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LOCAL ACTION WITH INTERNATIONAL COOPERATION TO IMPROVE AND SUSTAIN WATER, SANITATION AND HYGIENE SERVICES

A cross-sectional study on water access within the Healthy Villages and Schools (VEA) program in the DRC

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In DRC, the Healthy Villages and Schools (VEA) National Program consists of a community participatory process towards sustainable access to improved water services, hygiene and sanitation where villages and schools are certified "healthy" once they comply with 7 WASH specific norms. Through a mixed-methods survey of household questionnaires, water quality testing of source and stored water samples, mapping of water sources, and discussions with key informants, this study looked at VEA implementation in the Katana health zone, South Kivu province, to ascertain lessons learnt from the program. From 206 household surveys and 71 focus group discussions, it was determined that there are two primary barriers to effective water supply coverage: accessibility to a source within 30 minutes and delivery of water that conforms to WHO guidelines of <1 E. coli CFU/100mL. Additional demographic and WASH knowledge, attitudes, and practices outcomes as well as challenges associated with the VEA are discussed.

Introduction

The National Program for Healthy Villages and Schools (VEA) was first introduced by the government of the Democratic Republic of the Congo (DRC) in the 1990s as the main initiative to provide water supply in rural and peri-urban communities. In 2006, UNICEF partnered with the Ministry of Health to re-launch the program in all provinces of the country, with a program objective to ensure equitable access to safe and affordable water, ensure equitable access of all people to adequate sanitation and hygiene services to end open defecation, to ensure water resources are used more efficiently in all sectors, to ensure the sustainability of freshwater harvesting and supply to reduce the number of people impacted by water scarcity, and to support and strengthen local participation in improving water and sanitation management (Programme National Ecole et Village Assainis 2017). The program had succeeded in certifying 2,883 villages and 1,000 schools, a population of over two million people, by the end of 2012. (Partow and Philip 2013). The current second phase covering 2013-2017 resulted so far in an additional 4,380 healthy villages (over 3,000,000 people) and 1,008 healthy schools.

The PNVEA is an eight-step process for water, sanitation, and household and environmental hygiene development. The steps of the process are: 0) community decision to engage in PNVEA; 1) signing of a Memorandum of Agreement between health zone and village; 2) the initial Knowledge, Attitudes, and Practices survey (KAP); 3) the community analyses its hygiene and sanitation; 4) election of a VA Committee; 5) the community develops a Community Action Plan; 6) implementation of improvements identified in the Action Plan; 7) final KAP survey; and, 8) certification by the Chief of Medicine of the health zone (DRC Ministry of Health 2013).

In order to become certified as a Healthy Village, the following standards must be met: the existence of a dynamic VA Committee; at least 80% of population has access to safe drinking water; at least 80% of households use hygienic latrines; at least 80% of households properly evacuate household waste; at least 60% of people wash their hands with soap or ash before eating and after using the toilet; at least 70% of the population knows the waterborne disease transmission routes and ways to prevent; the village is cleaned at least once a month (DRC PNVEA).

After feedback from the first phase of the VEA program, where only 2% of certified villages had maintained “health status” according to standards, an improvement for phase two included a post-certification process, aimed at consolidating results over time through regular post-certification visits and re-evaluation of the “healthy status” of villages and schools (Eau et Assainissement pour l'Afrique 2012; Hydroconseil 2014). The motivation for including this post-certification was the finding that most villages were not able to maintain all standards as program support was withdrawn from the villages. This new post-certification allows the health zone to follow-up with villages for three years at 6 to 12-month intervals and identify emerging problems in the villages. With the advent of water safety planning, the VEA program integrated several components of the water safety plan (WSP) process into the existing project cycle of towards certification.

As part of an operational research program on WSPs, UNICEF contracted with Tufts University to conduct an independent field evaluation of the implementation of WSPs by partners supported by UNICEF in the Democratic Republic of the Congo. The specific objectives of the study in DRC are to assess the water use elements of the VEA process through: 1) household KAP surveys on water, sanitation, and hygiene (WASH); 2) water quality testing to determine water safety of household stored water and source waters; and, 3) a Tanahashi analysis of water supply coverage. The study was realized in the Katana health zone, in the province of South Kivu.

Methods

The evaluation was completed with support from the Provincial Health Division (DPS), the Bukavu Regional School of Public Health and Tearfund, using a mixed-methods protocol, including household surveys, water quality testing, and focus group discussions. The overall study consisted of the following: 1) Tufts assessment visit with UNICEF to implementing partners in November 2015; and, 2) a field study of WSP implementation in the Katana Health Zone in October 2016 comprised of household KAP surveys and water quality testing, source mapping and water quality testing, and focus group discussions with Healthy Villages (VA) Committees, Community Health Workers, Health Development Committee members, village chiefs, and water management committees.

Implementing partners and UNICEF provided lists of certified villages, from which 20 were randomly chosen for inclusion. An attempt was made to match 20 control villages based upon location and population, 10 from Steps 0-5, during the initialization and planning phases and 10 from Step 6 of the VA process, during the building of infrastructure. Households were randomly selected by starting in the village centre and skipping a certain number of houses. The number of households visited per village was determined by sampling 3.5% of all households in the village.

Household surveys were carried out in the local language by trained enumerators and comprised of 58 questions and observations on household demographics, knowledge, attitudes, and practices towards water, sanitation, and hygiene, and knowledge of VA work. During each survey, a household stored water sample was collected and tested for temperature, pH, electrical conductivity, total dissolved solids, salinity, and free and total chlorine residual if deemed appropriate. Additional samples were collected aseptically and stored on ice, transported to a field laboratory established at the UNICEF Bukavu office, and processed by membrane filtration with m-coliBlue24® media to quantify *E. coli* and total coliforms. Turbidity was also tested for in all collected samples. Further water samples were collected from every water source identified by households to be used for drinking-water and were processed in the same manner.

Quantitative data analysis of the household surveys and water quality was conducted and a Tanahashi framework was completed in addition. Data was manually recorded, entered into EpiData5, exported to Microsoft Excel 2010 and cleaned. Descriptive statistics and statistical analyses were completed using Stata 10 software. Paired t-tests were performed to compare household collection point water to household stored water for all pairs where both samples were collected, and paired t-tests were performed on log-transformed values to compare the geometric mean *E. coli,* total coliforms, and turbidity. For all statistical tests, p-values <0.05 were considered statistically significant.

A Tanahashi framework analysis was conducted to evaluate the coverage of the water supply services in the Katana Health Zone (Tanahashi 1978; Secretariat of the Center of Excellence for Universal Health Coverage 2013). Coverage was evaluated across five categories, each being progressively selective to households only in the former category (Table 1).

Focus group discussions contained 5-34 questions and were held in each Health Area (AS) with the respective committees, with the exception of the water management committees. Every water management committee that was available was interviewed, and not necessarily all AS had active water management committees. Qualitative data from the FGDs were analysed and summarized according to key themes.

Table 1. Tanahashi framework analysis coverage definitions

Coverage	Indicator	Measurement
Availability	Quantity of water supply	# HH with a functional source capable of providing 20 L/pp/day / Total # of HH surveyed x 100
Accessibility	HH with availability in quantified distance	# HH ***with*** a functional source within 30 minute roundtrip of house / Total # of HH surveyed x 100
Utilization	HH use of accessible coverage	# HH ***using*** functional source ***within*** 30 minute roundtrip of house / Total # HH surveyed x 100
Adequate Coverage	HH with year-round coverage of supply utilized	# HH ***using*** 20 L pp/day ***from*** a functional source within 30 minute roundtrip of house ***with*** year-round access / Total # of HH surveyed x 100
Effective Coverage	HH with adequate coverage and source water that is in conformity with WHO guidelines	# HH ***using*** 20 L pp/day ***from*** a functional source ***within*** 30 minute roundtrip of house ***with*** year-round access ***that provides*** <1 CFU/100mL of *E.coli* / Total # of HH surveyed x 100

Results and discussion

In total, KAP surveys were conducted in 206 households from 41 villages in 17 AS in the Katana health zone. One hundred households were from certified villages in Step 8 of the Village Assaini, 54 from villages in Step 6, and 52 from villages in Steps 0-5. A total of 250 water samples were collected and analysed.

In summary, 53% of heads of household had not attended any form of school, however respondents were able to list sicknesses that can be obtained from drinking water, and most could show where they use a toilet (95%) and wash their hands (65%). The burden of water collection is high (median round-trip 60 minutes) and a majority of households use multiple sources (75%). No household reported treating their drinking water and 55% reported that they believed their water was safe to drink if it was clear. Almost all households stored their water in jerricans (96%). Many households responded that they believed their household drinking-water was safe to consume (79%). At the time of the visit only 64% of containers were observed to be covered. Furthermore, only 15% of households reported that a dirty storage container can make the water unsafe to drink.

Water quality of paired stored household and source water

Geometric mean water quality parameters were calculated for all drinking water samples (n=202). Geometric mean E. coli concentration in stored drinking water was 49.5 CFU/100 mL, total coliform was 1634.3 CFU/100 mL, and turbidity was 2.91 NTU.

Of the households that provided a water quality sample, 189 were linked to a source that was accessible and had water for the enumerator to collect a sample. Comparing the paired source and household samples overall, geometric mean *E. coli* concentration increased from 8.0 to 56.5 CFU/100mL (606% increase), while total coliform increased from 131.6 to 1634.0 CFU/100mL (1,141% increase) (Table 2). Both values were statistically significantly higher in household stored water than in source water ($p<0.001$), as was turbidity ($p=0.035$), indicating a substantial problem with the microbiological quality of stored household water.

Water quality results vary by source, with samples from protected springs having the lowest geometric mean *E. coli* at 1.6 CFU/100mL, yet all household stored samples, except those households using surface water, had an increase in *E. coli* concentrations from the source. Furthermore, all household stored water had an increase in total coliform concentrations over their paired source samples. Only households utilizing water from an unimproved source (surface or unprotected springs) had a geometric mean reduction in turbidity.

Table 2. Water quality of paired source and household water samples (n=206)				
	N	Source	Household	p-value
Mean (range) temperature of sample (°C)	181	23.7 (21.5-29.1)	22.3 (19.1-26.7)	<0.001*
Mean (range) pH of sample	181	6.5 (4.8-9.5)	6.8 (4.9-9.5)	<0.001*
Mean (range) EC of sample (µS)	181	159.0 (26-1,125)	152.5 (6.7-1,177)	0.079
Mean (range) TDS of sample (ppm)	173	113.3 (18.4-795)	111.9 (13.3-837)	0.433
Mean (range) salinity of sample (ppm)	173	79.3 (17.8-592)	79.4 (16.9-614)	0.979
Geometric mean (range) *E. coli* (CFU/100mL)	189	8.0 (<1-4,000)	56.5 (<10-17,300)	<0.001*
Geometric mean (range) total coliform (CFU/100mL)	189	131.6 (<1-11,400)	1634.0 (<10-18,200)	<0.001*
Geometric mean (range) turbidity (NTU)	189	2.50 (0.51-96.70)	2.90 (0.76-26.60)	0.035*

* Significant at the $\alpha = 0.05$ significance level.

Stored water samples from households in certified villages (VA Step 8) had the lowest geometric mean percent increase in microbiological concentrations from their paired source samples, while stored water from households in Steps 0-5 had the highest increase. However, it is important to note that overall, the geometric mean of *E. coli* concentrations was lowest in source waters from villages in Step 6 of the process, at 3.3 CFU/100mL.

Water supply coverage

Results of the Tanahashi analysis highlights two primary bottlenecks in water supply coverage for the households (Figure 1). The first barrier was access to a water source within 30 minute roundtrip of the household. Only 30% of all households had availability and reasonable accessibility to a functional water source, with a median collection time per trip to the source of 60 minutes (range: 10-480 minutes).

The second impediment to water supply was effective coverage, with only 5% of households using a source that met all requirements of effective water supply: the source produced 20L/pp/day, it was within 30 minute roundtrip of the household, it was used by the household, the source reportedly produced water year-round, and the water at the source conformed to WHO guidelines for *E. coli* (<1 CFU/100mL).

Focus group discussions

Theme #1 - Low management of risks to water safety and security: Stakeholders noted several control measures to protect sources undertaken during community work days, but the majority of actions were reactive instead of proactive. Communities have not been equipped to manage their water sources on their own. None of the VA committees or the Water Management committees treat water at their sources or anywhere else along the supply chain. Furthermore, committees and health volunteers can only train users on household water treatment and safe storage practices, but use is limited. A decrease in waterborne illnesses such as cholera, diarrhea, and malaria was widely noted by stakeholders in a majority of the focus group discussions. Furthermore, all discussions noted significant issues of water access including long distances to sources, lack of taps, low flow, and seasonality of supplies all of which contribute to conflict.

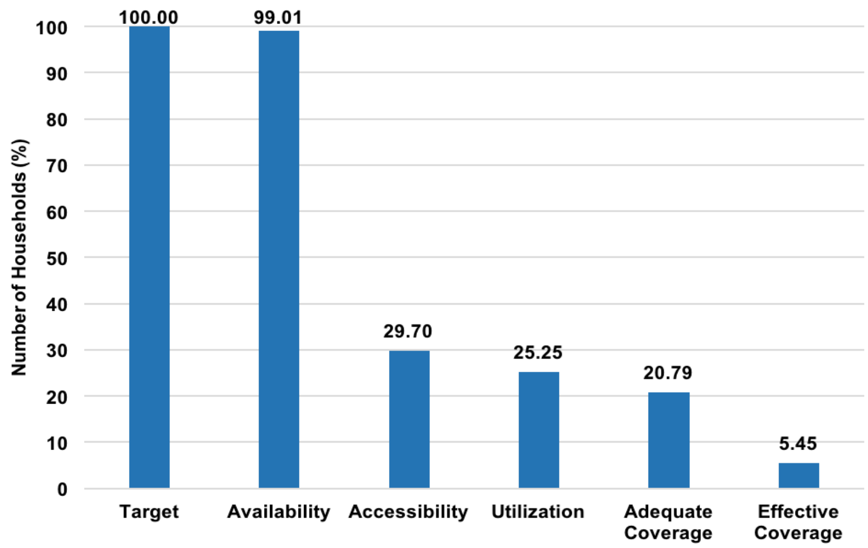

Figure 1. Tanahashi framework analysis of water supply coverage in Katana

Theme #2 - Need for technical and capital support: Many of the chiefs and VA committees noted that villagers contribute to many tasks through community work or small financial contributions. However, those contributions are not enough to keep up with the demand for more water sources, the extension of pipes, and the need for water of improved quality. Tools to integrate WSPs into PNVEA need simplification so VA committees are equipped to understand risks. Additionally, Water Management Committees would benefit from operation and maintenance training as well as WSP training for their supply systems, as they indicated that they had not received those programs.

Conclusion

In this study, we visited 206 households from 41: 100 households were from certified villages in Step 8 of the Village Assaini, 54 from villages in Step 6, and 52 from villages in Steps 0-5. A total of 250 water samples were collected. This study found that there is: 1) an immediate need to address the quality of water from sources and more particularly in the household; 2) a primary accessibility bottleneck to water supply coverage; 3) a significant gap in understanding risk in the management of water supply; and, 4) a need for capital and technical assistance in the improvement of water supply systems.

While 60.3% of the source water samples either conformed with WHO guidelines of <1 CFU *E. coli*/100mL or were in the 'low risk' category of <10 CFU/100mL, 33.2% of household stored samples were in the 'high risk' 100-1000 CFU/100mL and 'very high risk' >1000 CFU/100mL categories. No household stored water sample conformed to WHO guidelines for *E. coli* concentrations, and no household or source was found to be using any form of water treatment.

Based on the results of this study, it is recommended to institute promotion of household water treatment and safe storage (HWTS) practices. Additionally, it is recommended to invest in technologies that support the development of water sources within accessible distance of a home. Finally, a primary recommendation from focus group discussions is to simplify and rework the tools utilized in the Village Assaini training with a particular focus on risk identification and assessment.

Limitations to this study include a study area restricted to one health zone and a lack of longitudinal data on these outcome metrics. Future work analysing the effects of the VEA program, with a focus on program operation after certification would be informative in understanding long-term management. This study highlights two key factors to consider for the water use elements of the VEA program: the deliverance of safe water to consumers and the accessibility of water sources.

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