
| Distance to a water source             |                  |                |
| Less than 30 minutes                   | 69               | 99             |
| Over 30 minutes                        | 1                | 1              |
| Storage of Drinking Water              |                  |                |
| Plastic Container                      | 46               | 66             |
| Clay Pot                               | 24               | 34             |
| Personnel-in-charge of Fetching Water  |                  |                |
| Father                                 | 1                | 1              |
| Mother                                 | 44               | 63             |
| Female Child Under-18                  | 14               | 20             |
| Young Adult                            | 11               | 16             |
| Treatment of Drinking Water            |                  |                |
| Chlorination                           | 69               | 99             |
| No Treatment                           | 1                | 1              |
| Experience of Waterborne Disease within Family |            |                |
| Yes                                    | 1                | 1              |
| No                                     | 69               | 99             |
3.6 Household Sanitation Management

Table 3 consists of the respondents’ responses about their household sanitation management.

The Sanitation Inspector was also asked about their role in ensuring adherence; here are the relevant questions and responses given:

Q: Do you observe routine sanitation inspection?
R: “Yes. We do environmental sanitation weekly on Wednesdays for the market and last Saturdays of the month we do generally for households in the communities.”

Q: Do the sanitation inspectors emphasize handwash?
R: “Yes. They teach the villagers in the communities by demonstrating how to hand wash is properly done, emphasizing that each toilet should have soap available as they inspect.”

3.7 Respondents’ Handwash Practice

All (100%) the respondents reported that they washed their hands after using the toilet, while 99% affirmed that they practice handwashing before eating. A majority (97%) reported using soap and water to wash their hands. The two reasons outlined by some respondents for skipping handwashing were the absence of handwash stations at home (1%) and the feeling that handwashing is not an important activity (9%). The Sanitary Inspector was also asked about handwashing, here is the conversation:

Q: Were the villagers taught how to engage "hand wash" and how often do you observe health education?
R: “Yes (they are taught), (health education is observed) on a monthly basis.”

| Variable                                           | Frequency (N=70) | Proportion (%) |
|----------------------------------------------------|------------------|---------------|
| **Type of Toilet Facility**                        |                  |               |
| Pit Latrine (with slab)                            | 63               | 90            |
| Bucket Latrine                                     | 6                | 9             |
| None                                               | 1                | 1             |
| **Condition of Toilet Facility**                   |                  |               |
| Shared with other households                       | 7                | 10            |
| Not Shared                                         | 63               | 90            |
| **Personnel in charge of cleaning a toilet**       |                  |               |
| Mother                                             | 32               | 46            |
| Young Adult                                       | 38               | 54            |
| **How often toilets are cleaned**                  |                  |               |
| Daily                                              | 52               | 74            |
| At least once weekly                               | 15               | 22            |
| Once in a while                                    | 3                | 4             |
| **Availability of water in the toilet**            |                  |               |
| Yes, Always available                              | 70               | 100           |
| **Is the toilet comfortable to use**               |                  |               |
| Yes, it is                                         | 55               | 79            |
| No, it is not due to offensive odour               | 15               | 21            |
| **Defecate in other places besides the facility at home?** |                  |               |
| Yes, I do                                          | 67               | 96            |
| No, I do not                                       | 3                | 4             |
| **If yes, where do you defecate (N=67)**           |                  |               |
| Bush                                               | 67               | 100           |
| **Injury/attack during open defecation practice**  |                  |               |
| Scorpion bite                                      | 1                | 2             |
| Wounds due to sharps in the bush                   | 2                | 3.0           |
4. DISCUSSION

4.1 Sociodemographic Characteristics

The rustic nature of the village could be easily inferred from some of their sociodemographic characteristics. Only 2.9% of the respondents had attained tertiary education, and their major occupations were farming (38.6%), and trading of farm produce (41.4%). These statistics are like those obtained in some other surveys conducted in rural areas [14,15].

4.2 Water, Sanitation and Hygiene Management in Abimbola Village

The Government of Nigeria, the European Union, and UNICEF's collaboration to ensure that villages in the Local Government had access to improved water and sanitation facilities is quite commendable. The strategy employed by the agencies is also worthwhile. The provision of manual handpumps as opposed to electricity-powered boreholes with elaborate piping systems ensured that the villagers had constant access to a water supply. This is indeed a much more sustainable means of ensuring rural communities with zero or limited to electricity could have access to water all year round. Another survey that assessed the quality of the water supplied by the handpumps in the study location revealed that based on the drinking water parameters assessed, the water was safe for drinking [16]. The technical know-how and resources required to maintain an electric borehole pump and the pipe networks cannot be compared to that of a handpump [17]. The presence of resource persons within the LGA to carry out maintenance activities on the handpumps also ensured the facilities were long-lasting. Results from a rural water survey in Swaziland also affirmed that the imposition of facilities that required a level of technical know-how beyond the rural dwellers' capacity. The unavailability of spare parts was a key factor contributing to why many rural water supply schemes were not sustainable [18].

Examining other rural water supply studies in Nigeria, the situation in Abimbola village was better. Among rural communities in Ibadan, the most accessible water source reported was surface water [19]. A study by Okafor and Nwude examining the water supply of communities in Akwa Ibom State, Nigeria, revealed that the motorized pump boreholes provided by the State Government in Ibaka community were not functional due to erratic power supply and poor maintenance. The locals were left with no choice but to depend on privately owned boreholes and a stream [20]. Another study examining the progress of the Oyo State Rural Water and Sanitation (WATSAN) Project revealed that a major challenge with the boreholes provided for rural areas in Oyo State was the absence of maintenance structures. It was also noted that the handpump facilities provided in one of the communities visited had lasted for close to a decade, while the motorized pump borehole provided could not even last up to a year due to poor maintenance 19]. Rural areas are typically known to lack basic infrastructures like good road networks, basic healthcare facilities, and power supply [15, 21]. This makes it important for future rural interventions in other communities to build locally sustainable facilities.

Furthermore, the nearness of the water sources to the villager's houses was also praiseworthy. A review paper by Ishaku reported that 70% of rural households in Nigeria were without access to improved water supply and that this faction depended on unimproved sources like streams and water ponds. The same review also reported that the majority of the women and children in these affected communities walked for over 3 km to obtain water for domestic purposes [22]. Another review on rural WASH in Sun-Saharan Africa in 1999 reported that the average amount of time expended on fetching water was 134 minutes/day, and the average amount of water available for use was 10 L/person/day [23]. However, in recent times notable progress has been made in increasing the accessibility of rural areas in Sub-Saharan Africa to WASH facilities. The African Developmental Bank Group has attributed a significant part of this progress to increased investment by Governments and donor organization, as observed in the study location [24].

The partnership between the organizations and the villagers in ensuring each household had access to improved sanitation facilities was also astounding. This relieved the pressure on the villagers, who would have probably found it difficult to construct concrete pit latrine slabs and seal the pits appropriately. The construction of sanitation facilities with readily available materials like wood and palm fronts makes maintenance less of a burden. However, there could be challenges accessing the facilities accessed while it rains or at night. The simple pit
5. CONCLUSION AND RECOMMENDATION

The condition of water and sanitation in the village was quite impressive. A report by the World Bank estimated that over 50% of rural areas did not have access to improved drinking water sources and sanitation [19]. Another estimate by the Federal Government of Nigeria via the Ministry of Water Resource reported that the coverage for basic sanitation service in rural areas to be at 27% [30]. However, 90% of the households in this village had access to unshared improved sanitation, and all the community members had access to improved drinking water sources. Both the water and sanitation facilities available in the village provided at least basic service. Moreover, the donor agencies’ noble assistance to provide sustainable facilities (made with locally available materials) in the form of manual handpump boreholes and pit toilets should be imbibed by other organizations. This ensures the local communities can maintain the facilities with little or no assistance long after the project. The cost of building, utilizing, and maintaining facilities like electric boreholes and pour-flush or septic latrines commonly found in urban areas is significantly higher. An upgraded traditional pit latrine has been estimated to cost less than USD 50, while three compartments of pour-flush toilets combined with urinary and washing facilities cost between USD 10,000 to USD 15,000 [31].

Furthermore, future community-based sanitation interventions should account for the availability of sanitation facilities in non-household areas like farms, worship centres, markets, and other institutions. This ensures open defecation is not practised when locals are outside their homes. Therefore, institutional leaders like religious leaders and market heads need to be consulted alongside the community leaders. Also, the use of ash as soap for handwash could be addressed by educating the villages about local ways to make soap. A more acceptable soap can be made with local materials such as ash, soft water, fat, and soap molds which are all locally available [32].

CONSENT

Verbal and written consent approval was obtained from the village head and every study participant to engage the villagers in the survey. Parents of respondents gave consent under the age of 18; assent was also gotten from such individuals.

ETHICAL CONSIDERATION

An ethical approval could be obtained from a review board due to the time constraint; the
research took place during a health outreach in a distant village. We only had a narrow timeframe to collect sufficient information to collect valuable data and create awareness about the current state of rural WASH in Nigeria.

**FUNDING**

This research was funded by the Livingstone Explorers Initiative International.

**ACKNOWLEDGEMENT**

Special thanks to the Livingstone Explorer initiative for their assistance in data management. Also, we appreciate the village head and residents of Abimbola village for their participation in the study.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

**REFERENCES**

1. WHO/UNICEF. Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines. Geneva: World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF). Licence: CC BY-NC-SA 3.0 IGO; 2017

2. WASH Watch. Counting how many people have water, sanitation and hygiene by Stuart Kempster; 2017. Available: https://www.washwatch.org/en/blog/counting-how-many-people-have-water-sanitation-and-hygiene/

3. UNICEF. UNICEF Conveys Key Players in Sanitation Markets in West Africa; 2018b. Available: https://www.unicef.org/wca/press-releases/unicef-convenes-key-players-sanitation-markets-west-africa

4. Water Aid. WASH and inequalities Post-2015 Tool kit; 2015. Available: https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/7%20WASH%20and%20inequalities.pdf

5. Ezeh OK, Agho KE, Dibley MJ, Hall J, Page AN. The impact of water and sanitation on childhood mortality in Nigeria: Evidence from demographic and health surveys, 2003–2013. Int. J. Environ. Res. Public Health. 2014;11:9256–9272. DOI: 10.3390/ijerph110909256.

6. Wardlaw T, Salama P, Brocklehurst C, Chopra M, Mason E. Diarrhoea: Why children are still dying and what can be done. Lancet. 2010;375:870–872. DOI: 10.1016/S0140-6736(09)61798-0.

7. UNICEF. Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. UNICEF; 2017. Available: https://www.unicef.org/publications/index_96611.html

8. NDHS. Nigeria Demographic and Health Survey Abuja, Nigeria and Rockville, Maryland, USA: National Population Commission (NPC) and ICF International; 2013.

9. Wada OZ, Oloruntoba EO, Adejumo M, Aluko OO. Classification of Sanitation Services and Students’ Sanitation Practices among Schools in Lagos, Nigeria. Environment and Natural Resources Research 2020. 2020;10(3). Available: https://doi.org/10.5539/enrr.v10n3p55

10. Wada OZ, Oloruntoba EO. Safe Reopening of Schools During COVID-19: An Evaluation of Handwash Facilities and Students’ Hand Hygiene Knowledge and Practices. European Journal of Environment and Public Health 2021, 5(2), em0072. Available: https://doi.org/10.21601/ejeph/9704

11. Sridhar MKC, Okareh OT, Mustapha M. Assessment of knowledge, attitudes, and practices on water, sanitation, and hygiene in some selected LGAs in Kaduna State, Northwestern Nigeria, Journal of Environmental and Public Health. 2020;Article ID 6532512. DOI:https://doi.org/10.1155/2020/6532512

12. Ohwo Odafiwotu. Dimensions of inequality in urban and rural water, sanitation and hygiene services in Sub-Saharan Africa. European Scientific Journal. 2019;5(8). DOI:10.19044/esj.2019.v15n8p144

13. World Bank. NG Sustainable Rural Water Supply and Sanitation Sector Project (P170734). Project Information Document (PID); 2019. Report No: PIDC26989.
14. Olawade DB, Wada OZ, Afolalu TD, Barka IA. Evaluations of hypertension among adult residents of tinda rural community, Nigeria. International Journal of Public Health and Epidemiology Research. 2020;6(2):154-159.

15. Wada OZ, Olawade DB, Afolalu TD, Oluwatofarati AO, Akinwalere IG. Prevalence of hypertension among rural adults and availability of management services in Abimbola Community, Ayedadae Local Government Area, Osun State, Nigeria. J Hypertens Manag. 2020;6(2):154.

16. Olawade DB, Wada OZ, Afolalu TD, Oladipo TC, Asogbon O. Assessment of rural water supply in selected communities in Osun State, Nigeria. Int J Environ Sci Res. 2020;26(1): 556177.

17. Global Water Initiative. Making the right choice: comparing your rural water technology options. GWI Technical Series: Hardware Quality for Sustainable Water & Sanitation. Ref.: 2012-07-E.

18. Okorie A, Mabuza M, Aja-Okorie U. Donor funding and sustainability of rural water supply and sanitation technologies in Swaziland. ATPS Working Papers. 2001; 30:VI.

19. Gbadegesin Niyi, Olorunfemi Felix. Assessment of rural water supply management in selected rural areas of Oyo state, Nigeria. African Technology Policy Studies (ATPS) WORKING PAPER. 2007; SERIES NO. 49.

20. Okafor CN, Nwude NO. Sanitation and Hygiene Practices of Nigeria’s Economic Characteristics: Study of Two Akwa Ibom Communities. British Journal of Applied Science & Technology. 2016; 14(2):1-12. Article no BJAST. 20512 ISSN: 2231-0843, NLM ID: 10166454.

21. Afolalu TD, Wada OZ, Olawade DB, Suntai AD. Prevalence of diabetes mellitus among adult residents of Tinda rural community, Nigeria. Journal of Biosciences and Medicines. 2020;8, 107-116. DOI:https://doi.org/10.4236/jbm.2020.811010

22. Nkwocha Edmund E, Pat-Mbano Edith C, Okeoma Immaculata O. Sanitation indicators in the rural communities of the South-Eastern Nigeria: Additional evidence of policy failure in rural development. African Research Review; An International Multidisciplinary Journal, Ethiopia 2012;6(1), Serial No. 24, ISSN 1994-9057 (Print), ISSN 2070-0083 (Online).

23. Rosen Sydney, Vincent Jeffrey. Household water resources and rural productivity in Sub-Saharan Africa: A review of the evidence 1999. Development discussion paper. no. 673

24. Salami Adeleke, Stampini Marco, Kamara Abdul, Sullivan Caroline, Namara Regassa. Development aid and access to water and sanitation in sub-Saharan Africa, Working Paper 2011; Series No 140, African Development Bank, Tunis, Tunisia.

25. World Health Organization. Environmental health in emergencies and disasters: A practical guide / edited by B. Wisner, J. Adams. World Health Organization. 2002. ISBN9241545410

26. Umegbou Emmanuel I, Moses E Offor. Access to sanitation in some rural communities of Enugu State, Southeast, Nigeria: A Survey Study. International Journal of Health Sciences & Research 2018. ISSN: 2249-9571

27. Olalekan RM, Vivien OT, Adedoyin OO, et al. The sources of water supply, sanitation facilities and hygiene practices in oil producing communities in central senatorial district of Bayelsa state, Nigeria. MOJ Public Health. 2018; 7(6):337–345. DOI: 10.15406/mojph.2018.07.00265

28. Cronk R, Slaymaker T, Bartram J. Monitoring drinking water, sanitation, and hygiene in non-household settings. Priorities for Policy and Practice. 2015; 218(8):694-703.

29. Ogunsuyi HO, Akinnawo CA. Quality assessment of soaps produced from palm bunch ash-derived alkali and coconut oil. J. Appl. Sci. Environ. 2012;16 (4) 363-366.

30. Ishaku H. Water supply dilemma in nigerian rural communities: Looking
towards the sky for an answer. Journal of Water Resource and Protection 2011;03:598-606. DOI: 10.4236/jwarp.2011.38069.

31. Global Sanitation Fund and Water Supply and Sanitation Collaborative Council. Sanitation Sector Status and Gap Analysis: Nigeria; 2009.

32. Diane Vukovic. How to make wood ash soap; 2020. Available:https://www.primalsurvivor.net/wood-ash-soap/

© 2021 Wada et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/67466