INTRODUCTION

Water is needed for the maintenance of health. Its importance is not only related to the quantity, but also the quality. Access to water in the required quantity is needed to achieve good personal and domestic hygiene practices; while good quality water ensures that ingested water does not constitute a health hazard, even in a life time of consumption. It is however estimated that as much as 1.1 billion people do not have access to safe drinking water, while the drinking of contaminated water is responsible for 88% of the over four billion cases of diarrhoeal diseases that occur in the world every year, and the 1.8 million deaths that result from them. It is also indirectly responsible for the 50% of childhood malnutrition that is linked to diarrhoral diseases, and the 860,000 deaths that result from them each year.

The WHO estimates that 94% of diarrhoeal diseases are preventable through modifications to the environment, with improved access to safe drinking water alone able to reduce diarrhea episodes by between 20% and 35%, according to two systematic reviews. These health benefits, and the fact that a ready access to water saves the time of water drawers for more productive activities explain why access to adequate quantity of safe water was made one of the Millennium Development Goals, and why it was recognized as one of the foundations of Nigeria’s developmental efforts, by the National Economic Empowerment and Development Strategy (NEEDS) document.

Target 10, goal 7 of the millennium
development goal sets a 2015 target to reduce the proportion of people without access to safe water by half; while the 2005 National Water and Sanitation policy expects a 100% coverage by 2011. These targets would however require extra effort to achieve in the rural riverine communities of the Niger delta region, considering the enormous effort required to make the huge water resources in the communities safe for drinking. According to the 2008 National Demographic and Health Survey, access to safe drinking water is still low in the rural communities of Nigeria at 43.8%, which is likely to be worse in the rural riverine communities of the Niger delta, because of the widespread use of overhung toilets in the communities, and the poor quality of groundwater, linked to saline intrusion and high concentration of iron, manganese and arsenic, as a result of the geology of the area.

It was not known the extent target 10, goal 7 of the MDG has been met in the communities, especially with the much publicized efforts of government and the oil companies in addressing the basic needs of the people of the Niger delta. This study assessed the situation of the community water supply in 22 rural and semi-urban riverine communities in Bayelsa and Rivers States, in the Niger delta; as part of a baseline Health Impact Assessment study conducted in the communities for a gas pipeline project. The report the findings and the recommendations of appropriate technologies that could be implemented to hasten the pace of meeting the MDG in the communities are hereby presented.

MATERIALS AND METHODS

This was a descriptive cross-sectional study using a structured interviewer-administered questionnaire, field observations and focus group discussions carried out in 21 communities, in four local government areas in south-south Nigeria. A triangulation of the qualitative research techniques were used to help gain a deeper insight into the context of the water situation in the study communities. These communities had a population of about 150,000 people (projected with the 2006 national census). The study set to detect a 5% difference in access to safe water, with an alpha error of 5%, acceptable beta error of 20%, and a statistical power of 80%; and using the national average of access to safe water in rural communities of 43.8%. Using the usual formula for sample size determination for descriptive studies, the minimum required sample size was thus determined to be 378.

The data were collected by the author and trained assistants and analysed for the type, operation, maintenance and functionality of water facilities, and the microbiological status of the water, using the membrane filtration technique, with Escherichia coli as the indicator organism.

The data were analyzed according to the standard method, and the results were considered to be significantly contaminated if they were found to be beyond the World Health Organisation (WHO) minimum acceptable values.

RESULTS

A total of 456 questionnaires were administered and retrieved. The respondents had an average age of 29.20 +/- 5.2 years; most (89.69%) had a secondary school education or less, and had spouses that were mostly engaged in fishing and farming (40.13%) (Table I).

Table 2 shows the water and sanitation facilities of the respondents. The most common source of drinking water was surface water (37.9%), with bottled/sachet water serving the needs of up to 19% of the households.

Table 1: The socio-demographic characteristics of study participants

| Variable                        | No. (N=456) | Percentage (%) |
|---------------------------------|-------------|----------------|
| **Age**                         |             |                |
| 14 - 19 years                   | 82          | 17.98          |
| 20 - 29 years                   | 171         | 37.50          |
| 30 - 39 years                   | 126         | 27.63          |
| 40 - 49 years                   | 77          | 16.89          |
| **Educational status of respondents** |            |                |
| No formal education             | 53          | 11.62          |
| Primary                         | 189         | 41.45          |
| Secondary                       | 167         | 36.62          |
| Tertiary                        | 47          | 10.31          |
| **Occupation of respondents’ spouse** |          |                |
| Fishing/ Farming                | 183         | 40.13          |
| Self employed                   | 89          | 19.52          |
| Civil servant                   | 55          | 12.06          |
| Employed in private sector      | 47          | 10.31          |
| Student                         | 24          | 5.26           |
| Unemployed                      | 58          | 12.72          |
Most (61.2%) of the drawers of water for the households spent less than 15 minutes to complete the round trip to the water sources, while most (60.8%) of the households stored their drinking water in jerry cans.

A lot (48%) of the drinking water used by the households were not treated, even as only 12.72% of them used an improved sanitation facility, and the two-week period prevalence of diarrhea amongst them was 27%.

The number and type of water supply facilities in the 22 study communities are shown in Table 3. There were a total of 374 community water supply facilities in the communities, an average of 17 per community, but only 89 (23.80%) were functional as at the time of the study; an average of 4.4 per community. Only 46 (12.3%) of the water facilities provided piped supply, though with very few household connections, with only 17 (36.96%) of them functional as at the time of the study.

Table 4 shows how the water facilities in the communities were provided. Most (64.7%) of the facilities were provided by government and its agencies like the Niger Delta Development Commission, but this included the protected hand-dug well constructed during the colonial and immediate post-colonial periods, and the hand-pumped well provided by several ad-hoc government water supply programmes.

The water facilities provided by the oil companies were either provided as part of their social responsibility to the communities, or as part of the remediation for an oil spill. Those provided as part of the company’s social responsibility were mostly functional, mainly because they had functional committee for the maintenance of the facilities, though with most of the maintenance costs borne by the oil company.

Table 5 shows the results of the microbiological analysis of the water sample collected from various water sources in the communities. Members of four of the communities had during the field study complained of the quality of water from their facilities, and some members had refused to drink from the facilities.
Table 5: The results of the microbiological analysis of the water sample collected from the various facilities in the communities

| Facility               | Number tested | Number positive (%) |
|------------------------|---------------|---------------------|
| 1. Community piped supply | 17            | 11                  |
| 2. Protected hand-dug well | 2            | 2                   |
| 3. Hand pumped well     | 2             | 0                   |
| 4. Machine pumped well  | 13            | 3                   |
| 5. Surface water        | 22            | 22                  |
| **Total**               | **56**        | **38**              |

More than two third (67.9%) of the samples tested were found to contain significant numbers of *Escherichia coli*; especially the samples collected from surface water from which members of the communities routinely drank from.

**DISCUSSION**

The study showed that the study communities were served by an average of 4.4 functional community water supply facilities, and that most of the inhabitants spent less than fifteen minutes to draw water from the facilities. This is consistent with the WHO recommendation of less than 15 minutes to and fro journey to the drinking water source, that ensures the provision of adequate quantity of water required to satisfy the drinking water and sanitation needs. The situation in the study communities was also better than the figures obtained during the 2008 National Demographic and Health Survey. According to the survey, only 71.9% of Nigerians residing in the rural areas had access to water within 30 minutes, compared to the 91% obtained in the study. The situation in the study communities was helped by the efforts of the oil companies operating in the communities who provided more than 30% of the community water facilities in the communities.

However, as much as 76.2% of the community water facilities in the study communities were not functional as at the time of the study (Table III). This has also been noted in other communities in Nigeria; and blamed on factors that include amongst others, the absence of a responsible body for the operation and maintenance of the facilities, and poor workmanship by dubious contractors. These factors were also noted in the study communities as most of the non-functional facilities were those provided by government and its agencies, without any arrangement for their maintenance and operation. On the other hand, facilities provided as part of an oil company's social responsibility were found to be mostly functional, because they had functional committees constituted and funded for the operation and maintenance of the facilities.

The non-functional water facilities forced 66% of the households into drawing their water from non-improved sources. This is worse than the national average for rural areas of 53.4% and very unhealthy considering that as high as 67.9% of the water facilities were found to have *e.coli* count higher than the WHO recommended level. It is also not surprising that the two week period prevalence in the communities was 26.97%, much higher than the 8.9% average for rural areas in Nigeria. The quality of water in the communities can be improved not only by ensuring the functionality of the water facilities, but most importantly by encouraging the use of point-of-use water purification systems. The use of point-of-use water purification systems would fully tap the huge surface water resources in the communities, and particularly discourage the use of the expensive, but dubious bottle/sachet water that was used by 19.08% of the households to satisfy their drinking water needs. Point-of-use water purification systems have been found to deliver as much health benefits as an improved water source, and among the most cost-effective approaches in preventing diarrhoeal diseases.

Promoting the use of the point-of-use purification systems require a deliberate effort, especially because 48.03% of the households did not see the need to purify water of suspicious quality before drinking; while up to 29% use alum and cloth filtration that are not particularly effective in disinfecting the water in the communities. Even boiling that is often recommended has been found to fail under conditions of heavy faecal contamination as found in the study communities; because of the ease with which household utensils are recontaminated. More social marketing activities would therefore be needed in the communities to specifically promote the use of the coagulant/chlorine combination that was used by just 5.92% of the households, but have been found to be very effective.

Members of four of the study communities had complained of the quality of water from their facilities. This is probably related to the high iron and manganese content of the water, as
indicated by a previous study in the Niger delta.10 Also, the fact that most of the water facilities in the communities had elaborate water treatment facilities points to the enormity of the problem posed by the high inorganic content of the ground water. The type of technology used to deal with the poor quality ground water is probably inappropriate, and responsible for the high level of non-functionality of the water facilities. The sustainable use of the water facilities therefore lies in adopting an appropriate technology that can address the need, yet simple enough to be operated and repaired by readily available expertise21. There are already several low-cost and rugged technologies that can be applied at household and community levels in the communities for the treatment of water with high inorganic content22,23; such technologies should as a matter of urgency be adopted and promoted in the communities.

Conclusion: The communities had easy access to water supply, but most of the facilities were either contaminated or nonfunctional. The operation and management of the facilities by members of the communities, and the promotion of point-of-use purification systems are hereby advocated.

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CONFLICT OF INTEREST: The study was part of a baseline study for a health impact assessment study, for an oil and gas pipeline project.

REFERENCES

1. Huttly S, Morris S, Pisani V. Prevention of diarrhoea in young children in developing countries. Bulletin of the World Health Organization 1997; 75(2):163-174.
2. Ezzati M, Hoorn SV, Rodgers A, Lopez AD, Mathers CD, Murray CJ. Estimates of global and regional potential health gains from reducing multiple major risk factors. Lancet 2003; 362: 271–280.
3. WHO, United Nations Children’s Fund (UNICEF), and Water Supply and Sanitation Council. Global Water Supply and Sanitation Assessment 2000: Report. New York: UNICEF 2000.
4. Prüss-Ustün A, Bos R, Gore F, Bartram J. Safer water, better health: costs, benefits and sustainability of interventions to protect and promote health. World Health Organization, Geneva, 2008.
5.Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM Jr. Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: A systematic review and meta-analysis. Lancet Infect Dis 2005; 5: 42–52.
6. Clasen T, Roberts I, Rabie T, Schmidt W, Cairncross S. Interventions to improve water quality for preventing diarrhoea. Cochrane Database Syst Rev 2006; 3: CD004794.
7. UN Millenium Development Goals Available at: http://www.un.org/millenniumgoals. Accessed June 2007.
8. Water Aid Nigeria. Water and Sanitation in Nigeria: A briefing on national policy. Water Aid Nigeria. 2008.
9. Federal Ministry of Water Resources. National Water Sanitation Policy. Abuja. Department of Water Supply and Quality Control. 2005.
10. Amadi PA, Ofoegbu CO, Morrison T. Hydro geochemical assessment of groundwater quality in parts of the Niger delta, Nigeria. Environmental Geology and Water Sciences, 1989; 14: 195 – 2002.
11. National Population Commission (Nigeria) and ORC Macro. Nigeria Demographic and Health Survey 2008. Calverton, Maryland. 2009: 20 – 22.
12. Araoye MO. Research methodology with statistics for health and social sciences. Ilorin. Nathandex publishers. 2003. 119 – 120.
13. Billig P, Bendahmane D, Swindale A. Water and sanitation indicators measurement guide. Washington DC. Food and Nutrition Technical Assistance Project, Academy for Educational Development. 1999: 7 – 18.
14. Mates A, Shaffer M. Membrane filtration differentiation of E. coli from coliforms in the examination of water. J Appl Bacteriol 1989; 67: 343–346.
15. World Health Organization. Guidelines for drinking-water quality. 3rd ed. Geneva. World Heath Organization. 2006: 62 – 83.
16. World Health Organization, UNICEF. Water Supply and Sanitation Sector Monitoring Report 1990. New York, NY: UNICEF; 1992.
17. Ordinioha B, Adeosun A. A survey of the community water supply of some communities in Rivers State, south-south Nigeria. The Nigerian Health Journal 2008; 8: 39 – 42.
18. World Health Organization. The World Health Report: 2002: Reducing the Risks, Promoting Healthy Life. Geneva: World Health Organization. 2002.
19. Oswald WE, Lescano AG, Bern C, Calderon MM, Cabrera L, Gilman RH. Fecal Contamination of Drinking Water within Peri-Urban Households, Lima, Peru. Am. J. Trop. Med. Hyg., 2007; 77(4): 699 – 704.
20. Mintz E, Bartram J, Lochery F Wegelin M. Not Just a
Drop in the Bucket: Expanding Access to Point-of-Use Water Treatment Systems. American Journal of Public Health 2001; 91 (101): 1565 – 1570.

21. WEEL. Guideline manual for water supply and sanitation programmes. London. WEDC/DFID. 1998.

22. Hussam A, Munir AK. A simple and effective arsenic filter based on composite iron matrix: Development and deployment studies for groundwater of Bangladesh. Journal of Environmental Science and Health 2007; 42: 1869 – 1878.

23. Clasen TF. Scaling up household water treatment among low-income populations. Geneva. World Health Organization. 2009: 14 – 44);