Monitoring Committee has been set up with membership drawn from the Ministry of Water Resources and Environment, Health, Education, Benue State Environmental Sanitation Agency, NAFDAC, Benue State Planning Commission, and some Non Governmental Organizations.

Expansion of Survey

There is a need to include other parameters that impact the water quality at improved sources. Additionally, this one-time survey is a snapshot in the lifetime of each waterpoint sampled. To assess the effect of seasonality on the variation of water quality, there is a need for the survey to be conducted at multiple times over multiple years, representing contamination levels during both dry and rainy periods.

Water Quality Testing During Development

Future water projects should undergo water quality testing at the feasibility and completion stage of the water point.

Distribution of Survey Results

The results of surveys such as the one conducted in Benue State should be disseminated to relevant government agencies, partner organizations and interested parties within the impacted communities.

Concluding Remarks and Further Information

The details, results, and recommendations of this regional water quality survey highlight issues that are both relevant to and present in all WaterAid regions. While the data presented is specific to Benue, it has been presented in the briefing note to reinforce the general threat of waterpoint contamination as a result of improper maintenance, insufficient well depth, contamination source proximity, and other factors. The recommendations made in the final sections of this note are listed as actions that should be considered by WaterAid and its partners throughout the developing world, as the consequences of poor water quality know no regional boundaries.

Further information on the water quality survey and sanitary risk assessment can be obtained from the full report on the exercise. This report can be obtained through contacts at WaterAid Nigeria. Please contact Olatubosun Abass at olatubosunabass@wateraidn

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Briefing Note

WaterAid

Ensuring Acceptable Water Quality in Rural Communities

Recent water quality analysis of improved water points in Benue State, Nigeria, revealed lingering challenges in the pursuit of safe drinking water provision. This technical note present the findings of the water quality study, and recommendations for reducing and preventing contamination of boreholes and

Introduction

The provision of safe drinking water to impoverished communities is a fundamental objective of WaterAid. Through dedicated Water and Sanitation Units (WASUs) installed in Local Governments, WaterAid promotes the installation of waterpoints in rural communities. Most often, these waterpoints take the form of either boreholes or hand-dug wells. Participating local governments are largely successful in developing these waterpoints; however they still face difficulty ensuring that the resulting water supply meets minimum guidelines for acceptable water quality based on published standards.

These challenges have been highlighted by a recent survey of water quality at improved sources in Benue State, Nigeria. With a population of just over 4 million (NPC, 2007), Benue is a largely rural state with few sources of safe drinking water and annual shortages that cost the lives of its inhabitants.

Providing members of the rural community with access to potable water is a responsibility of the Local Government, one that reflects the task of many local jurisdictions worldwide.

Suzanne Porter

The water quality survey was conducted in the state between October 2006 and March 2007 by a postgraduate research student on Environmental Pollution Control of the University of Agriculture, Makurdi; a principal water quality analyst of the Benue State Rural Water Supply and Sanitation Agency (BERWASSA), and a WaterAid representative. The team's activities were supervised by a Water Quality Consultant to ensure water quality assurance and reliability.

The water quality analysts tested improved sources throughout the state for key contaminants that could compromise the health of community members who rely on these points. The findings indicate that conventional waterpoint development practices are not enough to ensure safe drinking water. Rather, additional measures must be carried out at the community,

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local government, and NGO levels to promote waterpoint sanitation and prevent contamination.
Water quality data collection was supplemented by a sanitary risk surveillance exercise, which delivered a list of common threats to the safety of water provided by boreholes and hand-dug wells. The results of the study and subsequent recommendations are presented in the remainder of this briefing note.

Analysis Methodology

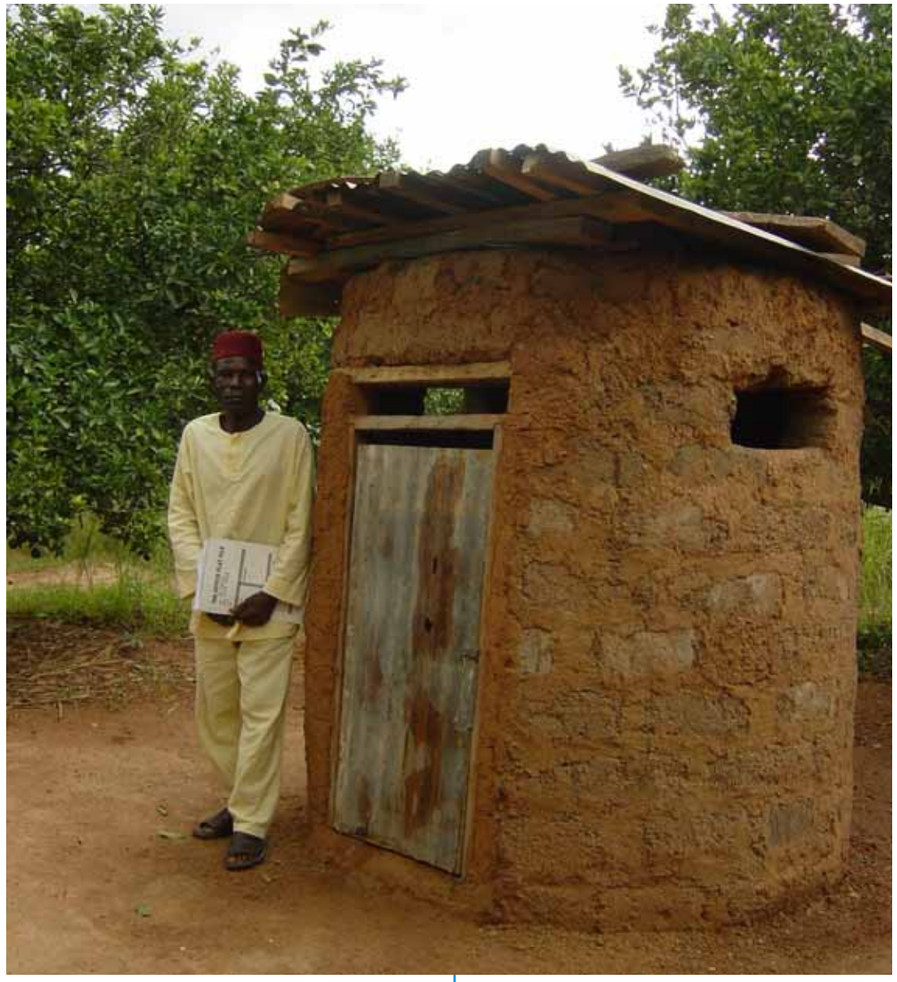
The water quality analysis conducted in Benue State targeted improved sources supported by WaterAid. Water samples were tested for the presence of contaminants, and a sanitary risk surveillance exercise was conducted at the site of each waterpoint. A total of 174 sources were tested, comprised of 132 boreholes and 42 hand-dug wells, during the dry months of the seasonal year. Water samples were collected in sterilized containers and taken the same day to the laboratory for analysis. This analysis was done in Benue State Environmental Protection Agency laboratory. The parameters tested in this survey are those determined by WaterAid Water Quality policy and the National Standard for Drinking Water Quality (NSDWQ):

- Acidity (PH),
- Turbidity (TB),
- Electrical Conductivity (EC),
- Arsenic (AC),
- Fluoride (F),
- Copper (Cu),
- Nitrate (No3), and
- Faecal Coliform (FC).

These parameters dictate the potability and appearance of the water from a given source. Management of proper levels of each according to the WaterAid Water Quality policy and National Standard for Drinking Water Quality (NSDWQ) is

Parameter	Range in Borehole	Allowable limit in (NSDWQ)	Range in Dug wells	Health Impact
P^H	6.05-11.74	6.5 – 8.5	6.22-9.21	None
Arsenic (As mg/l)	0.001-0.430	0.01	0.001-0.110	Cancer
Nitrate (NO_3 mg/l)	0.01-65.65	50	9.10 - 63	Cyanosis, and asphyxia (‘blue-baby syndrome”) in infants under 3 months syndrome”) in infants under 3 months
Fluoride (F mg/l)	0.01.2.10	1.5	0.01-253	Fluorosis, Skeletal tissue (bones and teeth) morbidity
Copper (Cu mg/l)	0.01-253	1	0.01-2.61	Gastrointestinal disorder
Total Coliform (cfu/mL)	1-71	10	2-75	Indication of faecal contamination

Table 1: Water Quality Parameters in relation to National Standard for Drinking Water Quality (NSDWQ)



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to keep away stagnant water that may contribute to the pollution of the wells. WaterAid Nigeria has already initiated sanitary risk surveillance training for staff of the Ministry of Water Resources and Environment and Local Government in order to address these sanitary issues.

Water Chlorination

Chlorination of all waterpoints that did not meet proper standards for drinking water should be embarked upon. Repeated chlorination may depend on its effect on the waterpoints.

Mitigation of Contaminants

Waterpoints with arsenic, fluoride, nitrate and copper concentrations above the NSDWQ allowable limit should be retested. If the test confirms the same result then remedial measures should be embarked upon. Arsenic in waterpoints can be treated by adding coagulants such alum or potassium permanganate. Defluoridation of waterpoints with excessive fluoride can be done through an alumina adsorption technique.

Water Quality Monitoring

A Water Quality Monitoring programme should be established within the operational structure of the state government. WaterAid Nigeria is already collaborating with the appropriate authorities to establish such protocol. A Water Quality

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metres in diameter;

- Rope and bucket lift contamination; and
- A cracked cement floor.

The sanitary risk results show that hand-dug wells are more prone to bacteriological contamination than boreholes. Factors identified by the sanitary risk analysts can be grouped into issues of physical protection of the waterpoint; well depth; and distance to sources of contamination, particularly open defecation.

Recommendations

The provision of safe and sanitary drinking water to rural communities extends well beyond the task of waterpoint installation. WaterAid has long acknowledged the role of sanitation and hygiene in community health and clean water delivery. Moreover, measures must be in place to ensure proper use and maintenance of the well. Only through an all-encompassing approach to safe water provision can the desired end result be achieved.

The contamination levels observed in boreholes and hand-dug wells in Benue State, Nigeria may produce health problems with prolonged water consumption. A greater proportion of the waterpoints included in the survey did not meet the guidelines set forth in the WaterAid Water Quality policy for drinking water. This is largely attributed to the sanitary condition of the environment around the waterpoint.

The results of the survey translate into direct actions that should be taken by WaterAid to ensure the quality and effectiveness of the services delivered to the rural communities. These actions are described below.

Sanitary Surveillance

Sanitary surveillance should be carried out periodically at three months intervals on WaterAid - supported waterpoints to ensure that the sanitary condition around these waterpoints is conducive to the preservation of safe drinking water. Open defecation by humans and animals, and dumping of waste close to these waterpoints should be discouraged. Proper drainage channels should be constructed around these waterpoints

Parameter	Boreholes (BHs) Range	Mean	% above WANG Limit	Hand Dug Well (HDWs) Range	Mean	% above WANG Limit	WANG Allowable Limit
P^H	6.05-11.74	7.58	38	6.22-9.21	6.00	52	6.5-8.5
TB FTU	1.00-292	29.14	22	4.00-247	59.77	19	5
EC mscm	1.00-2730	29.14	17	55.20-3240	117.60	35	1000
AS mg/l	0.001-0.430	0.092	11	0.001-0.110	0.060	2	0.01
NO_3 mg/l	0.01-65.65	30.25	24	9.10 - 63	33.42	36	45
F mg/l	0.01.2.10	0.26	20	0.01-25.3	0.56	19	1.5
Cu mg/l	0.01-253	0.69	14	0.01-2.61	31.53	12	2.0
cfu/mL	1-71	0.69	50	2-75	29.0	62	10/100

Table 2: Water Quality Parameters in relation to WaterAid Water Quality Policy

Acidity (P^H)

WaterAid-supported water points have a PH range of 6.05 11.74, a mean of 7.58 for boreholes, and a range of 6.22-9.21 and mean of 6.00 for hand-dug wells. Out of 174 water points tested, 38% (49) of boreholes and 52% (21) of hand-dug wells have a PH value outside of policy guideline values for drinking water. Water from boreholes was alkaline, while that of shallower hand-dug wells was more acidic. Acid waters can cause corrosion of metals and may add colour to water from handpump-fitted boreholes, however there are no known health implications.

Turbidity (TB)

Boreholes had a turbidity range of 1.00-292 FTU and a mean of 29.14 FTU. Hand-dug wells had a range 4.00-247FTU and a mean of 59.77FTU. 22% (28) of boreholes and 19% (7) of hand-dug wells had turbidity levels above WHO guide limits for drinking water. Turbidity in water is more of an aesthetic contaminant than a health problem.

Electrical Conductivity (EC)

17% (22) of boreholes and 35% (17) of hand-dug wells had electrical conductivity concentration levels that exceed published guidelines. Very high conductivity levels were recorded in hand-dug wells in a number of specific communities within Benue State. The shallow depth of these wells and geology of the environment may have been responsible for this. For health purposes drinking water should not have very high electrical conductivity as it is related to the concentration of ions originating from inorganic compounds.

Arsenic (AS)

Out of the 174 water points, 11% (14) of boreholes and 2% (1) of hand-dug wells did not meet recommended guide values for arsenic in drinking water. Possible causes of arsenic in groundwater are physical processes such as weathering, biological activities and human activities. Arsenic has long been recongised as toxic and carcinogenic.

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Fluoride (F)

13% (20) of boreholes and 19% (8) of hand-dug wells have fluoride levels above recommended guide values for drinking water. The source of Fluoride in these waterpoints may be traced to the geology and groundwater composition. Although fluoride is important in the development of healthy teeth and bones, dental problems and skeletal distortion may arise from excessive intake.

Copper (Cu)

14% (18) of boreholes 12% (4) of hand-dug wells did not meet WaterAid guidelines for drinking water. The cause of copper in waterpoints may be traced to corrosion by copper plumbing and incineration of local materials and refuse. Exposure to a high concentration of CU in water can cause gastrointestinal disturbances including nausea and vomiting, as well as liver and kidney damage.

Nitrate (No3)

24% (31) of boreholes and 36% (15) of hand-dug wells exhibited nitrate concentration levels above guide values. Hand-dug wells are more susceptible to nitrate contamination. The source of contamination is often agricultural fertilizer, organic manure, and human and animal waste. Nitrates are regulated in drinking water primarily because excess levels can cause metaemglobinemia, or blue baby disease.

Faecal coliform (FC)

50% (66) of boreholes 62% (26) of hand-dug wells had a faecal coliform count exceeding limits for drinking water. All boreholes and hand-dug wells analysed for faecal coliform showed some level of contamination, however hand-dug wells had a substantially higher proportion of faecal coliform pollution. This may be due to the shallow depth of the wells, and the sanitary condition of the environment. Indiscriminant open defecation by humans and animals are common in these rural areas. See figure 1 for the proportion of water points that exceed the National Standard for Drinking Water Quality (NSDWQ) allowable limit.

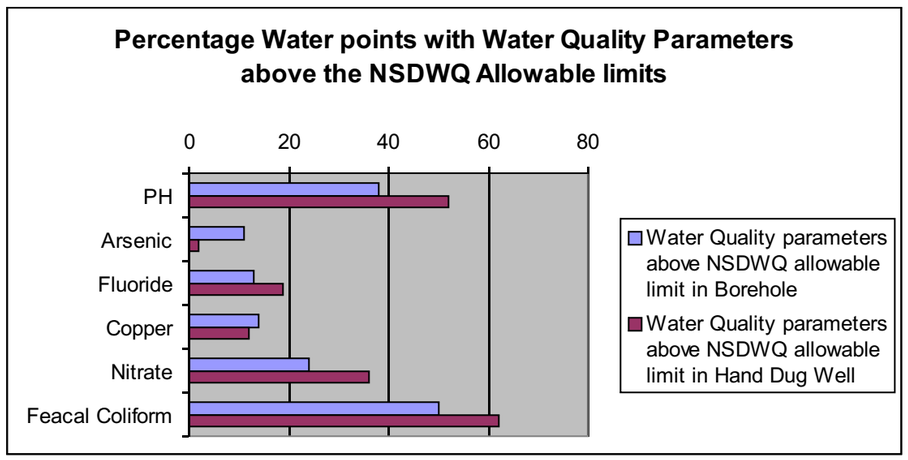

Fig 1: Percentage of Water Quality Parameters above the NSDWQ allowable limits

Suzanne Porter

Sanitary Risks

The presence of faecal coliform was detected in every waterpoint sampled in this analysis. This characteristic is a primary contributor to the potency of unimproved water sources, and presents a major health threat when concentrations are substantial. As a result, each waterpoint included in the analysis was classified by sanitary risk level, based on faecal coliform concentrations.

Boreholes

Of the 132 boreholes tested, 5% operate at high sanitary risk; 75% at medium risk; and 15% at low risk. A majority of WaterAid boreholes sampled in Benue State were categorized as medium risk, corresponding to a score of 3 to 5 on a 10 point risk assessment. This assessment cataloged environmental factors and community behaviour patterns that commonly threaten water quality. For boreholes the most common factors included:

- The location of latrines within 10 metres of the borehole;
- Animal breeding and agricultural cultivation within 10 metres of the borehole;
- A cracked apron, or an apron that is less than 2 metres in diameter;
- A cracked or poor drainage channel, likely the result of pounding activities within 2 metres of the borehole; and
- A loose hand pump at the point of attachment.

Hand-dug wells

54%, or more than half of the hand-dug wells surveyed operate at a high sanitary risk level; and 46% at medium risk with no wells classified at low or no sanitary risk. Whereas only 5% of boreholes were categorized as high risk, a majority of hand-dug wells were put in this category. Factors identified to be responsible for this are:

- The location of latrines within 10 metres of the well;
- An animal, human waste or refuse dump within 10 metres of the well;
- Poor drainage within 2 metres of the well;
- An apron that is less than 2

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