The Akugbene Water Filter Project

A case study by R20 Regions of Climate Action

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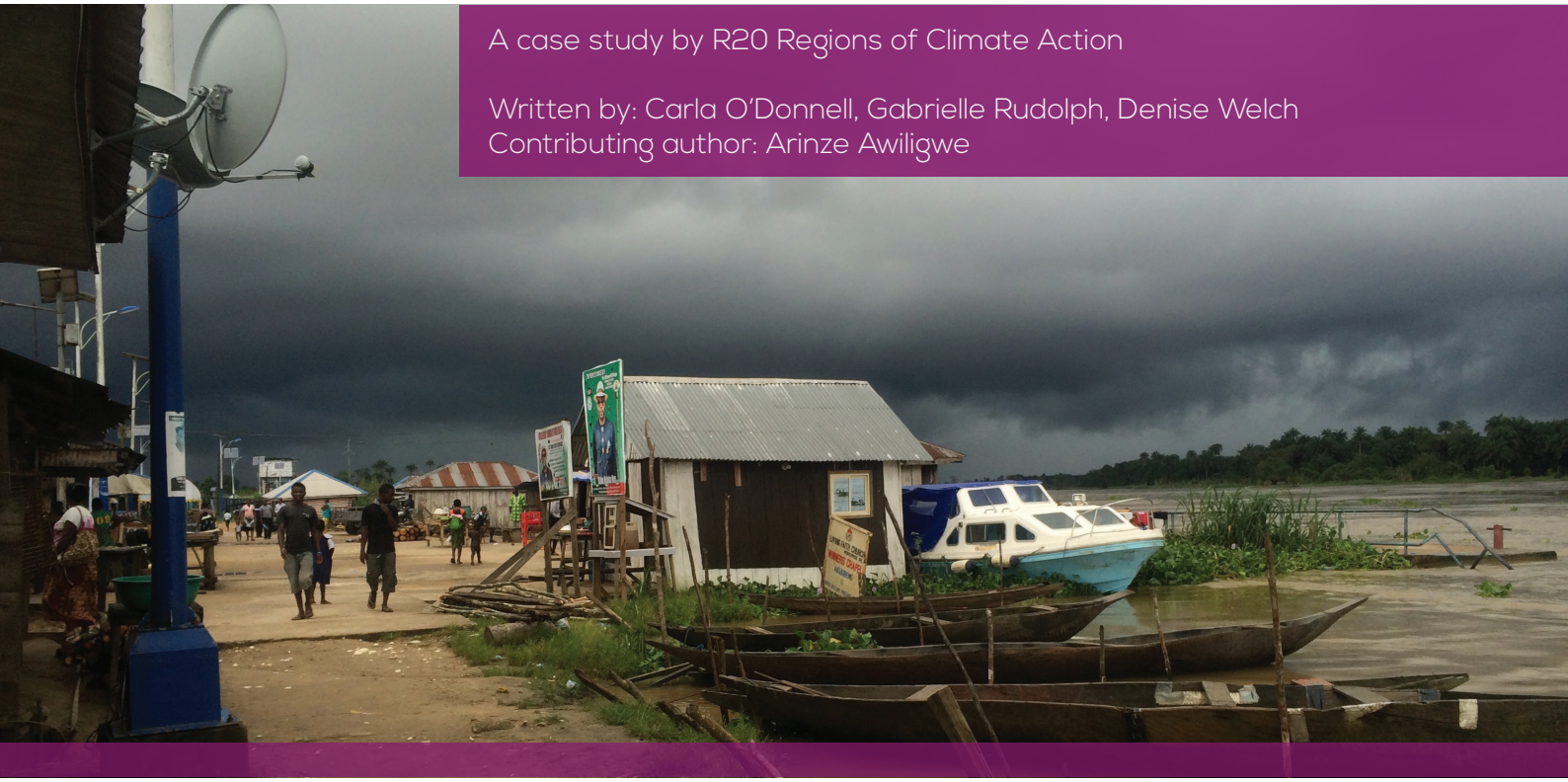

DELTA STATE

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ACKNOWLEDGEMENTS

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The **Delta State Ministry of Environment's Climate Change Department** is a government agency poised towards assessing the vulnerability of its local communities to the impacts of climate change and promoting the development of a low-carbon and climate-resilient economy in the State. The Department is coordinating the Delta State Territorial Approach to Climate Change (TACC) programme that has carried out numerous quick-win (pilot) projects including the Hydraid Biosand Water Filter project and locally constructed biosand water filters.

R20 Regions of Climate Action is a coalition of partners led by regional governments that work to promote and implement projects designed to produce local economic and environmental benefits in the form of reduced energy consumption and greenhouse gas emissions; strong local economies; improved public health; and new green jobs. These local actions can help the world achieve our shared global environmental and economic goals. R20 is the official Delta State TACC international consultant and assisted with the selection and implementation of several "quick-win" pilot projects (biogas, solar water heating, water filter). R20 also developed, in collaboration with local experts, the Delta State Integrated Territorial Climate Plan (ITCP). The ITCP includes a climate change strategy and five-year action plan for the State.

Triple Quest is a social enterprise created out of a joint venture between Cascade Engineering and The Windquest Group. The mission of Triple Quest is to provide sustainable, essential-needs products for people that earn $2 or less by partnering with NGOs and entrepreneurs. Triple Quest distributes the Hydraid® BioSand Water Filter which is a simple, durable and highly effective technology with no moving parts which makes it ideal for developing world conditions.

The Foundation for Partnership Initiatives in the Niger Delta (PIND) is a non-profit foundation that works to establish and encourage innovative multi-stakeholder partnerships that support programs and activities, which empower communities to achieve a peaceful and enabling environment for equitable economic growth in the Niger Delta.

Life and Peace Development Organization (LAPDO) is a Nigerian non-profit organisation focused on community and sustainable development.

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INTRODUCTION

Purpose

This case study documents the deployment of biosand water filters to selected households in the Akugbene Community of the Bomadi Local Government Area of Delta State, Nigeria. The Akugbene water filter project aims to increase access to clean drinking water, reduce instances of water-borne illnesses, as well as limit local environmental damage caused by the use of fuel wood.

Climate change, flooding, disease

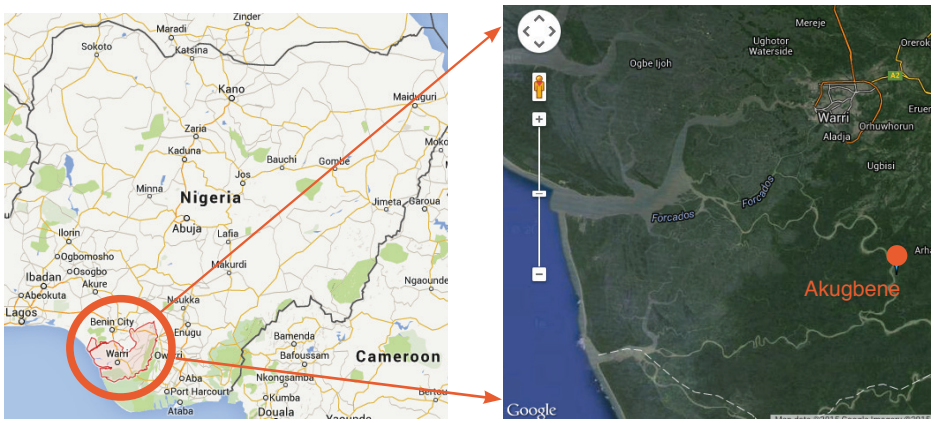
The majority of the scientific community agrees that anthropogenic activities have significantly altered, and continue to alter, the earth's climate conditions. Intensive use of fossil fuels results in the emission of greenhouse gases, such as carbon dioxide and methane. Greenhouse gases trap heat in the earth's atmosphere, thus increasing the ambient temperature. This increase in temperature allows the atmosphere to become highly saturated with moisture, resulting in increased rainfall, and subsequent increased flooding[1].

Flooding is associated with numerous negative environmental impacts, as well as ramifications throughout society as a whole. Damage to native biota, farmland, animals, and the displacement of people, are among many devastating affects of flooding[2]. However, climate change and flooding also have a significant impact on human health. Increased flooding and runoff due to heavy rainfall leads to a decrease in the quality of surface waters, and may lead to microbiological contamination[3,4]. Prior studies depict connections between heavy precipitation and waterborne outbreaks of disease, such as cryptosporidiosis and cholera[5,6].

In addition to flooding, rising sea levels are another consequence of climate change that is responsible for the contamination of drinking water in the phreatic surface in coastal areas. Increased salinity levels in drinking water due to saltwater intrusion (even into boreholes)may negatively impact the health of those in the community, specifically high-risk groups such as women and children[7].

Sanitation and Hygiene

While climate change evidently increases contamination rates in drinking water, personal hygiene plays a role in susceptibility to waterborne illnesses as well. Frequent hand washing and bathing with clean water are examples of actions that can increase health and wellbeing. However, washing oneself with contaminated water may be counterproductive, and increase the likelihood of contracting waterborne diseases. Examples of waterborne



Delta State, Nigeria
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Akugbene Community, Delta State
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diseases related to hygienic practices include intestinal worms, also known as Soil-transmitted Helminths, and Trochoma, which is a leading cause of preventable blindness of infectious origin[8]. Prevention of these diseases is achievable through proper hygienic practices carried out with clean water.

Nigeria's Delta State: Akugbene Community

Nigeria's Delta region is particularly vulnerable to flooding due to the fact that it borders the Atlantic Ocean. This renders the country subject to coastal flooding, as well as flooding caused solely by heavy rainfall within the watershed of streams and rivers. The Akugbene community is especially vulnerable to riverine flooding, as the small isolated community of about 4,000 people borders the Forcados River[2]. This vulnerability to flooding inevitably comes with increased rates of contaminated water, and general lack of access to safe drinking water. In fact, it is estimated that in the country as a whole, 63.2 million people do not have access to clean drinking water, and nearly 97,000 childhood deaths each year are attributed to diarrhea caused by dirty water and poor sanitation[10].

While flooding is one of the root causes of contamination, yet another problem the Niger Delta region faces is a lack of water treatment infrastructure. In remote communities, such as Akugbene, people frequently consume water from the river. A popular water treatment method is to boil the water within the household. If done correctly, this effectively eliminates microbiological contamination factors and improves water quality. However, there are a plethora of disadvantages associated with boiling water as well. For example, if done incorrectly, —as is often the case when done at home— microbiological contamination may worsen, as the increased temperatures provide an ideal environment for harmful bacteria to proliferate[11]. In addition, the fact that firewood is the main fuel source for boiling is another pressing problem.

Firewood, also referred to as fuel wood, is increasingly exploited in the

Niger Delta region. This exploitation, among other practices such as urban expansion and agricultural development, contributes to increased rates of deforestation[9]. Deforestation is harmful because it results in a loss of biodiversity and overall environmental degradation. On a local scale, deforestation leads to a lack of water retention capacity and excessive runoff, due to the fact that trees play a role in absorbing groundwater[12]. This notion is particularly applicable in the Delta region given that the ecological landscape is partially composed of a coastal vegetation zone and a freshwater swamp forest, both of which are likely to contain saturated soil[9]. In addition to absorbing water, trees also play an important role of absorbing carbon dioxide during photosynthesis. Therefore, trees aid in regulating the amount of greenhouse gases in the atmosphere[12]. This role is also important in the Delta region due to the fact that oil refineries and other fossil fuel processes release excessive amounts of carbon dioxide and other greenhouse gases through gas flaring[9]. The situation in the Delta region exemplifies the cyclical nature of human activity, health, and climate change.

The Solution

As advised by the World Health Organization, interventions to improve the quality of water are extremely effective at the household level. Numerous water purification methods, such as solar disinfection, sodium dichloroisocynurate tablets, and filtration devices, are implemented at household levels. Biosand filters are one particular innovation that has been proven successful in water filtration and diarrheal disease reduction, notably in lower income regions. The fact that biosand filters effectively eliminate microbial contamination, as well as produce sufficient amounts of treated water—unlike other household water treatment methods—makes the filters an appealing and efficient mechanism to distribute in the Niger Delta region of Nigeria[10].

Objectives of the Project

- To promote carbon-neutral technology that is appropriate for the region;
- To deliver affordable and cost-effective solution for water insecurity;
- To build capacity of the local community to maintain the technology themselves and promote good personal hygiene practices to sustain the health benefits of the technology; and
- To contribute to the reduction of deforestation.

IMPLEMENTATION

With the support of the community leaders, workshops were carried out for Akugbene's women residents on the health risks associated with contaminated water, good sanitation practices, and the local environmental impacts of the use of fuelwood. Based on consultations between the chairman of the community and other community leaders, participation at the workshops and need, 52 women were selected as recipients of the biosand filters. Women were given preference due to their active role in raising children and household management. In addition, households with more children were also given preference.

As the biosand filters were being assembled, the beneficiaries were instructed on how to assemble them themselves and on maintenance. Installation of a filter is very easy and takes under 30 minutes to complete.

One month following the installation, the project partners surveyed the beneficiaries to monitor the use of the filters and gather information about potential problems. The survey revealed that 98% of households were successfully using the technology. At two months from the installation date, another monitoring survey was carried out, showing the same positive result. With each household having an average of six members, the total number of people benefitting from the water filters is 312.

52

30min set up

98% usage rate

312 people

Personal hygiene and sanitation training

THE HYDRAID® BIOSAND FILTER (BSF) TECHNOLOGY

The Biosand Filter (BSF) is an alternative approach to the provision of safe drinking water that is affordable and is deployed in conjunction with personal hygiene training for maximum impact. While governments focus on large-scale, energy dependent, high-cost water supply systems, the BSF provides an energy-neutral and environmentally friendly solution.

The Hydraid® Biosand Water Filter is a simple lightweight home size filter, manufactured by Cascade Engineering and distributed by Triple Quest with no moving parts. The filter combats the leading causes of death and disease in the developing world by reducing parasites, bacteria, and viruses found in contaminated water. One filter is designed to deliver safer water for a family for more than 10 years.

It is made of UV resistant medical-grade FDA approved plastic, 0.77m in height and 0.42 m in diameter. When empty, it weighs 3.6 kg and when filled, it weighs 63.5 kg. With a filtering capacity of 47 litres per hour when used intermittently, it requires no electricity or plumbing, depending solely on gravity. Installation takes about 30 minutes and surface biological layer of the BSF forms naturally in about two weeks.

A fully installed Hydraid BSF has layers of sand and gravel, a filter plate and an external fitted lid. The latter prevents contamination and unwanted materials from entering the filter. Below the lid is the filter plate which prevents the disturbance of the water surface when water is poured into the filter. Water travels through the sand column, removing pathogens and suspended solids. Below the sand column is a layer of gravel that prevents sand from clogging the affluent pipe. Below the gravel is a layer of larger gravels referred to as the drainage which promotes water flow and prevents clogging near the base of the container[1].

This family-sized, intermittent-use Hydraid® filter is based on a centuries-old slow sand filtration technology and grew out of work conducted in Nicaragua in the early 1990's by leading water expert Dr. David Manz of the University of Calgary, Alberta. Having been extensively tested, it is reliable and shows sustained high end-user adoption rates when compared to other point-of-use water technologies. Health impact studies have demonstrated improved water quality in the field with a 95% reduction of E. coli and 59% reduction in diarrheal disease cases[13].

Water is poured into the top of the Hydraid® filter as needed. The water makes its way through a diffuser and the surface biological layer that consumes pathogens, then down through layers of sand and gravel. Safe water collects at the base of the filter and flows by gravity out of the filter through plastic piping attached to the unit's exterior. It works based on the principle of filtration and affects both the physical, chemical and biological property of water. In addition to the removal of solid particles, it is effective in removing bacterial, protozoan and viral contaminants, heavy metals[14] and turbidity present in water through a combination of biological and physical processes that take place in a container of layered sand[15]. It is proven to also reduce discoloration, unpleasant taste and odor present in water.

The Hydraid® filter works for all water sources: ponds, lakes, cisterns, reservoirs, rivers, streams, shallow and deep wells, rain water, spring water, water from piped systems, delivered water, grey water etc.

The Hydraid filter reduces greenhouse gas emissions by decreasing the need to treat water by boiling it. On average one Hydraid filter prevents the release of about 6-10 tonnes of C02 each year it is in use. For families in the developing world this means less smoke inhalation and reduced spending on fuel. For companies seeking to achieve environmental and social impact goals, Hydraid projects produce Gold Standard certified carbon credits for organizations and companies to purchase.

1 Triple Quest LLC: http://www.hydraid.org

Workshop on benefits of water filter

CHALLENGES

- One of the major challenges encountered was the lack of adequate communication networks. The community has limited access to tele-communication services making it difficult for the implementation team to set meetings with members of the community.

- Due to poor road infrastructure, the implementing partners had to reside in Akugbene for the duration of the project's implementation.

- Training took longer than intended due to the language barrier. With the help of locals who volunteered to translate, the issue was resolved.

LESSONS LEARNED

Focus on Women: The women of Akugbene had a key role to play in this project thanks to their pivotal household responsibilities. In order to ensure an inclusive approach and maximum impact, the beneficiaries were encouraged to be active participants. Their feedback throughout the project's implementation and during post-installation monitoring was crucial to ensuring the project's success.

Importance of training: The biosand filters require a 21-day post installation period to allow the bio-layer to form before filtered water can be considered safe for drinking. The women initially expressed concern about the long wait, but their concerns dissipated once the health implications of premature use were communicated.

Demand for filters: News of the benefits of the water filters spread quickly throughout the community, raising demand for the filters by non-beneficiaries. Therefore, future projects will take into account the procurement of additional filters in order to reach additional households.

RECOMMENDATIONS & NEXT STEPS

Recommendations

- Make the technology available to other households in the community;
- Recruit trainees to train community members who have not participated in the hygiene workshop; and
- Monitor the health impacts from use of the biosand filters.

Next Steps

- To create a special fund for water-filter projects;
- Project partners to explore financially sustainable ways to replicate and scale up the project throughout the Niger Delta and Africa (eg. through the use of carbon credits); and
- R20 to showcase this project at COP21 as part of an initiative to promote local actions and generate support from national governments.

REFERENCES

1. Pachauri, R. K. , 2014. Climate Change 2014 Synthesis Report. Intergovernmental Panel on Climate Change, [Online]. Available at: http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf [Accessed 23 March 2015]

2. Amadi, L, 2015. Climate change, environmental security and displacement in Nigeria: Experience from the Niger Delta Flood Disaster, 2012. African Journal of Environmental Science and Technology, 9, (54-64)

3. Dura, G, 2010. Environmental health aspects of drinking water-borne outbreak due to karst flooding: case study. Journal of Water and Health, 8 (513-520)

4. Hunter, P. R. 2003. Climate change and waterborne and vector-borne disease. Journal of Applied Microbiology. 94 (37–46)

5. King BJ, Monis PT. 2007. Critical processes affecting Cryptosporidium oocyst survival in the environment. Parasitology, 134 (309-323)

6. Mendelsohn J, Dawson T. 2008. Climate and cholera in KwaZulu-Natal, South Africa: the role of environmental factors and implications for epidemic preparedness. Int J Hyg Environ Health, 211(1-2):156-162

7. Forests and water. 2015. [ONLINE] Available at: http://www.fao.org/docrep/010/a1598e/a1598e02.htm. [Accessed 26 March 2015]

8. CDC - Global Sanitation and Hygiene Related Diseases and Contaminants - Healthy Water. 2015. [ONLINE] Available at:http://www.cdc.gov/healthywater/wash_diseases.html. [Accessed 26 March 2015]

9. Enaruvbe, G.O., 2014. Analysis of deforestation pattern in the Niger Delta region of Nigeria. Journal of Land Use Science

10. WaterAid Nigeria - Home. 2015. [ONLINE] Available at: http://www.wateraid.org/ng. [Accessed 26 March 2015]

11. Clasen, T.F., 2009. Scaling Up Household Water Treatment Among Low-Income Populations. WHO Guidelines for Drinking-water Quality

12. Trees of Life: Can forests save the Earth from greenhouse gases? “Sustainability” Boston University. 2015. [ONLINE] Available at: http://www.bu.edu/sustainability/trees-of-life-can-forests-save-the-earth-from-greenhouse-gases/. [Accessed 26 March 2015]

13. Stauber C.E. et al, 2012. Evaluation of the impact of the plastic biosand filter on health and drinking water quality in rural Tamale, Ghana. Int. J. Environ. Res. Public Health, 9 (3806-3823)

14. Pokhrel D, Viraraghavan T., F. ASCE, Braul L., 2005. Evaluation of treatment systems for the removal of arsenic from groundwater. Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management. 9:3 (152-157)

15. Sobsey M.D., Stauber C.E., Casanova L.M., Brown J.M., Elliott M.A. 2008. Point of use household drinking water filtration: a practical, effective solution for providing sustained access to safe drinking water in the developing world. Environ. Sci. Technol. 42 (4261-4267)

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