Community-based approach towards the recognition and prevention of waterborne diseases in the Niger Delta

Community-based approach towards the recognition and prevention of waterborne diseases in the Niger Delta

Nina Bos, Ida van Grevenbroek, Myrthe van Wijchen, Sara Vande Velde,
Dewi Pinna, and Eva Fijen

June 29, 2018
ACT Period 6: YMC-60809
Commissioner: International College of Commerce
Coach: Paul van Haperen
Academic advisor: Dr. Ir. MAE (Annemarie) Wagemakers

Cover page: World Unity, 2015

Contact details

Project Manager Commissioner:

- Willem Arendsen
- e-mail address: warendsen@icc-edu.nl

Acknowledgement

The Foundation International College of Commerce funded this project, and supported it by being physically present at meetings, accessible via email and phone contact, and being open for suggestions and ideas. We would like to thank ICC for their support, and broadening our worldview by getting insight in the situations that the people in the Niger Delta live in.

We would also like to thank the interview respondents: nine students from Nigeria, a local NGO and a Dutch thesis student. We thank them for taking the time to talk to us and answer our questions. Their input was immensely valuable for this project. Without them, the project would not have been the way it is now.

Lastly, a major thanks to our coach Paul van Haperen and our academic advisor Annemarie Wagemakers. They made it possible to push our boundaries, to think critically, and to think out of the box, resulting in an increase in quality of the report.

Kind regards,

The Wageningen Student Consultants Team

Nina Bos
Eva Fijen
Ida van Grevenbroek
Dewi Pinna
Sara Vande Velde
Myrthe van Wijchen

Wageningen
Student Consultants

Table of Contents

Executive Summary

This project aimed to find out which strategies are best suited for the Foundation International College of Commerce to promote prevention of infections with and recognition of symptoms of waterborne diseases of the population in the Niger Delta region. The International College of Commerce's existing student network was used as a starting point to reach the local population.

The Wageningen Student Consultants took a broad approach. The adapted Local Ecological Framework was used to take the whole context into account of the Niger Delta area. Furthermore, the project focussed on the local situation by interviewing local students and conducting six literature studies on the contextual background of the country, the current water, sanitation, and hygiene practises in the Niger Delta, the pathology of waterborne diseases in the Delta region, technological interventions, communication strategies, and the use of the International College of Commerce's student network.

The main outcome of the project is the identification of two strategies in which the student network can be used: 1) obtaining a community-engagement course at university level or 2) obtaining a volunteering programme via student associations. This project prefers the community-engagement course. This course would exists of trainings in different domains, to provide the students with a basis to execute projects in their local community. The universities can, in collaboration with the ICC, explore the possibilities for the development of a course at university level that encourages community engagement of students. These first plans can be presented to the NUC, and be further developed and elaborated on as a collaboration between the universities, NUC and ICC. Certain conditions have to be met for the intervention to be successful. Moreover, success is more likely when the intervention is monitored and evaluated.

This course should entail knowledge and awareness of waterborne diseases, technological interventions and other preventive measures, and communication strategies. Firstly, the trainings should provide the students with information about the diseases typhoid fever, cholera

and dysentery. Per waterborne disease, information needs to be provided regarding symptom recognition and needed actions to limit disease transfer and actions to be performed in critical situations. Secondly, the trainings should include information about all six water treatment methods, so that the households can make their own choice, and the three additional actions. The treatment methods are: biosand filter, ceramic filter, chlorination, flocculant-disinfectant powder, solar disinfection and boiling. Furthermore, safe storage, handwashing with soap and safe food handling/preparation were also taken into account. Thirdly, trainings should include communication strategies for capacity building. These include: the set up of committees, theatre for development, distribution of pamphlets/posters, radio for development, and the celebration of (international) water, sanitation and hygiene events. To create the highest impact, a combination of these strategies is best.

Further research needs to be done to obtain additional data on local water, sanitation and hygiene practices, epidemiology of waterborne diseases in the Niger Delta, and healthcare centres, specifically their accessibility and expertise.

It is important to mention that the advice created in this report is directed towards ICC only. Therefore, it is not advisable to send this report to other stakeholders in the Niger Delta region as politically sensitive information might be present in the report. ICC is advised to keep this report as a recommendation for themselves and to make a custom made version to approach stakeholders in the region.

Main Take-aways

Report Chapter	Main takeaways
Introduction	International College of Commerce wishes to implement an awareness program in collaboration with their student network for the recognition and prevention of these waterborne diseases. However, International College of Commerce needs information on how to best approach such a program. This Academic Consultancy Training project attempts to advice the International College of Commerce on how to best collaborate with the students at six Universities in the Niger Delta to help spread awareness amongst the Niger Delta population on recognition and prevention of waterborne diseases by using information, communication and education.
Theoretical framework	This project builds on two key theoretical frameworks; the adapted Local *Ecological Framework* and the *World Bank Capacity Development Framework.*
Methodology	Brainstorms, academic literature, and semi-structured interviews to answer the research questions
Water, sanitation and hygiene practices	The water, sanitation and hygiene practices in the Niger Delta are currently *very poor*. Water sources and sanitation facilities are lowest on the scale.
Pathology	It is most important that people are *able to recognize the symptoms* of waterborne diseases and have the availability to go to a health care centre for treatment close to their community.
Technological interventions	There are multiple technologies to disinfect water and actions that prevent (re)contamination of water. It is important that households have the *choice* to apply the technology which is most fitting in their situation.
Communication strategies	There are multiple possible communication strategies that can work in the Niger Delta. Some are more mass media focused, and others are more focused on direct involvement of people in the community. A *combination* of both strategies creates most impact.
Collaboration ICC and student network	There are two options to implement a course, either via universities or student associations. The universities can, in collaboration with the International College of Commerce, explore the possibilities for the development of a course at university level that encourages community engagement of students. These first plans can be presented to the National Universities Commission, and be further developed and elaborated on as collaboration between the universities, National Universities Commission and International College of Commerce. The consent of the National Universities Commission to develop a formal course at university level is crucial. If it is done via a student association, the National College of Commerce is most likely not (formally) involved.

Discussion	There is a *lack* of epidemiological data, and there is *no blueprint* for the perfect plan. Moreover, *more research* has to be done to increase the understanding of the current water, sanitation and hygiene practices in the Niger Delta.
Conclusion	The *preferred option* is the development of a course implemented in the universities' curricula, as it is possibly a more sustainable way to set up a formalized project within the Niger Delta Universities then the students associations could do. There are *multiple conditions* to be met for this intervention to work.
Recommendations	There are *recommended interventions* on the societal, community, and relationship level (figure 1). Based on *impact and feasibility* of the recommendations, next steps are included for the International College of Commerce (figure 2).

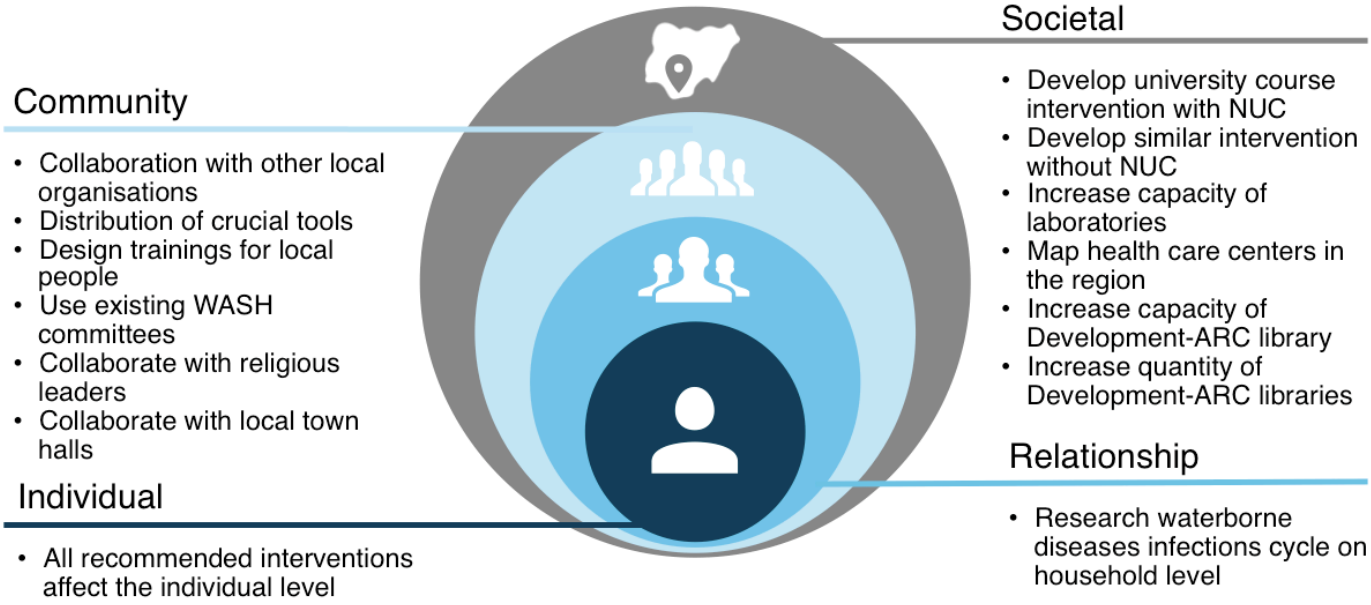
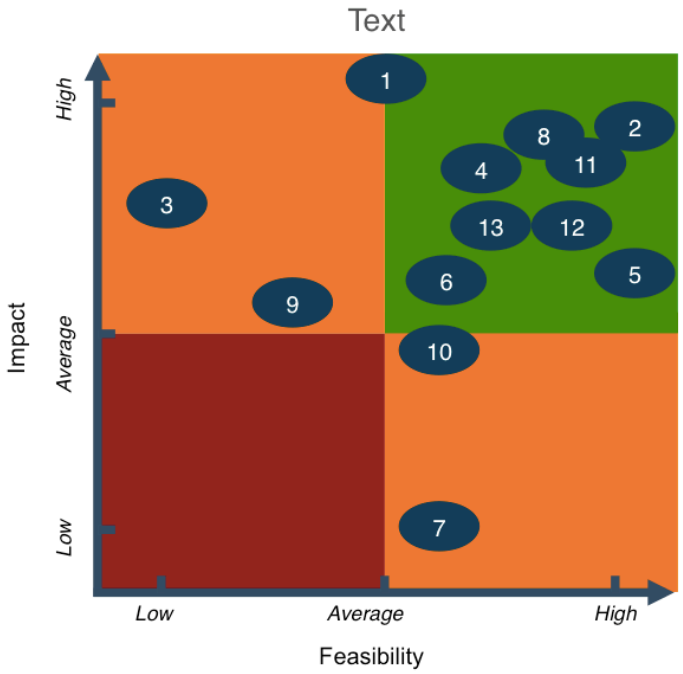


Figure 1. Recommendations



1. Develop university course intervention with NUC
2. Develop similar intervention without NUC
3. Increase capacity of laboratories in the Niger Delta
4. Map health care centers in the region
5. Increase capacity of Development-ARC library
6. Increase quantity of Development-ARC libraries
7. Research waterborne diseases household infections cycle
8. Collaboration with other local organisations
9. Distribution of crucial tools
10. Design trainings for local people
11. Use existing WASH committees
12. Collaborate with religious leaders
13. Collaborate with local town halls

Get in touch with universities in the Niger Delta and propose the implementation of a community engagement course for students. Get in touch with NUC to find approval for the implementation of this course.

Increase the capacity , qualitiy and quantity of the Development-ARC libraries.

Initiate collaboration with local leaders/townhalls/existing WASH committees/local organisations.

Map out the number, capacity and knowledge of healthcare centres in the region.

Figure 2. Impact – feasibility matrix & Next steps; what can ICC do tomorrow?

Abbreviations and Acronyms

ACT	Academic Consultancy Training
AIDS	Acquired Immunodeficiency Syndrome
AMSA	African Medical Students Association
CAWST	Centre for Affordable Water and Sanitation Technology
CDC	Centers for Disease Control and Prevention
GTFCC	Global Taskforce on Cholera Control
HIV	Human Immunodeficiency Virus
HWTS	Household Water Treatment and Safe Storage
IBM-WASH	Integrated Behaviour Model for Water, Sanitation and Hygiene
ICC	International College of Commerce
ICE	Information, communication and education
IFRC	International Federation of the Red Cross and Red Crescent Societies
IMF	International Monetary Fund
INGO	International Non-Governmental Organisation
IO	International Organisation
IV	Intravenous
LEK	Local Ecological Knowledge
M&E	Monitoring & Evaluation
MSF	Médecins Sans Frontières
NAFDAC	National Agency for Food and Drug Administration
NBS	National Bureau of Statistics
NDDC	Niger Delta Development Commission
NDUMSA	Niger Delta University Medical Students Association
NGO	Non-Governmental Organisation
NNPC	Nigerian National Petroleum Corporation
NUC	National Universities Commission
ORS	Oral Rehydration Salts
OVC	Oral Cholera Vaccines
PCR	Polymerase Chain Reaction
P&G	Procter & Gamble
PMN	polymorphonuclear
PSI	Population Services International
RANAS	Risks, Attitudes, Norms, Abilities and Self-regulation
RCT	Randomised Controlled Trial
RDT	Rapid Diagnostic Test
SAGE	Strategic Advisory Group of Experts
SDG	Sustainable Development Goals
SODIS	Solar Disinfection
SVA	Student Volunteer Army

TAF	Technology Application Framework
TCV	Typhoid Conjugate Vaccine
TIP	Technology Introduction Process
TNOC	Transnational oil company
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WASH	Water, sanitation and Hygiene
WB	World Bank
WHO	World Health Organisation
WUR	Wageningen University and Research

1. Introduction

1.1 The Academic Consultancy Project

The Foundation International College of Commerce (ICC) has been informed, via the Development-ARC library project in the Niger Delta region of Nigeria, that the infection with the waterborne diseases dysentery, typhoid and cholera has reached an epidemic level in this region (ICC-EDU, 2018). Waterborne diseases can originate from pathogens like bacteria, viruses or parasites. These diseases can be transmitted via water. Infection of people occurs via the faecal-oral route, which means that the pathogen can infect a person when it is ingested via contaminated food or drinks and excreted from the infected person's body via faeces. Faeces can end up in the water, where it can be transmitted to other persons who drink or wash their food with contaminated water (Petersen, Rifai, Suarez, & Stein, 2005). The prevalence of waterborne diseases is associated with poor hygiene and sanitation (Wasiu, Akintayo & Popoola, 2014). When left untreated, these diseases can cause rapid death.

The ICC is a foundation that initiates and supports life-changing educational projects in West Africa (ICC-EDU, 2018). The ICC is eager to know how they can support the Niger Delta region with the recognition and prevention of infections with waterborne diseases. They want to provide practical tools for students so they in turn can inform and educate people in their hometown on the recognition and prevention of infections with waterborne diseases to empower the local population in the Niger Delta. The Niger Delta is situated in the west part of Africa and is a political conglomeration of nine states in Nigeria, see figure 3 (Olawoyin, Oyewole & Grayson., 2012). The region is home to about 30 million people (Nigeria has a total population of 186 million), and this number is increasing (Stakeholder Democracy, 2018; Gasa, 2000). ICC aims to focus on all aspects of water, sanitation and hygiene (WASH) and the most significant waterborne diseases in the Niger Delta.

Figure 3. Nigeria and the Niger Delta Region with its nine states (VON, 2018)

ABOUT THE COMMISSIONER

Based in Amsterdam, the Netherlands; The International College of Commerce (ICC) is accredited and partners with United Kingdom professional awarding organisations as an education provider in the Benelux region. ICC introduced renowned professional education bodies like ACCA, CIMA, CIM, CISI and ICEAW into the Benelux education market; and as such, we are delighted to be the foremost institution since 2001.

More so, as a Foundation, the International College of Commerce initiates and supports education projects in partnership with local universities, college and schools in diverse parts of West Africa. “We believe that the role of education in poverty eradication, in close co-operation with other social sectors, is crucial to reducing poverty”.

Supported by Dutch government universities: Maastricht Universiteit; VU University Medical Center Amsterdam; and Wageningen University and Research, ICC and the Development-ARC (Academic Resource Centre) are setting up libraries for higher education students in the Niger Delta of Nigeria. A project that will empower the locals with the necessary knowledge to make practical changes in their lives and surroundings – all by themselves

Paul Oviawe is the proprietor of the International College of Commerce. He was born in Warri, Delta state of Nigeria. Since early age Paul was deeply concerned about the contemptuous living conditions of the poor and the hardships they were undergoing in the Niger Delta; a region with abundant human and natural resources, but still struggling with mass impoverishment.

It was his early experiences that left a deep impact on him and propelled the emotions of anger and fear, causing him to look for scholarly solutions to reducing poverty. Today, with a successful career in academia, Paul is a well-regarded figure and one of the most influential Africans in the Benelux region.

** Written by ICC Project Manager Willem Th. Arendsen*

ICC wishes to implement an awareness program in collaboration with their student network for the recognition and prevention of these waterborne diseases. However, ICC needs information on how to best approach such a program. This Academic Consultancy Training (ACT) project attempts to advice the ICC on how to best collaborate with the students at six Universities in the Niger Delta to help spread awareness amongst the Niger Delta population on recognition and prevention of waterborne diseases by using information, communication and education (ICE).

It is important to mention that the advice created in this report is directed towards ICC only. Therefore, it is not advisable to send this report to other stakeholders in the Niger Delta region as politically sensitive information might be present in the report. ICC is advised to keep this report as a recommendation for themselves and to make a custom made version to approach stakeholders in the region. ICC can use this knowledge and the recommendations to set up an actual working project.

In addition to the problem of waterborne diseases in the Niger Delta, large oil producers damage local water resources and threaten the public health (Bruederle & Hodler, 2017). Environmental hazards caused by oil polluted water are slow poisons. Consequently, it takes a while to cause death or disease (Ordinioha & Brisibe, 2013). For example, prior to conception, nearby onshore oil spills increase neonatal mortality, stunting, and wasting (Bruederle & Hodler, 2017). However, in spite of the project member's intensive search, there is to the member's knowledge no existing academic literature that links oil polluted water to the prevalence of waterborne diseases. This project will therefore not focus on this correlational relationship. Rather, the project will take the oil polluted water as a context factor in the region.

1.2 Contextual Background

The presence of waterborne diseases in the Niger Delta is due to a couple of factors. This section deals with the underlying background of the waterborne diseases in the Niger Delta, by touching upon topics such as Nigeria's history since independence, its political-economy, bureaucracy, and involved stakeholders to the project.

Historical Background

Since the fifteenth century, Nigeria and the Niger Delta especially have seen different European rulers; the Portuguese, French, Dutch, and British (Le Billon, 2017). In 1960, Nigeria became formally independent from Great Britain, and in 1963, it accepted a new constitution that formally made Nigeria a republic (Gasa, 2000).

At the moment, there live an estimate of 186 million people in Nigeria and about 30 million people live in the Niger Delta (Stakeholder Democracy, 2018). In the Niger Delta region, there are five major linguistic categories (Delta Cross, Edoid, Igboid, Iljoid, and Yoruboid) (Le Billon, 2017). Within these categories there are multiple different languages and dialects.

Political-Economy of the Nigerian State and the Niger Delta region

With a production of crude oil of 2.18 million barrels a day, Nigeria is the largest producer of petroleum in Africa and it accounts for 90 per cent of Nigeria's foreign exchange earnings (Le Billon, 2017). These numbers show that the state is largely dependent on royalties paid by 'transnational oil companies' (TNOCs), taxes, and rents that come from the mining of oil. Although Nigeria is rich in natural resources, with a GINI coefficient of 48.8 (World Bank, 2013) the incomes generated from these natural resources are not distributed equally among the Nigeria population. Consequently, Nigeria is on place 152 of the 187 measured countries in terms of social equality (World Bank, 2013). Scholars from different schools of thought see this as the main driver for social unrest in the country.

Scholars writing from a dependency and Marxist political economy approach, explain the present of violent conflicts in especially the Niger Delta by applying the 'triple alliance' theory. For example, Turner and Terisa (1978) applies the concept of 'commercial triangle' to explain the dominant classes present in Nigeria. Turner and Teris see the dominant classes in Nigeria as a nexus between international capital forces and local Nigerian associates that consists of private sector middlemen, also categorized as 'compradors' and state officials. According to Turner and Teris, the 'compradorial elites' are the hegemonic class of retired technocrats, army generals, and top politicians, who sustain the interests of international capital in the Nigerian state system. Accordingly, Turner and Teris portrays the Nigerian state as a 'captured state' constrained by the interests of international capital.

Building on this, Evans (1997) argues this 'capture' infiltrates the whole Nigerian state system such as the political and economic conditionalities as prescribed by the neo-liberal economic reforms of the International Monetary Fund (IMF) and the World Bank. Consequently, politicians and state managers' first priority is sustaining profitability of transnational markets rather than accommodating the interests of the local population (Evans, 1997). According to Evans, this leads to the impoverishment of the populace and calls this the 'predatory state'. Evans characterizes the 'predatory state' as consisting of 'captured' and 'weak' institutions with a lack of social cohesiveness, an aversion to development, low autonomization, patron-clientelism, and proneness to societal fragmentation (Evans, 1997).

Similarly, Frynas (2000) and Kuru (2002) call the institutional framework of the Nigerian state a 'rentier state'. Frynas (2000) argues that a rentier state lacks a long-term productive outlook in order to make the revenues obtained from natural resources contribute to the gross domestic products and national income distribution equally. This is often at the expense of the real productive sectors of the economy (Frynas, 2000). Kuru (2002) argues that the Nigerian 'rentier state' is a colonial legacy since the economy was solely oriented to production and export of primary commodities. Consequently, rentier states such as Nigeria were focused and are still focused on short-term wealth creation rather than long-term diversified investments (Kuru, 2002). Similarly, Le Billon (2017) goes even further by arguing that Nigeria is a mono-economy and dependent on export, much more than during the colonial period.

Bureaucracy in Nigeria and the Niger Delta region

According to Grugel (2002), the distribution of 'rentier' revenues in combination with a patrimonial political culture enforces corruption in the public realm. Patrimonial political culture are the rooted norms, values, and networks of inherited traditional patterns of politics in post-colonial African states. Although the state has the features of an institutionalized administrative states, it operates along patron-client networks and entrenched historical patterns of solidarity and authority (Grugel, 2002). This description of Nigeria as a patrimonial political culture rentier state, is in line with what Joseph (1987) calls 'prebendalism' in his description on the politics in Nigeria. 'Prebendalism' is the idea that office holders use their position to generate material benefits for their communities and themselves to such an extent that in the case of Nigeria

statutory purposes of state offices become secondary concern (Joseph, 1987). Similarly, the Nigerian state has been called ‘politics of plunder’ since the start of the oil boom by Gore & Pratten (2003). Within this context, it is difficult to get long-term changes for the better of the whole population

Stakeholders

There are several important stakeholders in this project. The local communities living in the Niger Delta region, the students at the universities in the Niger Delta, Non-Governmental Organisations (NGOs) and International Organisations (IOs) working with waterborne diseases in the Niger Delta, and the National Universities Commission (NUC). These stakeholders will be impacted by the solution or could have an impact on the solution. Other stakeholders are international oil and and exploration companies, Shell, Nigerian National Petroleum Corporation (NNPC), various ministries, Federal Government, State Government, local medical centres, local water companies, municipalities, and local businesses. These latter stakeholders are part of the problem and could possibly be part of the solution, however due to the limited scope of the project they will not be directly included in the research. In figure 4, a complete and more in depth stakeholder analysis can be found based on the Rainbow diagram by Chevalier and Buckles (2008). After a discussion between the project team members and ICC agreed to situate the various stakeholders in the diagram, as can be viewed in figure 4. The stakeholders are placed according to their level of effectiveness to the problem, and their level of influence on the problem.

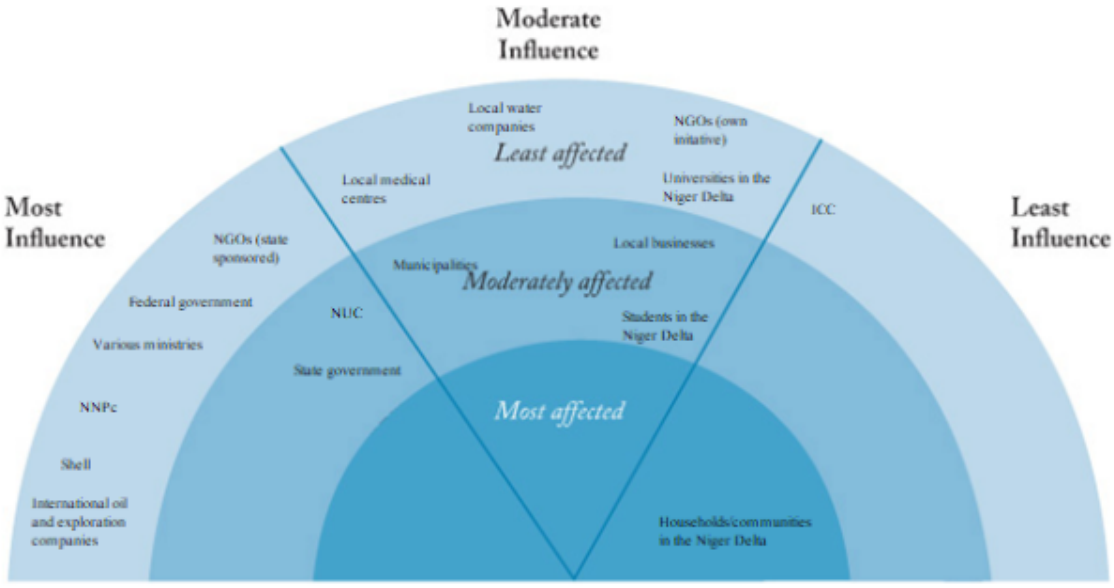


Figure 4. Stakeholder analysis on the rainbow diagram (Chevalier & Buckles, 2008).

1.3 Problem Definition

To implement an awareness program, this report will address two major problems; the knowledge gap regarding the design of the trainings, and the content of those trainings, which is based on the knowledge gap of the students and their communities. To contribute to the successful implementation of an awareness program, the ACT team explores which interventions seem to be most effective in minimising infections with, and recognising symptoms of waterborne diseases and how the student network can use such interventions. A best practices analysis on WASH projects in similar contexts will underpin an understanding to the project problem (House & Reed, 2004). In order to make these best practices applicable to the Niger Delta context, the ACT project will shed light on the local context using data gathered via semi-structured interviews (Halvorson, Williams & Dunkel, 2011; Small, Harding & Lamont, 2010).

Integrative project purpose and research question

The purpose of the project is to define recommendations on strategies that the ICC can use to promote the recognition and prevention of waterborne diseases in the Niger Delta with the use of their existing student network. In order to fulfill this purpose, the following main research question has been established:

Which strategies are best suited for ICC to promote prevention of infections with and recognition of symptoms of waterborne diseases of the population in the Niger Delta region through ICC's existing student network?

This main research question is divided in the following sub-question with subsequent approaches:

1. *What are the current water, sanitation, and hygiene practices in the Niger Delta?*
2. *What is the pathology of the waterborne diseases typhoid, cholera and dysentery?*
    a. *What is the cause of the different waterborne diseases in the Niger Delta?*
    b. *Which transmission routes are known of these diseases in the Niger Delta?*
    c. *What are the symptoms of the most prevalent waterborne diseases in the Niger Delta region?*
    d. *Which treatments are available and applicable in the Niger Delta region?*

3. *Which interventions have been described to work best, in terms of impact and feasibility, to minimise the infections with and recognise symptoms of waterborne diseases?*
    a. *Which technologies have been described to work best, in terms of impact and feasibility, to minimise the infections with waterborne diseases?*
    b. *Which communication strategies have been described to work best, in terms of impact and feasibility, to empower the local population?*
4. *How can the collaboration between ICC and their student network be structured to increase capacity building, in order to empower the local population regarding the prevention of infections with and recognise the symptoms of waterborne diseases in the Niger Delta?*

1.4 Setup of the report

The report is structured as follows: First the chapter regarding the theoretical framework is explained, it situates the project within the academic field of development studies with reference to the Ecological Framework and the Capacity for Development framework. Secondly, the methodology chapter outlines which methodology was used with regards to the literature study and the undertaken interviews. Thereafter, the results chapters (chapter 4 to 8) presents the four sections on which results have been generated namely; (1) the current water, sanitation, and hygiene practices in the Niger Delta region; (2) the pathology of waterborne diseases and knowledge level of the student network; (3) technological and communication interventions; and (4) the collaboration between ICC and the student network. The discussion section provides a filled out theoretical framework, and highlights the limitations and strengths of this research that need to be taken into account before recommendations can be made and the conclusion section attempts to answer the main research question of this project. The final section attempts to make the project actionable by providing recommendations and a chart that shows which recommendations could have the most impact and are most achievable for ICC.

2. Theoretical Framework

This academic consultancy project builds on two key theoretical frameworks; the *Ecological Framework* (WHO, 2018a; Akpabio & Subramanian 2012) and the *World Bank Capacity Development Framework* (2009). The first framework is used in order to adequately incorporate all the different forces involved that influence the presence of waterborne diseases in the Niger Delta. This framework clarifies that no single factor can adequately explain on its own why some people or groups have a higher risk of getting infected with waterborne diseases, while others are protected from them. The second framework is used as a technique to incorporate and design local capacity building through ICC's student network. The sections below attempt to give a deeper understanding of the two theoretical frameworks.

2.1 The Local Ecological Framework

The Local Ecological Framework that is used in this project to map all different forces that influence the presence of waterborne diseases in the Niger Delta, is based on two different ecological frameworks; the World Health Organisation's (WHO) Ecological Framework and the Local Ecological Knowledge framework of Akpabio & Subramanian (2012).

According to the Ecological Framework of the WHO, the causes that contribute to a certain behaviour vary from individual to societal factors (Figure 5). Firstly, the individual level includes personal history and biological factors that influence how individuals behave. Secondly, the relationships level takes into account family and friends. Thirdly, the community level, such as workplace, neighborhoods, and schools, also influences one's behaviour. Lastly, at the societal level, factors like governmental policies or local regulation practices are taken into account to clarify the influence that social and cultural norms and procedures have on someone.

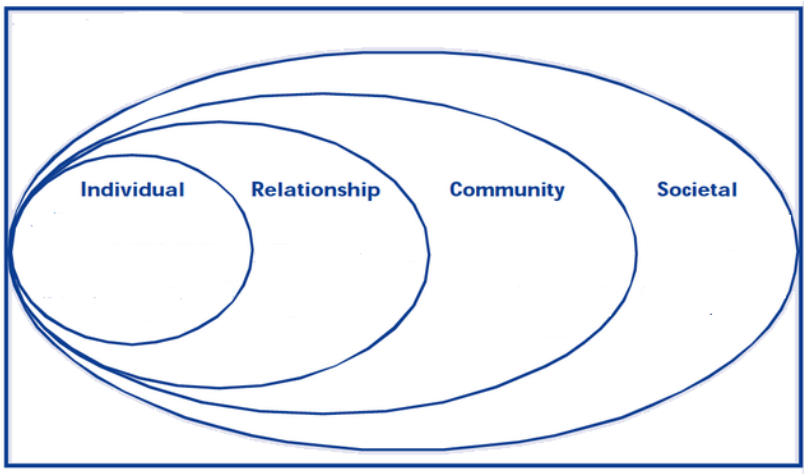


Figure 5. Ecological Framework (WHO, 2018a)

The Local Ecological Knowledge (LEK) framework takes the *human-environment* relationship as a crucial element that influences the context of people's behaviors and practices. Consequently, the LEK framework is able to provide a structural approach to the contextual roles of the environment on the human lives, such as, but not limited to, perceptions, beliefs, values, norms, emotions, spirituality, physical location, age, economic position, exposure, and education (Akpabio & Subramanian, 2012). In this project the environment is the water, and thus the human-water relationship. These culturally defined human-water relationships are potentially large barriers to accomplish behavioral change and should therefore be taken into account when designing an intervention. As a result, the LEK framework is able to determine the reasons behind certain practices, in the case of this project; certain water and sanitation practices can be identified that might (not) lead to the prevalence of waterborne diseases.

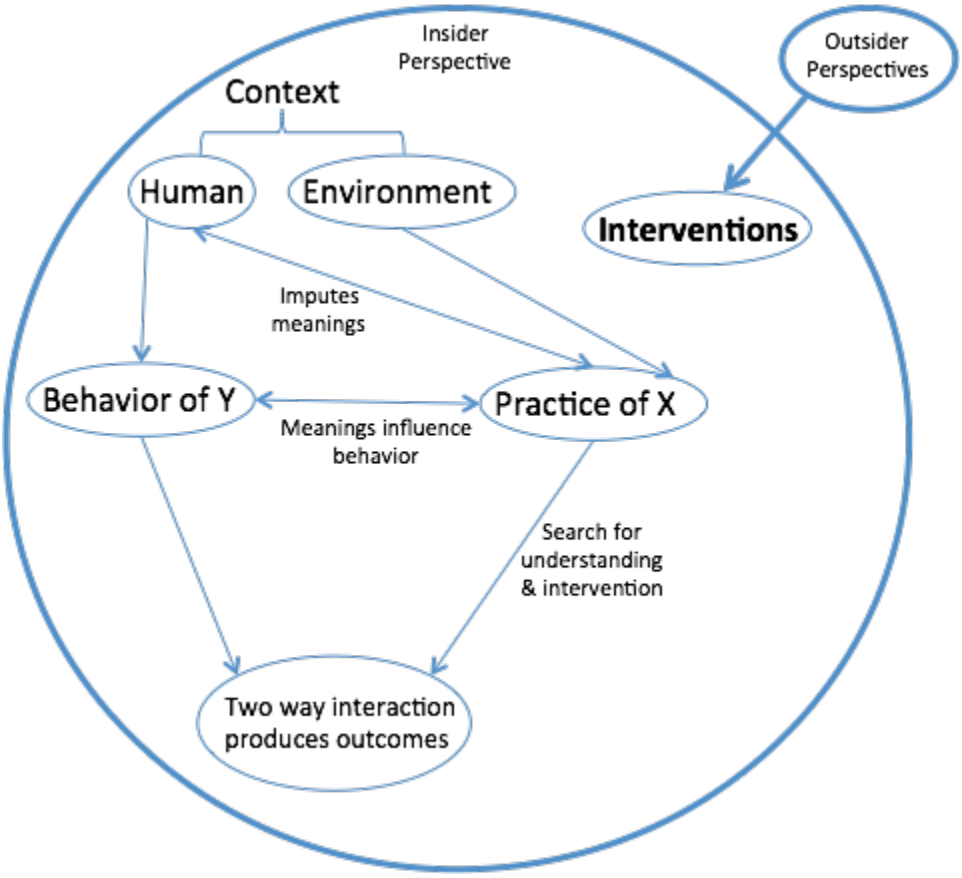


Figure 6. Local Ecological Knowledge framework (Akpabio & Subramanian, 2012)

Figure 5 shows how the different elements of the human-environment relationship are linked to, and influenced by, different behaviors and practices that are given meanings. The LEK framework visualises the mechanisms that govern local meanings about certain practices and behaviors (X and Y) which produces certain (negative or positive) outcomes to that local population. As a result, interventions by the 'outsider perspectives' to influence the 'outcome' should take into account all these different elements of the 'insider perspective' (human-environment context, behavior of Y, and practices of X) in order to change the 'produced outcome' or, differently put, to make the intervention successful. Additionally. it becomes clear to the outsider where exactly an intervention can best be undertaken in order to change the produced outcome.

However, due to the methodological scope of this particular academic consultancy project, it is not possible to get a full grasp of the different behaviors of Y and practices of X. For example, the researchers are not able to do proper ethnographic research techniques such as participant observation in the field, which is identified by Akpabio and Subramanian (2012) to be of key importance when trying to identify the different behaviors and practices within a community. Therefore, this academic consultancy project attempts to integrate the two ecological frameworks in order to still be still able to account for the importance to understand the insider's perspective first before designing interventions from the outsider's perspective. As a result, the project is able to distinguish between all key levels of the insider's perspective influencing the individual, relationship, community, societal, and how these different levels are linked to one another with the use of the Local Ecological Knowledge framework (figure 7). This framework will be a key asset for the rest of this research project.

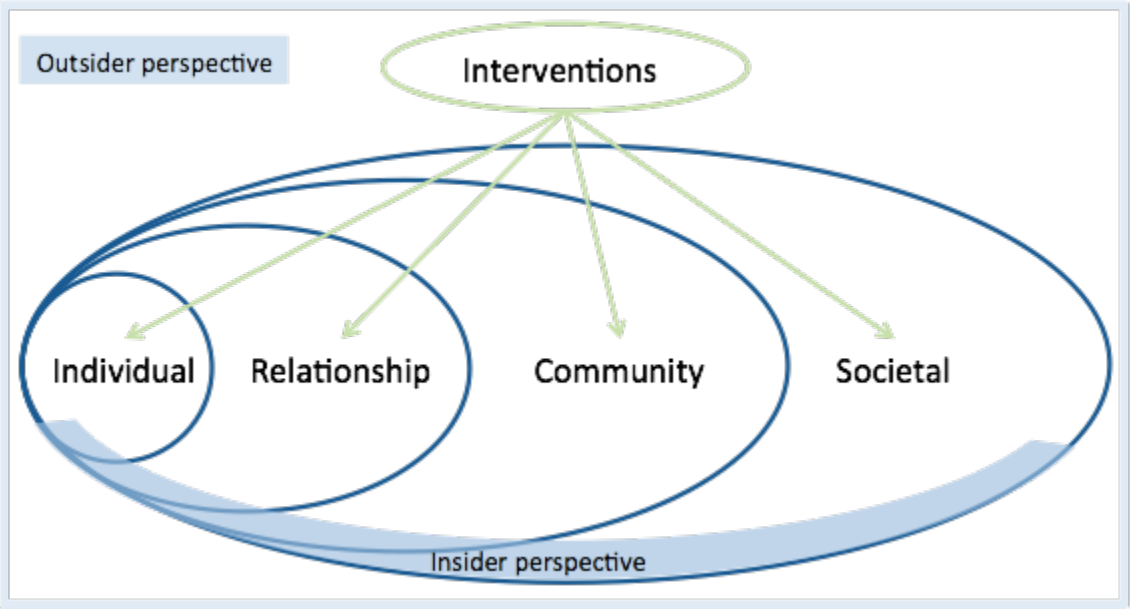


Figure 7. Adapted Local Ecological Framework. (Adapted from WHO, 2018a)

2.2 The Capacity Development Framework

ICC aims to establish a way of providing the six state universities they are in contact with, with tools to educate and spread awareness on waterborne diseases among the students''s hometowns. Chen, Acey, and Lara (2014) underline the high value of capacity building through informed decision making of university students. Their research highlights the importance of doing research activities in "an iterative way, and accountability is built into the process [that ensures] input on assets, problems, and scenarios gathered, presented, and reflected by community concerns" (Chen et al., 2014). Accordingly, this ACT project attempts to build community capacity through the involvement of the local community as proposed by Chen et al. (2014). This way of approaching a development project has been conceptualised by the World Bank (2009) in their Capacity Development Framework (figure 8).

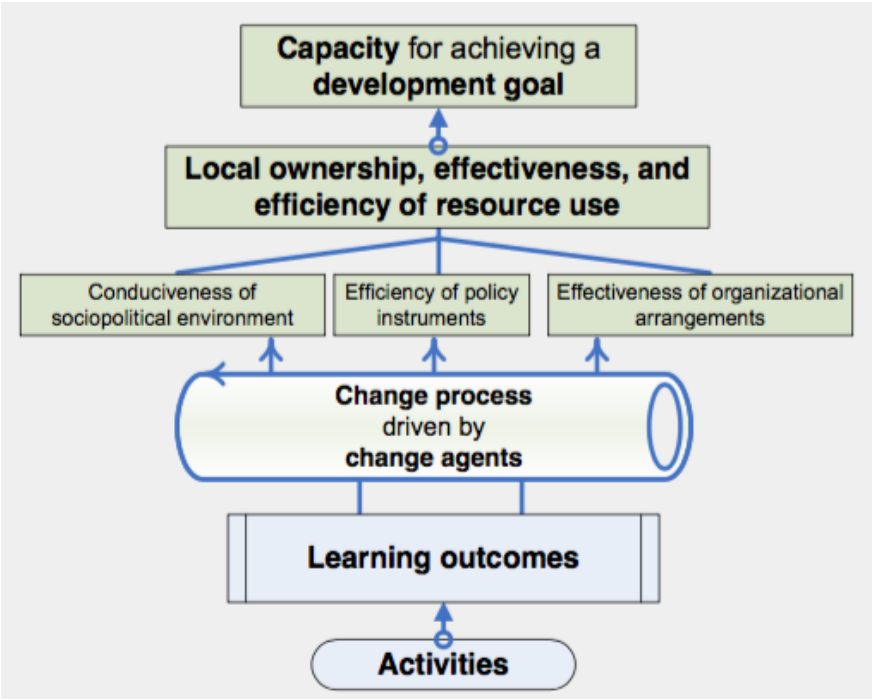


Figure 8. Capacity Development Framework (World Bank, 2009)

The Capacity Development Framework presents key elements of local capacity building by agents of change, that leads to the capacity for achieving a development goal (figure 8). The central idea of the framework is that through knowledge and information, agents of change can enhance (1) the conduciveness of the sociopolitical environment, (2) the efficiency of policy instruments, and (3) the effectiveness of organizational arrangements, which would all

contribute to achieve the development goal. Accordingly, this ACT project focuses on capacity building of local university students in order to enhance their ability to be agents of change. In the discussion section of this project, the Capacity Development Framework will be filled out according to the gathered results. This provides a clear overview of how the students can be agents of change and how the development goal could be reached and what conditions there are.

3. Methodology

To determine the main problem and thus the main research question of this project, the group organised a meeting with the commissioner to discuss this. Afterwards, there was a brainstorm amongst the group members to determine which topics needed to be covered to provide sufficient recommendations to the commissioner. This resulted in the four sub-questions that were explained in the introduction. This ACT project conducted literature studies for each sub-question and conducted a total of 11 semi-structured interviews; see appendix B for overview of interviewees. Because literature was searched per question and due to time limitations, this project did not undertake a systematic literature review.

Literature that was relevant to answer the sub-questions was identified according to three steps. First, the inclusion and exclusion criteria were established for the different sub questions: they can be found in table 1. Secondly, search terms were chosen for different search engines, they can also be found in table 1.The search engines used were, PubMed, Wageningen University and Research (WUR) library, and Google Scholar. To find reports of implemented WASH projects, Google was used. In addition, databases of NGOs and IOs dealing with waterborne diseases were searched.

The Ecological Framework as developed by the WHO and the Local Ecological Knowledge framework as developed by Akpabio and Subramania, were combined to create the adapted Local Ecological Framework. As came to the fore in the adapted Local Ecological Framework (figure 5), this project aimed to include both the insider and outsiders' perspective, while also

focusing attention on the different levels described by the WHO's Ecological Framework. The literature studies conducted provided the team with an outsider's perspective. To obtain the insiders perspective as well, 11 semi-structured interviews were held. The Capacity Development Framework was used and filled in on the basis of the literature and interviews. This framework, filled in according to the steps that need to be taken to set up the intervention, aims to provide a bottom-up approach to make the intervention sustainable, as top-down interventions that were solely focused on the technological aspects proved to be unsustainable (Sobsey, Stauber, Casanova, Brown & Elliott, 2008).

In order to write the main take-aways, next steps, discussion, conclusion and recommendation sections, the group held several brainstorm sessions to determine the content of each section. Afterwards group members were assigned to elaborate on the determined content and created a complete section.

3.1 Interviews

To obtain the insider's perspective, nine interviews were conducted with students from universities in the Niger Delta, one interview was conducted with a local NGO in the Niger Delta, and one interview was conducted with a Dutch student who had done her thesis research in the Niger Delta. The nine students from the universities were found via the ICC, who had contacts within the universities, who in turn searched for participants. In the end, they found eleven students who were willing to be interviewed by the ACT team, but due to bad weather conditions only nine interviews took place. Each interview with the students lasted about 45 minutes. The local NGOs were searched for and found using Google. E-mails were sent out to six different NGOs, but only one responded. The interview with this local NGO lasted about an hour. The Dutch thesis student was found because her thesis came up in one of the search results. She was subsequently contacted via Facebook and was keen to be interviewed by the team. This interview also lasted about an hour. Two project members were involved per interview, of which one member conducted the interview and the other member made minutes. The duos differed per day, in the end all team members were involved with at least two interviews. The interview guide (appendix A) was designed simultaneously with the different literature reviews, which allowed the interviewers to already have some knowledge on the topic discussed. Furthermore, the interview guide allowed the interviewers to think about different angles, which creates a

higher probability to gain well-grounded data (Edwards & Holland, 2013). Examples of asked questions are: “Are you aware of any waterborne diseases in your community?” and “What is the main source of water used by households for drinking purposes?”. The interview guide was slightly adapted for the interviews held with the local NGO and the Dutch thesis student. For example, the university students were asked if they were willing to be an advocate to transfer knowledge back to their communities. All questions concerning the course were left out for the local NGO and the Dutch thesis student. Only the questions asking about the local situation and context were asked to these two participants. This project conducted the interviews via WhatsApp Calling. Due to poor internet connection, it was not possible to have interviews via Skype.

3.2 Literature study

The interviews were used to partly answer all sub-questions, subsequently literature was also used. The topics and research questions were established after group discussions and brainstorms, as mentioned earlier. This determined beforehand what literature was useful to answer the subsequent questions. For sub-question one about the local WASH practices, literature was searched to discover the local practices concerning water, sanitation and hygiene. Inclusion and exclusion criteria, as well as used search terms, can be found in table 1. To determine which diseases needed to be researched for this project, a meeting with the commissioner was held. This resulted in the focus on typhoid fever, cholera and dysentery. To answer the sub-question concerning the pathology of the three diseases, reviews were used to describe the causes of the diseases, the transmission, symptoms and diagnoses, treatments and possible vaccination options (for inclusion and exclusion criteria and search terms see table 1). Academic literature was searched to discover the prevalence of the diseases in the Niger Delta but this was in vain. E-mails were sent out to International Non-Governmental Organisations (INGOs) (Red Cross - Dutch and international, MSF - Dutch, United Kingdom and international, Oxfam - Dutch and international, Save the Children - Dutch). However, no INGOs could provide sufficient data of waterborne diseases in the Niger Delta. To determine which technological interventions needed to be taken into account for this project, databases of NGOs and IOs were searched to find WASH related project that covered technological interventions (for inclusion and exclusion criteria and search terms see table 1). This lead to the inclusion of six household water treatment methods, safe storage, handwashing and safe food handling.

Interventions at the sanitation level were not included in this project, as this is not something that households can easily do without a large change in the societal structures (UNICEF, 2013).This project took the contaminated water as a context factor, and addressed what the population can do in their households to ensure safe water. Interventions at the point-of-use are important temporary measures until the core problem is addressed (Clasen et al., 2015). The six water treatment methods are currently established treatment technologies and are most commonly used in studies and in interventions by NGOs/IOs (Clasen et al., 2015; Tiwari, Schmidt, Darby, Kariuki & Jenkins, 2009; Lantagne, Quick & Mintz, 2006; WHO, 2007; UNICEF, 2011; IFRC, 2008). Some treatment methods do not prevent recontamination after treatment, and it is advised that every project that aims to implement treatment methods should also include safe storage (Lantagne et al., 2006), which is what this project thus also incorporated. Additionally, interventions regarding handwashing with soap and food preparation were discussed, as these are also interventions at the household level. To determine the communication strategies to answer sub-question 3b, a best practice analysis was done (see table 1). Non-academic literature was searched that was published from 2010 onwards. If the reports described interventions conducted in Africa or Asia and were related to WASH projects, the practices were analysed. This resulted in seven reports that described seven different or similar communication strategies that were taken up in this project. Academic literature was then searched to underpin these strategies. For the fourth and final sub-question, brainstorms were held within the group to determine the collaboration strategies that needed to be incorporated in the project. This resulted that the universities' curricula and students associations were to be discussed in detail. Subsequently, a brainstorm was held to decide which steps need to be undertaken by ICC to implement the programme. Literature was searched to describe and strengthen the collaboration strategies and subsequent steps (see table 1 for inclusion and exclusion criteria and search terms).

Table 1. Inclusion/exclusion criteria and search terms for literature study.

	Inclusion criteria	Exclusion criteria	Search terms
WASH practices	Water practices, Sanitation practices, Hygiene practices, Niger Delta, Anthropological / Development Sociological studies, Scientific and non-scientific NGO reports, Methods used: participant observation, in-depth interviews, qualitative, Literature from 2010 onwards	Literature older than 2010, Quantitative methods, Research outside of Niger Delta	Niger Delta AND Water practices OR Sanitation OR Hygiene OR WASH
Waterborne diseases	Reviews from 2005 onwards, Literature consist of human subjects, Worldwide, English	Literature older than 2005, Experimental treatments, Animal models	(Cholera OR *Vibrio cholerae* OR Typhoid OR Typhoid fever OR *Salmonella typhi* OR Bacillary dysentery OR Shigellosis OR *Shigella dysenteriae*) AND (recognition OR prevention OR treatment OR WASH)
Technological interventions	WASH projects, Treatment methods appropriate for household use, English, Studies conducted in developing countries Literature from 2000 onwards	Methods not appropriate for household-level, Studies conducted in developed countries, Literature from before 2000	technology OR technical OR technological interventions for water OR sanitation OR hygiene (used in both academic and non-academic search engines), biosand filter, ceramic filter, chlorination, flocculation OR flocculant AND disinfection OR disinfectant, solar disinfection, boiling, handwashing, safe food handling OR preparation
Communication strategies	Waterborne diseases, WASH projects, Developing countries, English, African and Asian project, Reports from 2010 onwards, Articles from 2000 onwards	Developed countries	WASH projects OR reports AND Africa OR Asia OR Nigeria OR Niger Delta AND communication strategies AND community level (used in both academic and non-academic search engines)
Collaboration student	Student - community engagement projects, Literature from 2000 onwards, English, Worldwide, Development and developing countries	Literature from before 2000	Community OR Student OR University OR Student Associations AND engagement OR project

4. Current Water, Sanitation, Hygiene Practices in the Niger Delta

In order to be able to advice ICC on how best to use their student network in reducing the prevalence of waterborne diseases in the Niger Delta region, it is important to first get an understanding of the current water, sanitation and hygiene practices in the region, which could make clear what practices can be improved. This chapter attempts to provide the understanding of current water, sanitation and hygiene practices.

4.1 Water practices

The WHO and United Nations Children's' Fund (UNICEF) have recorded the progress of access to drinking water in Nigeria from 1990 onwards (WHO, 2015). Based on statistics from different years, they can conclude that in 1990, 40% of the total population had improved access to drinking water and in 2015, this percentage had risen to 69% (WHO, 2015). The report calculated that this is a gain of 48% of improved drinking water sources between 1990 and 2015. These statistics are similar to the wider region of Sub-Saharan Africa (WHO, 2015). There is no specific data, however, on where the unimproved drinking water sources are situated within Nigeria. Therefore, it is hard to say whether this percentage is representative for the Niger Delta region. From the interviews, it was possible to derive more specific data of the Niger Delta region. The students identified the river as the main access for drinking water. Figure 9 on the right hand side shows the definitions of 'improved' drinking water and sanitation sources (WHO, 2015). This figure highlights that surface drinking water

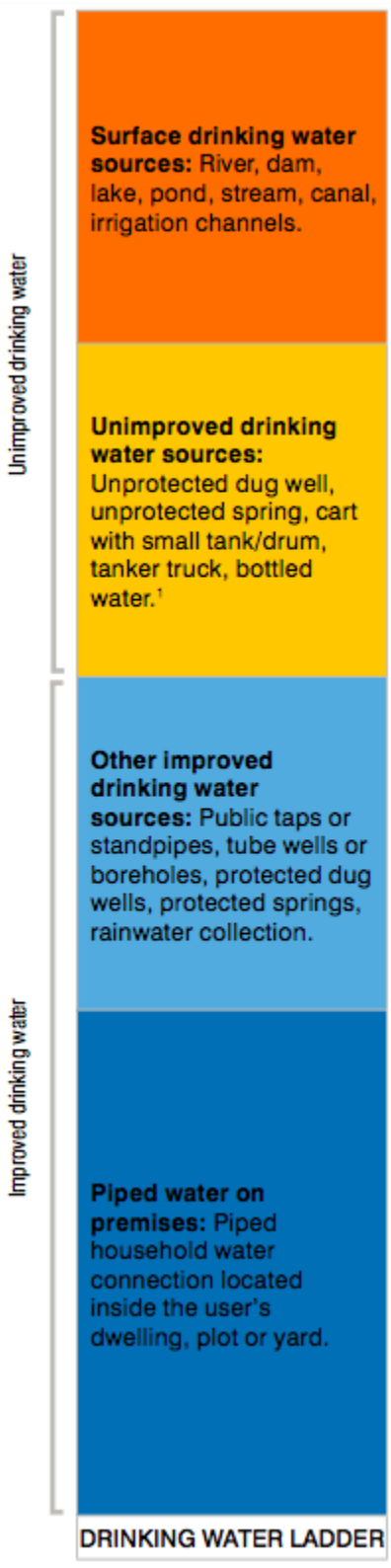


Figure 9 (WHO, 2015)

(such as rivers) are the worst category in the drinking water ladder. Since all students described the river as their communities' main or only source of drinking water, it becomes clear that parts of the states where the students come from (Edo State, Bayelsa State, Akwa Ibon State, River State, Delta State, and Cross River State), are likely to deal with unimproved water sources (table 2). It should be mentioned, however, that the students came from the parts of these states that are situated near the river, which might imply that conditions within the states are different. Better conditions could be observed further away from the river where, according to most students, boreholes are a possible technique to use for getting cleaner water. Akpabio (2012) found similar results in his research on WASH behaviors in Akwa Ibon State in the Niger Delta region, since he mentions that streams, rivers, and rainwater were the main source of drinking water. Additionally, Akpabio outlines public water services were hardly in place, and if available they were observed to be non-functional (2012). Student 5 observed the same thing when he said: *"there was a public water pump built twenty years ago, but it's now abandoned"* (table 2).

Figure 10. (WHO, 2015)

4.2 Sanitation practices

The sanitation statistics of Nigeria are quite different to those of wider Sub-Saharan Africa (WHO, 2015). In 1990, 38% of the total population of Nigeria had improved sanitation (WHO, 2015) (figure 10). However, 25 years later in 2015, this percentage dropped to 29%, which is in stark contrast to the increase of improved sanitation in wider Sub-Saharan Africa from 24% in 1990 to 30% in 2015 (WHO, 2015). Furthermore, Nigeria is the third most regressive country in

the world when it comes to sanitation development and third in the world with longest queues for toilets (WHO, 2015). The report does not make clear why sanitation conditions dropped with almost 10% in Nigeria. However, it can possibly be explained by the high population growth of Nigeria; within the same 25 years, the population of Nigeria almost doubled from 97.55 million in 1990 to 181,2 million in 2015 and (World Bank, 2018). Nonetheless, the total population of Sub-Saharan Africa as a whole, almost doubled in the same period as well; from 511 million to 1 billion people (World Bank, 2018). Nigeria has the largest population in Sub-Saharan Africa which could possibly be a reason why Nigeria has a harder time dealing with the population growth in relation to sanitation compared to other Sub-Saharan countries. Another explanation for the low sanitation conditions in Nigeria could be the fact that Nigeria and especially the Niger Delta deal with a violent political context, as described in the introduction. This violent political climate could have resulted in the idea that the government did not have the resources to implement a thorough sanitation infrastructure in those areas the conflict has taken or still takes place.

In the interviews, most students identified their sanitation facilities to be a latrine on a platform floating above the river (table 2). Student 5 said: *"We have a platform over the river"* and similarly student 7 said: *"We use a latrine which drops into the water"*. Student 4 and 6 say that the river water or fish will take away the human excreta; *"those people very close to water, they have a platform above the water. So it goes directly into the water. Fish eat everything that comes in the water."* and: *"We use a latrine, which they built like a toilet on top of the water. The water takes away the materials."* In addition, student 9 answered something similar to the question where they get there water from, by saying: *"There is a certain side at the river where we fetch the water for drinking. The community made it clear that no bathing or washing of clothes is allowed in that section of the river, solely for drinking and cooking, so that side is clean to the eyes of the community."* Only student 8 mentioned that they have a toilet close to their house. However it's unclear if this toilet can be identified as an improved sanitation facility.

It is too short sighted to conclude that this might result in the community thinking the water becomes clean from fish eating their human excreta. Furthermore, most students mentioned as well that people do not have an alternative than getting water from the river and that people know the water is contaminated. However, they did not mention that using the river for both

drinking water and for disposing human excreta is a risky thing to do. Therefore, this practice of sanitation does say something about the believe people have in the self-cleaning ability of the water or about the relationship between disposing human excreta and contamination of the water.

According to the sanitation ladder of the WHO (figure 8), a latrine above open water is characterised as the worst category of unimproved sanitation. Akpabio (2012) similarly notes there are mainly two toilet systems in rural areas; pit latrines and open defecation, of which the latter is most common in locations close to the river. Furthermore, in the state of Akwa Ibon in the Niger Delta, Akpabio (2012) found that only 5.6% of households have their own in-house toilet system, the highest category of improved sanitation as characterised by the WHO (2015). Furthermore, the WHO (2015) report mentions that a third of the hospitals and clinics in Nigeria do not have access to clean water and improved sanitation, and 16% do not have a place to wash hands with soap. As a result, mothers and babies who need basic healthcare facilities during pregnancy, giving birth and the first stages of human life, are especially vulnerable to catch waterborne diseases. Consequently, Nigeria deals with the fact that one women in every 23 wil lose a baby due to infections (WHO, 2015).

Akpabio (2012) attempts to explain the devastating situation of sanitation in Nigeria and especially the Niger Delta as caused by the local and national government since they do not integrate sanitation facilities when planning water supply services. Consequently, households are left to decide on their own what to do with their human excreta. As a result, communities come up with their own 'rules' of what is clean and what is dirty according to traditions and rituals (Douglas, 1966). As such, it is culturally determined whether people find it 'clean' to use their water source for all human activities, such as drinking, excreta disposal, food washing, and bathing.

4.3 Hygiene practices

According to the report of the WHO (2015), in Nigeria only 8% if the rural population has a handwashing facility at home with water and soap. In addition to that, according to the students (table 2), the local people either *''seldom wash their hands''* (student 1) and *''they wash their*

hands in the river'' (student 3). These quotes show that handwashing with clean water and soap is not a habitual behavior in the Niger Delta. Moreover, according to the students ''*people have access to soap, soda, but it is quite expensive*'' (student 3).

With regards to washing of foods, the students all mention that they wash the food with water from the river, in the same water as where they deposit their human excreta. Consequently, food items can get contaminated with bacteria from human excreta. Additionally those people who buy food on the street from food vendors, cannot be sure the food is not contaminated. Evidence shows that food sold on the streets is often contaminated, and the vendors often have links with illness (Chukuezi, 2010). These practices show that local knowledge on the fact that food can also be contaminated is limited and needs attention as well.

4.4 Behavior and practices

As described in the theoretical framework chapter, the Local Ecological Knowledge framework takes into account those socio-cultural meanings on 'dirt' as described by Douglas when designing interventions by outsiders (Akpabio and Subramanian, 2012). Figure 11 visualises the importance of the contextual factors that control sanitation behavior. The figure explicitly shows that sanitation behaviors are a function of the meanings held about water practices.

An example of this is the quote of student 4 and 6 about the possible level of self-cleaning ability of the fish and the river, which are believed to take away their human excreta. Within this quote is the believe that the water can to a certain extent clean itself and therefore people can use the river as a direct sanitation facility. Furthermore, the students refer to the fact that most people go further into the river in order to get the cleanest water. This might be due to the fact that the toilet platforms are close to the shore of the river. Within this idea is the believe that the water is less dirty further away from the shore. However, it was found that the bacteria from human excreta can contaminate the whole water source, which means the water further in the river is most probably also contaminated. Here again, the beliefs and meanings about the dirtiness and self-cleaning ability of the water determines the sanitation behavior of the community.

Figure 11. Local Ecological Knowledge Framework on Water & Sanitation Practices (Akpabio and Subramanian, 2012)

Table 2. Quotes of the interviewed students about water practices.

TOPIC	Student	Quote
Main source of water used by households	Student 1	"The water situation is a problem, my home town is in the hilly part, where streams and rivers are around. Obtaining groundwater is getting really difficult. people have to go to a stream in the neighbourhood. There, they search for water, which is not clean. If you want clean water, you have to buy water and you have to go into other cities.. The water is not drinkable from the streams and river; it is just for washing of clothes, as it is polluted. So if you want clean water, you have to spend lot of money to get water, but you still do not know what you are drinking."
	Student 2	"We go to a stream or river to get water. Or we wait for rainfall. We use alom to clean the water. But still a lot of water from the river is not drinkable in any means. Nonetheless, people still people drink it. That's the reason why the mortality rate is very high in our region; insignificant treatment of the water."
	Student 3	"I live on the creeks where the river is very polluted. We use this water as bathroom outside, to wash and cook. This is a big problem. Majority of people take boats to find water further on the river, as the water becomes less polluted the further you go on the river. Bottled water is very expensive, not

		accessible for the locals."
	Student 4	"I live in the rural areas. So my water comes from the river. My community uses the water for everything; washing and cleaning in the same water. We roll out the boat farther in the water to the middle of the river to get clean water, but still the water over there is not clean either. So our drinking water comes from further on the lake. This is because most places do not have a well." "A bore hole is quite expensive, people can not afford it. My community has only bottled water for staff of companies. Those are the only members of the community who have access to bottled water, because it is very expensive. My university here has a bore hole in the school."
	Student 5	"We do everything in the river. The garbage is also dumped in the river, which is why the water is bad and contains toxic waste. The water is polluted. There was a public water pump built twenty years ago, but it's now abandoned."
	Student 6	"We get water from the river and from the rain. We collect water from the rain during the wet season."
	Student 7	"We get water from the river. Digging a well close to the river is too difficult."
	Student 8	"We get water from the river or streams."
	Student 9	"We mainly get water from the river. There is a certain side at the river where we fetch the water for drinking. The community made it clear that no bathing or washing of clothes is allowed in that section of the river, solely for drinking and cooking, so that side is clean to the eyes of the community."
The one who fetches water	Student 4	"Mostly children or women fetch the water. In the morning men go fishing."
	Student 6	"We mostly go in groups, and we take as much as we can in gallons."
	Student 7	"With a metallic bowl we go to the river."
	Student 8	"My mother or siblings or they go together."
	Student 9	"The young siblings and our mothers, they store the water in native clay pots."
Usage of water	Student 4	"we do everything with the water; washing, cleaning, drinking."
	Student 5	" We use the river water for cooking, washing, drinking, and as garbage dump."
	Student 6	"We use the water for everything we do."
	Student 7	"Everything"
	Student 8	"We use the water for everything."
Sanitation facilities	Student 4	"We use a latrine toilet in the dryland. And those people very close to water, they have a platform above the water. So it goes directly into the water. Fish eat everything that comes in the water."
	Student 5	"We have a platform over the river."
	Student 6	"We use a latrine, which they built like a toilet on top of the water. The water takes away the materials."

	Student 7	“We use a latrine which drops into the water.”
	Student 8	“Toilets close to house”
	Student 9	“We have latrine or pit toilets.”
Handwashing	Student 1	‘’People seldom wash hands. Using soap is not a regular practice.’’
	Student 2	“I don’t know what the handwashing behaviour is like in my community. They do have access to soap.’’
	Student 3	“People wash hands before eating, as people eat with their hands. They also wash hands after taking care of the kids. However, they wash their hands in the river. People have access to soap, soda, but it is quite expensive.’’

5. Pathology of Waterborne Diseases

The objective of chapter 5 is to gain insight in the pathology of waterborne diseases prevailing in the Niger Delta by describing the cause, transmission, symptoms and treatment of these diseases and their prevalence in the Niger Delta.

As mentioned in chapter 4, people in the Niger Delta use mostly open defecation as sanitation facility, this causes contaminated water sources, facilitating transmission of waterborne diseases (WaterAid, 2016). The waterborne diseases that will be discussed are typhoid fever, cholera and dysentery. From the interviews, students were all aware of these diseases to some extent. Students 5, 6, 7, 8 and 9 mentioned typhoid fever, cholera and diarrhoea, but only students 1, 3 and 4 were aware of dysentery (table 3). This chapter falls mainly into the *individual level* of the adapted ecological framework as it touches upon factors such as the knowledge level of the student. Additionally, it touches upon the *societal level* as the students give information regarding the healthcare centres.

In this chapter, typhoid fever will be discussed first. Secondly, diarrhoeal diseases with the focus on cholera and bacterial dysentery will be discussed. Of each disease, information will be provided on the prevalence, cause, transmission route, symptoms, diagnosis and treatment, from both academic literature and interviewed students.

5.1 Typhoid fever

Typhoid fever is a febrile disease (WHO, 2018b). This is a type of disease that has fever as the main symptom. The WHO (2018b) stated that there were approximately 21 million infections of typhoid fever and between 222,000 deaths from typhoid fever globally in 2014.

In 2008, there was an estimate of 4.36 million cases typhoid fever in Africa (Ibekwe et al., 2008). Typhoid fever is a potential life threatening disease that is mostly encountered in tropical countries, like Nigeria. Nigeria does not have access to national surveillance programmes for typhoid fever. Complete epidemiological data on disease prevalence and incidence of typhoid fever in both Nigeria as the Niger Delta area are lacking. This made it hard to make valid

estimations of the current situation in the Niger Delta. 254 incidents of typhoid fever were reported in the year 2012 in a health centre in Amassoma, situated in Bayelsa state (Tamunobereton-ari, Uko, & Horsfall, 2013). Data on disease incidence can only be obtained from people who go to a health care centre. This is important to consider since it was estimated that only 57.2% of the African population seeks care when fever symptoms manifest (WHO, 2017). In a survey conducted by Adehor & Burrell (2008) with 330 responders, it was found that 41.4% go to a pharmacist when they have a fever, 36.2% take medication based on previous prescription, 6.9% will buy drugs from a chemist without prescription, and 15.5% apply traditional African medicine.

Previous studies on typhoid fever found no consequent distribution pattern for the occurrence of typhoid fever in regards to age, sex or social class (Zaki & Karande, 2011).

Causes of the disease

Typhoid fever is caused by the bacteria *Salmonella enterica*. There are multiple serotypes of *S. enterica*, but Doughari, Elmahmood, & Nggada (2007) showed that the most dominant strain in Nigeria is *Salmonella typhi*. This report was not able to find specific data regarding the presence of *S. typhi* in the Niger Delta.

Humans are the only known natural host for *S. typhi*, meaning the human body is the only place wherein the *S. typhi* bacteria can reproduce (Mweu & English, 2008). However, the bacteria can survive outside the human body for up to a couple of weeks in water or dried-up water sources (Cunha, 2004; Papagrigorakis, Yapijakis, Synodinos, & Baziotopoulou-Valavani, 2006). Infection occurs when humans ingest water or food contaminated with *S. typhi*. According to the interviews, all interviewed students were aware that typhoid fever, as well as cholera and dysentery, comes from the dirty water. However, only student 6 was aware that these diseases were caused by bacteria in the water. In addition, not one student indicated to be aware that they can also get the bacteria from contaminated food (table 3).

Transmission of the disease

S. typhi has a faecal-oral transmission route (figure 10), meaning the disease can be transferred by contaminated foods, fluids, fingers, flies and fields. *S. typhi* can be shed with human faeces

to the environment, especially when open defecation is a common practise. As mentioned in chapter 1, most interviewed students identified their sanitation facilities to be a latrine on a platform floating above the river in the Niger delta (table 2, students 4, 5, 6, 7). This way, river water can get contaminated, making it possible for the bacteria to spread and enter other water sources (Petersen et al, 2005). Further transfer of the bacteria can take place when people drink the contaminated water. Human faeces, which can contain a high concentration of the bacteria, was found to be the main source of *S. typhi* contaminated water. (Tamunobereton-ari et al., 2013). The water was tested in various regions of the Itu creek in the Niger delta. *S. typhi* was found to be present in these waters (Adebayo-Tayo, Onilude, & Etuk et al., 2011). Hellweger & Masopust (2008) showed that waterborne diseases are more prevalent when people use river water for drinking, fishing, bathing, recreational activities and irrigation of crops that later will be eaten raw. According to the interviewed students, the water of the Niger delta is excessively used for everything by the local people, like washing, cooking, drinking, toilet, garbage dump (tabel 3).

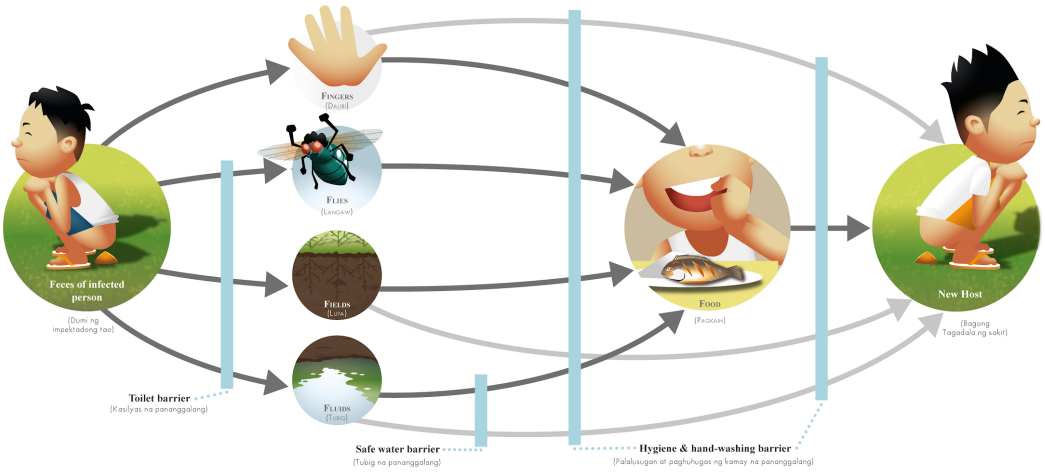


Figure 12. Pathways of faecal-oral disease transmission (UNICEF Philippines, 2014).

There is also major seasonal variation in occurrence of typhoid fever in Nigeria. Tamunobereton-ari et al. (2013) showed that the incidence of typhoid fever is higher both in the dry season as well as at the beginning of the rainy season. It was suggested that the reason for typhoid outbreaks in the dry season might be due to the low water supply. In this period, people congregate at the few water sources left. Infection of a single water source can in this case affect many people. In the beginning of the wet season, contaminated water can spread through

overflow of water sources caused by heavy rain. This way, pathogenic bacteria can spread over a larger area. However, one of the interviewed students indicated that typhoid fever is present all year (table 3, student 4).

Human-to-human contact and human-to-food contact are two other common ways to spread the *S. typhi* (Todd, Greig, Bartleson & Michaels, 2009). Especially the hands of food workers were suggested to be a major source of transmission. In Lagos, Nigeria, Smith et al. (2009) found that some food handlers were carrying *S. typhi*, making transmission to the environment via food very likely when no hygienic measures are taken. It was found that about 10% of infected people remain asymptomatic, meaning they carry the disease but do not show any symptoms (Kidgell et al., 2002). The incubation period of typhoid fever is highly variable, symptoms can manifest after one to six weeks after infection (Hakanen, 2001). Both asymptomatic patients as well as patients in the incubation period are infected and carry the bacteria. Therefore, they are able to shed the bacteria to the environment and transfer the disease to others without being aware.

Symptoms and diagnosis of the disease

The most common symptoms of typhoid fever include a sustained fever for about 10-14 days, chills and abdominal pain. In some cases, an infected person experiences rash, inflamed bones, general aches and pains, headache, loss of appetite, nausea, vomiting, diarrhoea or constipation, dry tongue with white patches, lethargy (which is a form of pathological sleepiness), intestinal bleeding (common after two to three weeks after infection), and/or acute renal failure (Cunha, 2004).

S. typhi can affect different organs. After ingestion of with *S. typhi* contaminated food or water, the bacteria are able to penetrate the wall of the small intestine and enter the bloodstream. Via the bloodstream, the bacteria can invade other organs like the liver, spleen, bone marrow, gallbladder and lymphatic tissue of the bowel (Tamunobereton-ari et al., 2013).

The interviewed students were able to link fever symptoms to either typhoid fever or malaria. These diseases share fever as a common symptom, but have a distinct pathology and treatment. Most of the interviewed students were not able to link the recalled symptoms to a

specific disease (table 3). Because waterborne diseases show many overlapping symptoms and share symptoms with other diseases, specific diagnosis of causing bacteria is needed to confirm the disease (Ochiai et al., 2008). This requires access to a laboratory that can process blood or stool cultures, as these are the the two most reliable techniques to diagnose *S. typhi* infection. These technologies were reported to be uncommon in developing countries such as Nigeria (Ochiai et al., 2008). The most frequently used test to detect *S. typhi* in developing countries is the Widal serological technique (Olopoenia & King, 2000). However, the test results are not always accurate, as false positive test are commonly encountered. During the interviews, students mentioned that the amount of accessible health care centers are scarce and doctors often are not present (table 3).

Treatment of the disease

In developing countries, like Nigeria, the most readily available treatment for typhoid fever is antibiotic treatment. Most commonly used antibiotics are ampicillin, chloramphenicol and cotrimoxazole (Okeke et al., 2005). However, in Nigeria, many sold drugs are fake. The National Agency for Food and Drug Administration (NAFDAC), reported 50% of circulating drugs are fake (Chinwendu, 2008). This has a major impact on the control of typhoid fever, potentially increasing morbidity and mortality due to typhoid fever. However, specific data regarding to the Niger Delta is lacking.

Another common problem with the use of antibiotics is the development of multidrug resistance. Multidrug resistance means bacteria cannot be killed by multiple different kind of drugs, which normally would be effective. Ehwarieme (2011) found that, in Warri, Nigeria, out of 20 people infected with *S. typhi*, all of the *S. typhi* bacteria had developed multidrug resistance. The development of bacterial resistance to drugs, is an increasing problem and often seen in the last couple of years. Multidrug resistance can develop when antibiotic treatments are performed incorrectly, like administration of the wrong dose or when treatment is stopped prematurely. Another cause of multidrug resistance is an ineffective composition of the antibiotic, which can for example be caused by poor quality of the antibiotic or bad storage (WHO, 2018c). This way, resistant bacteria can survive and reproduce. When other people get infected with these bacteria, the disease cannot be treated with the same antibiotic anymore. To reduce the effect of multidrug resistance of bacteria, there are a few precautionary measures that can be taken.

This way, resistant bacteria can survive and reproduce. When other people get infected with these bacteria, the disease cannot be treated with the same antibiotic anymore. Once a person shows symptoms and suspects a waterborne disease, that person should immediately go to a health care centre to seek help and to establish the correct diagnosis (Chinwendu, 2008). As typhoid fever may show the same symptoms as other diseases, such as malaria or other waterborne diseases, symptom recognition may be difficult. Correct diagnosis and determining of the resistance pattern of the bacteria is very important in order to start the right treatment (Ehwarieme, 2011).

Vaccines

Vaccination with typhoid conjugate vaccine (TCV) was advised by WHO's Strategic Advisory Group of Experts (SAGE) since april 2018. This recommendation was based on the growing rates of multidrug resistance of *S. typhi*, vaccine safety, feasibility, affordability, and efficiency. The WHO recommended administration of a single dose of TCV to children over the age of six months in typhoid-endemic countries. The introduction of TCV through routine immunization could reduce typhoid incidence, potentially resulting in a decreased need for antibiotics. However, to implement this vaccin, the region needs to be declared as typhoid-endemic (WHO, 2018d). In several developing countries, policy-makers have indicated the importance of updated data on disease incidence for the introduction of vaccination programmes. Complete and specific data is still lacking for the Niger Delta.

5.2 Diarrhoeal diseases

Diarrhoeal diseases are the overall third cause of death in Africa (Mondiale de la Santé, O., & WHO, 2018). Data from Unicef show that, in Nigeria, 10% of the children who die under the age of 5 are caused by diarrhoeal diseases (UNICEF, 2018). The Centers for Disease Control and Prevention (CDC) (2013) reported that diarrhoeal diseases are the fourth cause of death in Nigeria, with 5% of the population size of 12,033,000 affected. In the survey conducted by the Niger Delta Development Commission (NDDC) stated that diarrhoea is the most serious health problem. Diarrhoea was reported in 19.4% of the surveys (UNDP Nigeria, 2006).

Diarrhoea is the frequent defecation of liquid stool and is a symptom rather than a disease and could have multiple causes. However, the interviewed students indicated that diarrhoea itself is one disease and cholera a separate one (table 3). This indicates as that the students do not have a complete knowledge about diarrhoeal diseases.

Diarrhoeal diseases can be caused by a bacterial, viral or parasitic gastrointestinal infection. Poor hygiene and lack of sanitation facilitates spread of gastrointestinal infections as they are transferred via faecal-oral route (WHO, 2018e). Diarrhoea can be both acute or chronic and can be a symptom of different causes. This project will focus on cholera and dysentery, both diarrhoeal diseases are deadly when left untreated. Methods and tools exist for prevention and treatment and can be life-saving when administered correctly. Tackling cholera and dysentery by taking preventive measures will also lower transmission and prevalence of other waterborne diseases that are also transferred faecal-orally.

5.2.1. Cholera

In 2016, 132,121 cholera cases were reported to WHO from 38 countries (including Nigeria), with an estimate of 2,420 deaths (WHO, 2018f). Actual burden of disease however, was estimated to be much higher. Limited epidemiologic data exist regarding the prevalence and frequency of which the disease occurs in the Niger Delta area. Insufficient data collection could be assigned to the fact that not all cases are reported, or the resistance to communicated to the appropriate authorities out of fear for a negative impact on tourism and trade (WHO, 2018f).

Ali, Nelson, Lopez & Sack (2015) reported a total of 110,198,368 people were at risk for cholera in 2015 in Nigeria with an incidence rate of 2/1,000 (220,397 estimated cases out of 110,198,368 people at risk) and a case fatality rate of 3.80% (8,375 estimated death of cholera of 220,397 estimated cases).

A study done in the Amassoma community, located in the Niger Delta, indicated prevalence of waterborne disease like cholera may be causally related to the source of drinking water (Nwidu, Oveh, Okoriye & Vaikosen, 2008). In this study, cholera was found to be the second most occurring waterborne disease after typhoid fever. This study used data obtained from the

National Bureau of Statistics (NBS). Cholera is a well-known and targeted disease by international organisations such as UNICEF and Médecins Sans Frontières (MSF), in English known as Doctors without Borders. MSF is active in Nigeria with projects to prevent and treat Cholera outbreaks (MSF, 2018).

Cause of the disease

Cholera is a diarrhoeal infection caused by the bacterium *Vibrio cholerae. V. cholerae* O1 and 139 are the only serogroups that can cause the disease. Serogroup O1 is the main the most frequent cause of cholera. Infections with serotype serogroup O139 are rather rare (Adagbada et al., 2012).

Transmission of the disease

Cholera is faecal-orally transmitted (figure 10), meaning a person can be infected by ingesting with *V. cholerae* contaminated food or water. *V. cholerae* is shed in the the faeces and can spread to the environment in the absence of decent sanitation or hygiene measures. This cycle can repeat itself several times, causing rapid spread of the bacteria (Adagbada et al., 2012).

Adagbada et al. (2012) states that in order for a cholera outbreak to occur, two conditions need to be present. Firstly, Cholera must be present in the population. Secondly, insufficient sanitation systems, lack of hygiene and unsafe water sources that allows fast spread of *V. cholerae.* Contaminated food, drinking water and fomites (contaminated surfaces) as well as person-person contact are ways to spread the bacteria (MSF, 2018). Contaminated water and food are the most principal ways of disease transmission. The interviewed students only mentioned the transmission via water, they did not indicate to be aware of the bacteria present in the faeces, neither food transmission nor transmission via person-person contact (table 3). Furthermore, overcrowding facilitates transmission (Abdu, Aboderin, Elusiyan, Kolawole & Lamikanra, 2014).

Adagbada et al. (2012) concluded sex and age distribution are not constant for cholera infections and there is a seasonal variation with most cases reported in the dry season and at the start of the wet season. One of the interviewed students indicated that cholera is mostly present in the wet season (table 3, student 4). This is contradictory with the findings in the literature.

It was also found that people with a weak immune system (people carrying Human Immunodeficiency Virus) (HIV) or undernourishment) are more vulnerable to get infected and are more likely to develop more severe symptoms compared to healthy people (CDC, 2018). The Niger Delta has among the highest prevalence of HIV and Acquired Immunodeficiency Syndrome (AIDS) of Nigeria (UNDP Nigeria, 2006). Malnutrition is still a current important problem in the Delta area as well as the rest of the county (Rossi, 2014).

Diagnosis of the disease

75% of people infected with the *V. cholerae* bacteria stay without symptoms (asymptomatic carriers), but can still shed pathogenic bacteria with their faeces, unnoticeably contaminating the environment. *V. cholerae* can be present in faeces up to two weeks after infection (Adagbada et al., 2012). Cholera has an incubation period of 12 hours up to 5 days. This is the time between infection and symptom development. A cholera episode lasts relatively short; from 1 up to 7 days. Even when the episode has passed, patients can still carry the pathogenic bacteria for a couple of days up to 2 weeks (Adagbada et al., 2012). Cholera symptoms can range from mild to severe. According to Adagbada et al. (2012), about 80% of infected people develop mild symptoms. The other 20% will develop severe symptoms.

V. cholerae has the ability to adhere to the cells aligning the intestine. Furthermore, it produces a toxin, disrupting fluid and electrolyte balance across the intestinal barrier. Electrolytes are organic ions that carry out important physiological functions in the body. This results in an excessive outflow of fluid and electrolytes and rapid fluid loss via loss of watery stool and vomiting, causing dehydration symptoms. “Rice-water-stool” is a frequently used term to describe the stool as cholera patients. It has a grey look and can contain mucus (Adagbada et al., 2012). Other symptoms are intense thirst, fatigue and occasional muscle cramps, little urine production, sunken eyes, wrinkled finger skin (Wasiu et al., 2014). The interviewed students indicate that they are aware of some symptoms, like diarrhoea and vomiting, but not they were not able to link the symptoms to specific diseases. They were not aware of the distinctive “rice-water-stool” of cholera (table 3).

Untreated symptoms can rapidly progress leading to severe dehydration, causing kidney failure, shock, coma and death (Adagbada et al. 2012). UNICEF (2013) reported up to 50% of untreated patients can develop severe dehydration symptoms, resulting in potentially high mortality rates.

Early detection of *V. cholerae* is necessary as quick treatment is essential for a favourable outcome. Limited access to health care in Nigeria has contributed to a delayed diagnosis and treatment, resulting in increased mortality numbers (UNICEF, 2013). WHO (2017) reported that only 38% of children with symptoms of diarrhoea received prompt care in the African Region in the period 2010-2015. Recognition of the above described clinical symptoms can be a first suspicion of a cholera infection. Rapid Diagnostic Tests (RDTs) (the Crystal® VC dipstick rapid test (+/- $4/case) exist and can be a quick and easy way to detect *V. cholerae* bacteria in a stool sample. These quick test has the disadvantage to have both a low sensitivity and specificity. Therefore, specific laboratory tests like culturing or Polymerase Chain Reaction (PCR) are required to confirm the presence of the pathogenic *V. cholerae* bacteria that cause cholera (CDC, 2018). It's not necessary to identify *V. cholerae* in stool samples of all patients. It is important to identify the *V. cholerae* strain causing the outbreak at the start and to establish the resistance pattern of the bacteria at the start and end of the outbreak as well as to follow the resistance pattern over time.

Treatment of the disease

Rapid treatment of symptoms by fluid replacement is a relative simple method which potentially can be life-saving (UNICEF, 2013). Effective fluid replacement with Oral Rehydration Salts (ORS), in an attempt to maintain hydration status when dehydration symptoms manifest, can bring mortality down to less than 1% (UNICEF, 2013). Administration of rehydration fluids can be done by either ORS or intravenous rehydration. ORS are a low-cost, direct treatment of symptoms. ORS contain a mixture of water, glucose and electrolytes. Adults can need up to 6 liters of the ORS mixture on the first day when symptoms of mild dehydration manifest (WHO, 2006). ORS administration can be combined with the addition of zinc. Zinc is an essential micronutrient that is necessary to maintain vital physiological body functions like protein synthesis, cell growth and differentiation, immune function, and intestinal transport of water and

electrolytes. Growing children especially could benefit from zinc administration when suffering from diarrhoea (Lazzerini & Ronfani, 2011).Depending on the country's location and access to international transport routes, the price of an imported packet (Standard packets, containing the complete WHO/UNICEF-recommended formula for one litre of solution) may vary from $0.06-0.10 (WHO, 2006). One of the interviewed students mentioned the use of ORS when someone has diarrhoea (table 3, student 4). The other students did not mention any kind of treatments.

Intravenous (IV) administration can be useful in severe cases of hydration to provide fast rehydration. In this case, a combination treatment of IV-rehydration with antibiotics is recommended in severe cases. Patients can re-achieve their proper rehydration status within four hours of getting the right treatment (WHO, 2018f).

Antibiotics

Apart from treating the symptoms, antibiotic treatment is used to target bacteria that cause the disease. Antibiotica is not necessary for survival but it shortens the period of disease and the time bacteria are shed to the environment, thereby limiting possibility to transfer the disease. When antibiotics are given, less ORS is needed to cure patients. This means more people can be treated in the same amount of time when antibiotics are used. Antibiotic prophylaxis are not recommended as this induces antimicrobial resistance. For the antibiotics to be effective, it is necessary to start antibiotic treatment after symptoms of vomiting have passed and the patient is rehydrated. The appropriate choice for the most suitable antibiotic is important as antimicrobial resistance is a frequent occurring problem in recent years. The first antibiotic of choice is doxycycline. When the bacteria developed resistance against doxycycline, the antibiotic of second choice is azithromycin. A third possible antibiotic is ciprofloxacin. Due to the development of antimicrobial resistance, more than one dose could be necessary to be effective.

Decision making guide on treatment

WHO (as cited in UNICEF, 2013) constructed guidelines of appropriate steps (figure 11) that need to be taken when a case of cholera is suspected: Firstly, check dehydration state of the patient. Mild dehydration is defined as a fluid loss of 50-90 ml/kg body weight. Severe

dehydration occurs when fluid loss excels 100 ml/kg body weight. Secondly, determine the health status of the patient to check if there are additional factors, like malnutrition, that could affect the rate of fluid replacement. Thirdly, the stool output and fluid loss is monitored. Fourthly, rehydrate the patient and monitor the hydration status of the patient regularly. Fifth, it necessary that the patient maintains a good hydration status by replacing fluid losses, usually with ORS, until diarrhoea stops. Administer an oral antibiotic to dehydrated patients if necessary. Lastly, feed the patient as soon as they are able to eat to maintain strength. (UNICEF, 2013).

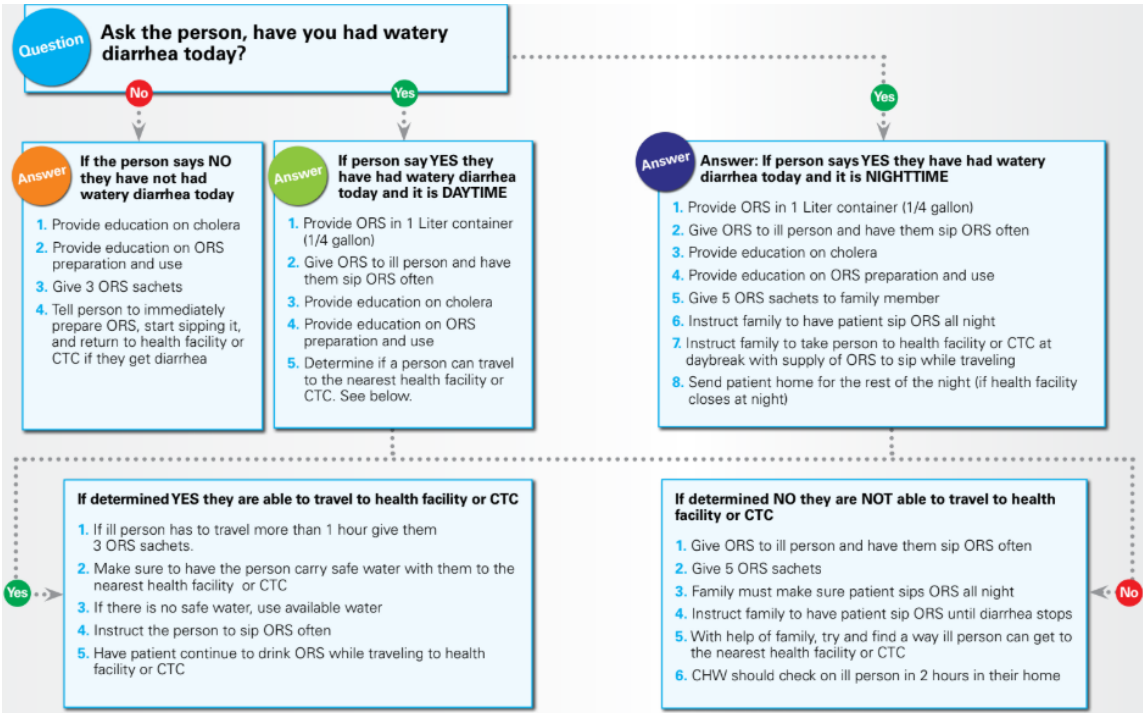


Figure 13. Decision making guide cholera prevention and treatment (UNICEF, 2013: 170-171)

Vaccins

Three Oral Cholera Vaccines (OCV) are currently available and all require two administrations (Dukoral®, Shanchol™ and Euvichol®) (WHO, 2018f). Vaccines are administered to the hole population when outbreaks occur or administered in areas where cholera is endemic. Criteria for decision making on OCV is done by WHO country, regional or headquarter offices. Furthermore, the Global Taskforce on Cholera Control (GTFCC) includes partners from all domains of cholera control (UNICEF, 2013; WHO, 2018f). Vaccination can never be a sole preventive measure. WHO and UNICEF recommend safe oral cholera vaccines should be part of a bigger action plan involving improved water and sanitation systems, hygiene promotion and education to control and prevent cholera outbreaks. A global strategy on cholera control with a target to reduce cholera deaths by 90% was launched in 2017. Long-term approach to combat and control cholera asks for a multidisciplinary approach including economic development, accessibility to safe drinking water, hygiene and sanitation This approach will increase general living conditions, resulting in a decrease of other waterborne diseases (WHO, 2018f).

5.2.2. Dysentery

Cause of the disease

The cause of dysentery can be either has bacterial or amoebal origin. The most frequent cause of amoebic dysentery is *Entamoeba histolytica*. The type of dysentery it causes is referred to as amoebiasis (WHO, 2018e). Severe cases of amoebiasis are rather rare. Moreover, diagnosis is difficult as *E. histolytica* can be easily mistaken for another harmless amoebae. There is lack of specific low-cost detection methods, and complex treatment is necessary (Showler & Boggild, 2013). For this reasons, amoebiasis is not further considered in this report. The bacterial form of dysentery, also called bacillary dysentery, can be caused by different species of the *Shigella* bacteria. For this reason, this form of dysentery is often referred to as Shigellosis (CDC, 2018).

It was estimated by the WHO (as cited by Williams & Berkley, 2016) that 165 million diarrhoeal episodes occur globally every year due to infection with *shigella*. 99% of these infections occur in developing countries. It is suggested that *shigella* is responsible for the death of 28,000 to

48,000 children under 5 years every year. Mainly children are affected. The occurrence of different *Shigella* species is geographically dependant and differs within Nigeria. In the South of the country, the most common identified serogroup was *S. flexneri*, followed by *S. dysenteriae.* In general, infections with *S. flexneri* cause dysentery more frequently and infections are more severe and last longer. This is the most common cause of shigellosis in developing countries. The occurrence of specific species is related to the socio-economic living conditions of the country. A shift from more severe towards less severe species of *shigella* was observed in countries where sanitation and hygiene drastically improved over time (Abdu et al., 2014).

A study conducted in Ile-Ife, in the Southwest of Nigeria, concluded that *Shigella* serogroups are important contributors to acute diarrhoea and mortality among children. These results were in line with findings of studies in other places in Nigeria, including Calaber, in the Niger Delta (Abdu et al., 2014).

Transmission of the disease

Shigella bacteria are transferred via the faecal-oral route (figure 10). Factors that increase transmission are poor personal hygiene, consumption of contaminated food and water and person-to-person contact. Like other enteric pathogens, *shigella* can also be transferred by flies, fingers and fomites (Abdu et al., 2014). Overcrowding also facilitates transmission (Abdu et al., 2014). Occurrence of *S. flexneri* as most common *Shigella* species is an indicator of poor sanitation and hygiene, which are major contributors to the transmission of waterborne diseases. Shortage of safe water supplies results in poor water management and forces people to turn to contaminated water sources and neglect to practise hygienic measures (Abdu et al., 2014). As mentioned earlier, the interviewed students were only aware of disease transmission via water (table 3).

Diagnosis of the disease

Shigellosis is a very infectious disease as only a small amount of particles are needed to cause the disease (Abdu et al., 2014). As in the case of cholera, people with a deprived immunity are more prone to suffer from dysentery.

Shigella bacteria cause shigellosis by harming the intestinal cells aligning the gut epithelial membrane. This makes the bacteria able to cross the intestinal barrier. This results in an inflammatory reaction and the release pro-inflammatory cytokines, followed by recruitment of polymorphonuclear (PMN) cells, to the place the of infection. PMN cells are a type of multinucleated white blood cells. In an attempt to clear the infection, PMN cells harm the epithelial cells in the intestine, making it possible for *Shigella* to invade (Williams & Berkley, 2016). This results in the following symptoms: watery diarrhoea; which can contain blood and/or mucus, vomiting, anorexia, lethargy, abdominal cramps and pain, and fever. Manifestation of symptoms can differ per individual. As mentioned before, the interviewed students did not distinguish between different kinds of diarrhoea (table 3). While bloody diarrhoea is common in Shigellosis, it is not a distinct symptom. Therefore, a diagnosis in the laboratory is still necessary.

Quick and cheap diagnosis with stool microscopy, in combination with methylene blue stain can show PMN cells in the stool which are an indication of infection. Diagnosis of bacterial dysentery must be confirmed by isolation of *Shigella* from faeces samples. This is done in a laboratory, preferably in collaboration with an international reference laboratory that has expertise on detecting and identifying the bacteria that causes Shigellosis. Microbiological culturing of *Shigella* is necessary to start the right treatment and determine antimicrobial susceptibility, which can differ by geographic area, and can also change over time (Williams & Berkley, 2016).

Another way to confirm *Shigella* infection in the laboratory is by multiplex PCR. This technology is not widely available in health care facilities as it requires specific and more expense tools as well as lab technician with expertise (Williams & Berkley, 2016).

Treatment of the disease

As is the case with cholera, severe dehydration due to excessive fluid loss is a problem in the case of shigellosis. Therefore, ORS and IV administration of rehydration fluids and electrolytes are also applied methods to treat shigellosis.

Antibiotics

Administration of antibiotics shortens carrier time of the bacteria and decreases the risk of dying. Antimicrobials used for the treatment of Shigellosis recommended by Williams & Berkley (2016) were Ciprofloxacin (1st line), Pivmecillinam, Ceftriaxone and Azithromycin (2nd line). Antibiotics are administered in a specific order, from most specific to a more broad spectrum to have the most specific effect and to avoid resistance development. Advantages of Ciprofloxacin as being an effective 1st line antibiotic were concluded to outway potential risk of harm.

However, multidrug resistance for *Shigella* is a current problem worldwide. Widespread resistance of *Shigella* to ampicillin, co-trimoxazole and nalidixic acid was reported by the WHO (as cited by Williams & Berkley, 2016). This problem is also occurring in the Niger Delta**.** A study conducted in Calabar, Cross River state, found that all the isolated *Shigella* species showed resistance to two or more antibiotics (Udo & Eja, 2004).

Table 3. Quotes of the interviewed students about pathology.

TOPIC	Student	Quote
1. KNOWLEDGE LEVEL		
Diseases awareness	Student 1	"Yes, diarrhoea with children, and typhoid. Cholera to older people."
	Student 3	"cholera, diarrhoea, dysentery, elephantiasis."
	Student 4	"40% of the population has a problem with waterborne diseases, especially in the rainy season. Waterborne disease like cholera grow during the wet season, but dysentery especially during the dry season. Typhoid fever is present the hole year-round."
	Student 5	"Tuberculosis, typhoid fever, diarrhoea."
	Student 6	"Yes, typhoid and cholera. Typhoid is more prevalent. For every 10 people, 4 have typhoid. It is common in my home town (Mochukoe. Abara, Delta state) Mostly women and children."
	Student 7	"Of course, every family has problems with some of the diseases. Typhoid fever, diarrhoea, cholera."
	Student 8	"Very well. Typhoid fever, cholera and diarrhoea and almost everyone is aware in the community."
	Student 9	"Typhoid and cholera."

Causes	Student 1	“Human activity, defecation in water, drinking the wrong water, no knowledge of boiling or not applied because it takes too much time and energy. Oil has an effect on the diseases. It reduces the availability of water and plants in the water.”
	Student 2	“People don’t know the diseases come from the water. They’re illiterate.”
	Student 4	“The water they drink.”
	Student 5	“Water pollution. Pollution is the cause of waterborne diseases.”
	Student 6	“It’s a waterborne disease, bacteria in the water.”
	Student 8	“Water.”
	Student 9	“Our local health practitioner would always say it is a result of contaminated water. They don’t always say what the cause of contaminated water is. Probably because of limited knowledge.”
Symptoms	Student 1	“Diarrhoea, loose tooth, dehydration, sign of fever, vomiting”.
	Student 2	“No, I can’t tell.”
	Student 3	“Inflammation of the skin, vomiting. I can’t link the symptoms to a specific disease.”
	Student 4	“Typhoid, high temperature, nausea, one sided headache, migraine.”
	Student 5	“Malaria increase temperature. Vomiting and coughing”
	Student 6	“No, we go to a health care centre to see if we have it, maybe headache, nausea, body pain, system deteriorated, making noise, general weakness, loss of appetite.”
	Student 7	“When you see someone with weakness of the body, loss of appetite, headache, joint pain, reduction physically and dehydration.”
	Student 8	“High temperature, stomach pain, coughing, stool, vomit.”
Transfer	Student 3	“Man are the first to get infected because they are on the water a lot. Children are more victims of outbreaks.”
	Student 4	“The water transfers the disease. All the problems are inside the water.”
	Student 8	“Water.”
Treatment	Student 4	“We use paracetamol. When a person has fever or vomits, we bring they to health care centres. When they have diarrhoea, ORS are given.”
	Student 5	“I was tested at the universities and it was typhoid fever.”

Severity	Student 1	“High mortality.”
	Student 8	“People recover depending on the treatment. Some die.”
2. HEALTH CARE		
Accessibility	Student 1	“One secondary health care centre nearby.”
	Student 2	“One health care centre.”
	Student 3	“No direct access. Need to travel a bit.”
	Student 4	“There is a primary health care system, but it has no certificate.
	Student 5	“One health care centre for everyone. Other communities are sometimes very far away. Some island communities cannot reach the health care centres easily.”
	Student 6	“One health care centre but there is no resident. There is a volunteer.”
	Student 7	“no qualified healthcare centre, more campaign. There is something, but I don’t qualify that as health care center.”
Tools	Student 2	“Some of the health care centre don’t have proper knowledge on treatment.”
	Student 3	“No doctors. We visit doctors in other states, but this could lead to mortality.”
	Student 4	“There are especially nurses present. Not always doctors. We need better health care with more doctors. Some health care centres cannot conduct tests.”
	Student 5	“There are no professionals, just volunteers helping the community.”
	Student 7	“no doctors, once they go to school they leave the community, they go work elsewhere, like for the government.”

6. Technological Interventions

This section will first examine six household water treatment methods and safe storage (HWTS). The six treatment methods are biosand filtration, ceramic filtration, chlorination, flocculant-disinfectant powder, solar disinfection and boiling. Each of those methods will be explained according to:

- What actions households need to perform to use the method properly;
- How long it takes until the water is treated and can thus be used;
- Whether the treatment method offers residual (=lasting) protection;
- The effectiveness of the methods regarding inactivating bacteria and reduction in occurrence of diarrhoeal diseases, and;
- How much the treatment method costs.

The next part of the chapter will take a look at interventions regarding hand washing with soap and safe food handling/preparation.

6.1 Household water treatment and safe storage

The six household water treatment methods that are discussed in this paper have benefits and drawbacks, and each one is appropriate depending on the situation and context (Tiwari et al., 2009; WHO, 2007). All treatment methods combined with safe storage have the potential to seriously reduce infections with waterborne diseases. Choosing the right method for a situation depends on several factors, such as inclusion of community-preferences, ability or willingness to pay and untreated water quality (WHO, 2007). The WASHtech project developed the Technology Application Framework (TAF) and the Technology Introduction Process (TIP) framework, which implementers can use to find out which technology fits best in which situation in order to tackle WASH related problems (Skat Foundation, 2018). These frameworks can be used to determine which treatment method will be most effective and feasible in a given community.

Some scientific studies have indicated that certain methods, such as the ceramic filter, can be locally produced. The students have not told the interviewers about the presence of a market of any treatment method, which likely means that all treatment methods that require additional equipment have to be brought into the community from outside. The treatment methods can

effectively prevent infections with waterborne diseases, if the methods are used correctly and consistently (WHO, 2007). A Monitoring and Evaluation (M&E) programme can be set up, to ensure the sustainability of the project. An example of how to set up such a program can be found by examining the *Toolkit for monitoring and evaluating household water treatment and safe storage programmes*, published by the WHO & UNICEF (2012).

Awareness of treatment methods

Of the six treatment methods discussed in this section, most students are only aware of the boiling method, but even that was not always used due to not having the strength (table 4, student 8), or because the water looks clean thus it means you can drink it without treatment (table 4, student 6). The students told the interviewers that bottled water is available, but only accessible to the rich because it is very expensive (table 4, students 1, 3, 6, & 7). The Dutch thesis student has told the interviewers that the government sometimes freely distributes bottled water, but only in areas that are accessible, and not the creeks (table 4). The students have not confirmed whether this is the case. The local NGO could tell the interviewers about filters and chlorination as a treatment method, but filters were only used in Lagos and not in the Niger Delta, and chlorination is not done by the households but by a consultant or third party (table 4). The students showed no awareness about filtration and chlorination as possible treatment methods, however, most did mention the use of alum (table 4, students 3, 4, 5, 8 & 9). Although alum visibly improves the clarity of water, the method only removes the turbidity and does not inactivate any bacteria (Crump et al., 2005; Agrawal & Bhalwar, 2009; WHO 2007). This means that alum cannot be used as a method to treat water in order to prevent infections with waterborne diseases. Student 3 showed awareness that alum only affects the clarity of the water and that it does not remove or inactivate the germs inside the water (table 4). Nonetheless, some methods, such as chlorination, are less appropriate for turbid water. In this case, a double dosage is advised or households have to strain the untreated water through a cloth first. Because alum is an already known method in the target area, this can be incorporated into the training program and instead of a double dosage (which would affect the smell and taste even more) or straining (which requires additional equipment), the households can use alum to remove the turbidity before adding the chlorination solution or tablet to the water.

Even though many students are aware that boiling can effectively increase the water quality, most of the students mentioned that even the households that boil their water only do so occasionally and still frequently drink untreated water (table 4, students 2, 4, 5, 6, 8 & 9). Additionally, student 1 was aware that solar disinfection (SODIS) can be used as a treatment method, but subsequently told the interviewers that it "*does not take care of the medical aspects*" (table 4). This shows that education is required for all six methods, to explain what the treatment methods entail and how they should be properly used. Students 3, 6 & 7 also mention water clarity as an important indicator of safe water. Some treatment methods do not visually improve the clarity, thus additional education is required for those methods.

Biosand Filter

The biosand filter (figure 12) was invented by Dr. David Manz (Stauber, Printy, McCarthy, Liang & Sobsey, 2011; Stauber, Kominek, Liang, Osman & Sobsey, 2012). The unit is usually about 90 centimetres tall and 30 centimetres wide. The housing can be made of concrete or plastic. The static water level is sustained about 5 to 6 centimetres above the sand, similar to the height of the outlet pipe (Lantagne et al., 2006). This shallow layer of water allows the biosand film to grow on top of the sand, which is needed in order for the method to produce properly clean water (Lantagne et al., 2006; Tiwari et al., 2009; UNICEF, 2013; IFRC, 2008). The diffuser plate with holes is then placed on top of the sand to protect the biosand film when water is poured into the unit (Lantagne et al., 2006). The water is then filtered through the biofilm layer *and* the through sand layer (IFRC, 2008).

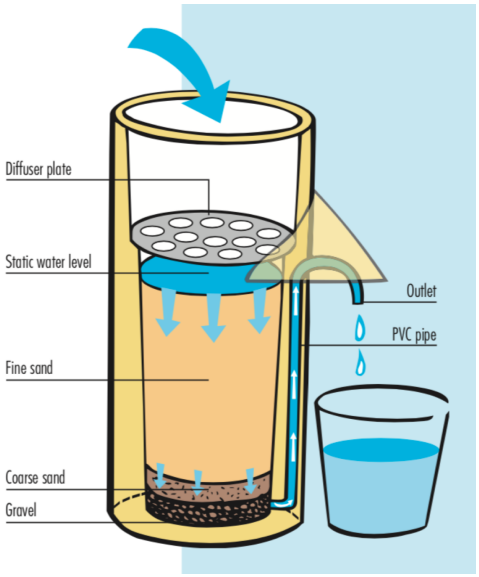


Figure 14: Biosand filter (IFRC, 2008)

The biosand filter, whether it is made of concrete or plastic, has a simple design and operation, consists of durable materials and has the capacity to produce large amounts of water that are safe to drink, with a flow rate of between 3 to 60 litres per hour depending on how dirty (turbid) the water is (Stauber et al., 2011; Stauber et al., 2012; Tiwari et al., 2009; Sobsey et al., 2008; UNICEF, 2011; IFRC, 2008). All that is required to use the unit is to pour water into the biosand filter and to collect the treated water that comes out of the outlet pipe in a bucket or pot. This treatment method offers no residual protection and the water thus has the chance to possibly become recontaminated: after the water is treated, it requires safe storage (Lantagne et al., 2006; WHO, 2007). The biosand filter is able to treat turbid water, but requires additional cleaning when the filter becomes clogged. When this is the case, the operator has to scrub and rinse the filter elements, remove the top few centimetres of the sand and throw away the overlaying water (Sobsey et al., 2008). The taste of water is not affected by this treatment method (Lantagne et al., 2006).

A major drawback of the concrete biosand filter is that it weighs a few hundred pounds, which makes it difficult to transport to remote locations and compromises upscaling (Stauber et al., 2011; Stauber et al., 2012; Lantagne et al., 2006; UNICEF, 2011). The plastic biosand filter however does not come with these difficulties because the housing is made of lightweight material, which makes it easier to be transported to remote areas and easier to produce (Stauber et al., 2012). The plastic biosand filter on the other hand has a greater possibility of breaking, because due to its light-weight, the unit might be moved in household settings, an issue that the concrete filter does not have. Frequent movement may also cause compression of the sand, which in turn can lead to a clogged filter, and that can possibly lead to cessation of use (Stauber et al., 2011).

The performance of the biosand filter is highly affected by the sand size and residence time. A randomised controlled trial (RCT) study that took place in Kenya used concrete biosand filters with 50 centimetres of river sand and advised the households that used the filter to wait at least 8 hours after 20 litres of water has been treated. In addition to this, the households were told to not use the water in the first two weeks after instalment and after every cleaning of the filter (Tiwari et al., 2009). Laboratory testing of the biosand filter showed that it has the ability to

reduce bacteria in the water by 81% up to 100% (Lantagne et al., 2006). The plastic biosand filter was part of an RCT study in Cambodia and the study found that diarrhoeal diseases occurred 59% less in households using the filter to treat their water compared to the control group, and the diarrhoeal disease episodes also lasted shorter for the treatment group (Stauber et al., 2011). A study with the plastic biosand filter conducted in Ghana showed equally promising results, with the reduction in diarrhoeal diseases for all age groups at 60%, and even more promising results across the group of children whose age is under 5-years-old, where the reduction of diarrhoeal diseases was 74% (Stauber et al., 2012). The study in Kenya found that in households where the concrete biosand filter was used, children showed significantly less symptoms of diarrhoeal diseases (2.0% overall) compared to the children of households in the control group control group (5.2% overall). The households that were using the biosand filters, were told to use the treated water for not only drinking, but for all purposes, including bathing and doing laundry, whereas the control group was instructed to continue their water practices as usual. When the biosand filter was used to treat water collected from the river, the children of those households showed a 54% reduction of diarrhoeal diseases compared to households that used untreated river water. The Kenyan study showed that on a daily basis, a child who drinks untreated river water has a 2.2% higher chance of showing diarrhoeal symptoms compared to a child who drinks river water that has been treated with the biosand filter (Tiwari et al., 2009). A review study found that the average result of the use of the biosand filter across five different trials that were set in low- to middle-income countries and with improved and unimproved water and sanitation sources, reduced infections with diarrhoeal diseases by a half (Clasen et al., 2015). None of the studies researched the effects regarding typhoid fever.

The plastic filter in the Cambodian study asked for a contribution of $10 of the households, but did not mention if this covers all costs or whether the remained costs are covered by a third party. The research was also not able to draw conclusions on the durability of a plastic biosand filter after installation (Stauber et al., 2011), this could possibly lead to additional costs. The study conducted in Kenya with concrete biosand filters estimated the cost at $15 to $25 per unit, provided the filter is produced locally (Tiwari et al., 2009). A different study conducted in Cambodia asked a contribution of $3 from the households, but elaborated that the full cost of installing the concrete biosand filter in the households is $67, the remaining costs were covered by a Canadian Agency (Lantagne et al., 2006). Yet another study concluded that the costs of a

biosand filter ranges from $25 to $100, it depends on the country it is installed in and the implementer, however, the only purchase is the concrete unit at the start because the parts are not likely to break so additional purchases are not required (Sobsey et al., 2009; Lantagne et al., 2006). The upfront costs are therefore a barrier to low-income households and implementers that want to include the poorest households need to consider free distribution, subsidy or financing (WHO, 2007).

Field studies conducted across different countries have tested the filter for reduced infections with diarrhoeal diseases, and the results of the field studies do not show an 81% up to 100% decrease in infections. There are of course differences between laboratory and field studies, for instance how the information is communicated to the households and whether or not the households perform the tasks necessary for maintenance. It also depends on whether the households use the treated water for all domestic tasks or just some tasks. The effectiveness in the field studies do show similar results, but whether a plastic or concrete biosand filter is feasible in a particular situation depends amongst others on how remote the area is and the expenses.

Ceramic filter

The ceramic pot filter (figure 13) is placed inside a plastic bucket or other storage vessel that can catch the filtered water. The contaminated water is then poured into the ceramic pot, and with the average speed of 1 to 3 litres per hour the water is filtered and caught in the unit below the ceramic pot (Van Halem, Van der Laan, Heijman, Van Dijk & Amy, 2009). Because the speed declines as the filter collects the impurities of the contaminated water, the method can produce about 8 litres of clean water in 4 hours and 20 litres in 10 hours. After the water is filtered, it needs to be safely stored to prevent recontamination (UNICEF, 2013).

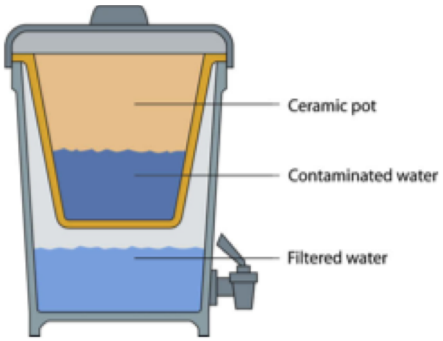


Figure 15: Ceramic pot filter (van Halem et al., 2009)

The operation of the ceramic pot is straightforward and does not require much education. When the flow rate significantly decreases, the pot needs to be scrubbed with a laundry brush to remove the collected dirt and restore the original speed of filtering (Sobsey et al., 2008). It is important to not scrub the pot too often as this will lead to a shorter lifespan of the pot. Studies have found that the lifespan can be up to five years, but implementers such as UNICEF recommend to use the ceramic pot filter for 1 to 2 years (Van Halem et al., 2009). The accessibility of the pot filter is decided by the affordability and the availability. It is possible to produce ceramic pot filters locally, and this is already the case in countries such as Cambodia, Ghana, Kenya and Honduras. Local production can ensure that the transport costs remain low, depending on how remote a certain area is from the production site, and the maintenance (scrubbing frequency) determines the lifespan. Local production has the additional benefit of supporting the local economy. The students have not told the interviewers about the presence of a market of ceramic filters (table 4), which likely means that this filter has to be brought into the community from outside.

This filtration method does not offer protection from recontamination, and high frequent scrubbing practices also result in a higher recontamination risk (Van Halem et al., 2009). Sobsey et al.'s review (2008) found that long-term use of the ceramic filter also depends on whether replacements parts are available. The review estimated the cost of an entire filter unit between $8 and $10, and the replacement of solely the ceramic element at $4-$5. The ceramic pot filter produced in Cambodia costs between $4 and $8 (Van Halem et al., 2009). The report of the WHO (2007) estimated the cost of a locally produced ceramic pot filter at $3, and its

longevity was a year. Because the ceramic filter most likely needs to be brought into the community from outside, transportation costs will increase the total costs because the creeks are difficult to reach (table 2). As is the case with the biosand filter, the upfront costs can be a barrier to low-income households and implementers should consider free distribution, subsidy or financing to not exclude the poorest households (WHO, 2007).

Laboratory studies found that the ceramic pot filter has the ability to remove 98% of the turbidity of untreated water. Cleaning the pot can cause the separation of clay particles from the pot, which increases the turbidity again and can lead users to believe that the quality of the treated water has decreased (Pérez-Vidal, Diaz-Gómez, Castellanos-Rozo & Usaquen-Perilla, 2016). The ceramic filter can treat turbid waters and it also removes organic matter and microbes. These are filtered out of the water because due to their size the microbes cannot penetrate through the pot filter (Sobsey et al., 2008; WHO, 2007). Ceramic pot filters are often impregnated with colloidal silver, which prevents the growth of bacteria inside the pot. A laboratory study has found that most bacteria can indeed not penetrate the pot due to the small pores, but only when the pot is impregnated with silver can 100% of the bacteria be filtered out of the water (Lantagne et al., 2006). Field studies conducted in Cambodia and the Dominican Republic revealed a 45%-49% reduction in the occurrence of diarrhoeal diseases (Stauber et al., 2011; Sobsey et al., 2008). UNICEF (2013) also reports a documented reduction of diarrhoeal diseases amongst the households that use the ceramic pot filter.

Due to the easy operation and maintenance and the ability to be locally produced, the ceramic pot filter has a great potential to be used in rural areas of developing countries (Van Halem et al., 2009; Pérez-Vidal et al., 2016). Whether this treatment method is appropriate for a household depends on the quality of pre-treated water, the availability and demand of the materials, how many people make up a household (due to the relatively low speed of 1-3L/h) and the preference of the population. The use of the ceramic pot filter as treatment method requires education and community training to guarantee the efficiency and required water quality (Pérez-Vidal et al., 2016; Lantagne et al., 2006).

Chlorination

Chlorination of water has been in use since the early 1900s in Europe and the USA, and has since helped to reduce infections with waterborne diseases in those regions. In developing countries, the CDC introduced chlorination at the point-of-use in response to cholera in Latin America in the 1990s (Lantagne et al., 2006). Chlorination as a household treatment method can come in two types: tablets or a solution (figure 14). For every 20 litres of clear water, a dosage of 5-10 ml or one tablet is required (Sobsey et al., 2008). Chlorination is less effective to use in turbid water; therefore turbid water could be strained through a cloth to remove most of the turbidity before the chlorine is added (Agrawal & Bhalwar, 2009), or households can double the chlorination dosage (Lantagne et al., 2006). After adding the solution to the water and shortly stirring it, households have to wait 30 minutes before they can safely use the treated water for all household purposes (Lantagne et al., 2006; Agrawal & Bhalwar, 2009; WHO, 2007). Chlorination provides residual protection to the water for several hours to even days (Arnold & Colford, 2007; UNICEF, 2013;), but the container should not be exposed to heat (e.g. direct sunlight) because this will increase the possibility of recontamination (IFRC, 2008). Although this treatment method provides residual protection, it is often combined with safe storage to prevent recontamination, and it also requires education in order to be properly used by the households (Arnold & Colford, 2007; Lantagne et al., 2006; WHO, 2007).

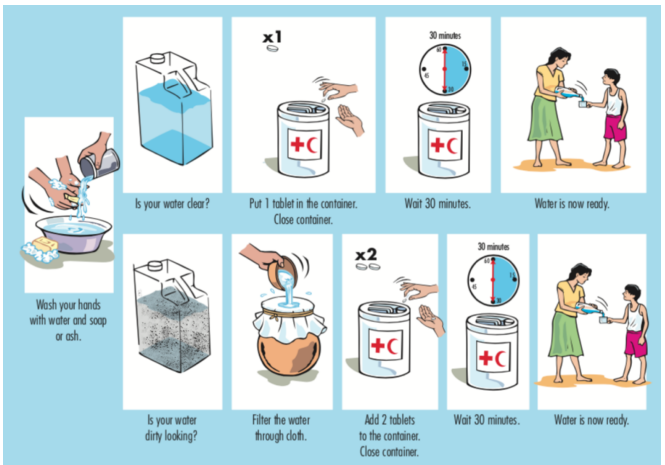


Figure 16: How to properly use chlorination tablets (IFRC, 2008)

A review analysis found that in nine out of ten studies executed to measure the effectiveness of the chlorination solution, the occurrence of diarrhoeal diseases under children decreased on average with 29%. Amongst the ten studies were at least two studies that did not include safe storage and education in their intervention programme (Arnold & Colford, 2007). Another review article found that chlorination is able to inactivate more than 99.99% of enteric bacteria (Agrawal & Bhalwar, 2009; WHO 2007), the bacteria that cause diarrhoeal diseases are enteric bacteria. Lantagne et al. (2006) reviewed four RCT studies and the outcome was a 44% to 84% reduction of diarrhoeal diseases. A fourth review article published in 2015 found that the average of 14 RTC studies reduced diarrhoeal diseases by 25%, but again this review included studies that did not provide clean storage containers (Clasen et al., 2015).

The chlorine solution can be produced locally which can make this option relatively cheap (no costs specified), and it is easily distributed (Arnold & Colford, 2007). However, the International Federation of the Red Cross and Red Crescent Societies (IFRC) (2008) states that communities cannot produce this product themselves and that is must be brought into the communities from outside. The NGO Population Services International (PSI) has collaborated with CDC to produce bottled chlorine solution and the full production cost of their bottle is $0.34. Funded by the United States Agency for International Development (USAID), PSI-CDC could sell the bottle for $0.12 in the Zambian market. The Jolivert Safe Water for Families Project developed a chlorine solution of their own, and they were able to sell it for $0.09 in Haiti, which is in within the budget of most Haitian households (Lantagne et al., 2006). Sobsey et al. (2008) found that one bottle of chlorine can treat over a thousand litres of water and would cost about $1. Chlorine tablets cost relatively more at $0.01 to 0.001/L. Using chlorination as a household method requires a constant purchasing of new bottles or tablets.

Even though chlorination is an effective and quick method, the use of chlorination to purify water can leave a strong scent and it may affect the taste of the water (Arnold & Colford, 2007; Sobsey et al., 2008; UNICEF, 2013). The WHO (2007) found that with some education, people can become used to the taste and smell of chlorine, as people in industrialised countries have. By shaking the water in a container or bottle, the air content is increased and this can possibly remove the chlorine taste from the water (IFRC, 2008). Additionally, a high intake of chlorate can be lethal (EFSA Panel on Contaminants in the Food Chain (CONTAM), 2015), thus

education is required to keep the solution or tablets out of children's reach and to always stick to the prescribed dosage.

Flocculant-disinfectant powder

Flocculant-disinfectant powder is developed by the company Procter & Gamble (P&G) in collaboration with the CDC. Every packet contains powdered ferric sulfate, which is the flocculant, and calcium hypochlorite, which is the disinfectant (CDC, 2014; Lantagne et al., 2006). For every 10 litres of water in an open bucket, households add the content of one pocket to the water, mix for 5 minutes and wait until the solids have sunk to the bottom of the bucket. After this, the water has to be strained through a cloth into a second storage unit, and then households have to wait 20 minutes before they can use the treated water for all household purposes (CDC, 2014; Colindres, Jain, Bowen, Mintz & Domond, 2007). Due to the chlorine, the use of flocculant-disinfectant powder offers residual protection of the treated water (Lantagne, 2006).

The flocculant-disinfectant powder is able to remove the majority of bacteria, in clear and (very) turbid water. In addition to this, five RCT studies have found that the use of the powder has led to a decrease in diarrhoeal diseases from 90% occurrence to less than 16%. These studies have been conducted in turbid water in laboratories, in developing countries, in rural and urban areas and all age groups were included in the studies (CDC, 2014). A study conducted in Guatemala documented a 24% reduction in diarrhoeal diseases amongst households that received the flocculant-disinfectant powder and a 29% decrease amongst households that received the powder and a storage vessel (Reller et al., 2003). A review article found that the use of the powder created larger effects amongst households that also received a storage container in addition to the sachets (Clasen et al., 2015). Another study, conducted in Kenya, found that the mortality rate in households that used the powder to treat their water was 50% less than in households that used untreated water. This study also found that the use of the powder resulted in a 25% reduction of diarrhoeal disease amongst children under the age of two (Crump et al., 2005).

Another important aspect of the flocculant-disinfectant powder is that it visually improves the water quality (CDC, 2014). However, in order to use this product, multiple steps have to be performed and households need a lot of equipment: at least a bucket and second storage unit, something to stir the water with and a cloth through which the water can be strained (CDC, 2014; WHO, 2007). Education is thus required when households are offered this product, to ensure proper use of the sachet (WHO, 2007). A study conducted in Haiti researched the attitude of households towards the flocculant-disinfectant powder, and 97% of households reported that water treated with the powder looks, smells and tastes better than untreated water (Colindres et al., 2007).

Flocculant-disinfectant powder is produced in Pakistan and sold to NGOs all over the word for $0.035 per packet. However, this does not include the transportation costs from Pakistan to the destination, so the total costs for one sachet is $0.10 (CDC, 2014). By setting the price at production costs for NGOs, P&G does not profit from the sale of the powder (Lantagne et al., 2006).

Solar disinfection

Solar disinfection is a method to disinfect water by exposing the water in a plastic or glass bottle (or clear and clean plastic bag if the latter is unavailable) to sunlight for a day: at least six hours, or two days when the weather is a bit more cloudy or when the water is cloudy (WHO, 2007; IFRC, 2008). This is usually done by placing it on the roof of a house (WHO, 2007). A corrugated-iron roof will be more effective as well (IFRC, 2008; Lantagne et al., 2006). Shaking the bottle every now and then can speed the process, because it oxygenates the water (IFRC, 2008). The heat and the ultraviolet radiation of the sun inactivates pathogens in the water, making it safe to drink. When treated, the water should either be directly consumed from the bottle or transferred to a clean glass. In contrast to boiling, this method works best for relatively clear water (WHO, 2007). SODIS only requires little capital investment, there is no supply chain needed which makes it an appropriate method for the very poor (Sobsey et al., 2008). A field study in Bolivia found factors that contribute to the use of SODIS in communities: promotion of perhaps less obvious advantages such as a better water taste and lower costs compared to boiling should be mentioned. Also, follow up is needed and a supply scheme for bottles should

be initiated. Trainings should be given on how to overcome difficulties such as turbid water, cloudy days, or rainy periods. Additionally mass media can bring success, and finally, it should be remembered that promising methods usually diffuse slowly (Heri & Mosler, 2008).

A study by Graf, Meierhofer, Wegelin and Mosler (2008) in Kenya found that biomedical knowledge of children and the social norm around water treating predicted the use of SODIS and hygiene behaviour. In addition, Kreamer and Mosler (2010) found that ''*involvement, ability, attitude, conviction as regards to health, social influence, affect and knowledge all play an important role in the decision to use SODIS*'' (pp. 76). This indicates that the context is very important for the implementation. According to Lantagne et al. (2006) both lab and field studies show positive outcomes for the use of SODIS. A lab study by Boyle et al. (2008) indicates that SODIS disinfected water from a number of waterborne pathogens effectively but 4% remained viable. This might be due to bacterial spore forming which can make the bacteria survive. In Kenya a study where SODIS was used there was a 86% reduction in cholera cases that regularly used the SODIS method (Byne, Fernandez-Ibanez, Dunlop, Alrousen & Hamilton, 2011).

A few benefits and drawbacks have already been discussed: it is a cheap method, has a proven reduction of pathogens, easy use and minimal change in water taste, and the chance of recontamination is reduced because it is usually drunk directly from the bottle in which the water is treated. Drawbacks are only a limited amount of water can be treated, and clean bottles are needed. Additionally, treatment can take longer if the water or weather is cloudy (Lantagne et al., 2006; IFRC, 2008).

Boiling

Boiling contaminated water is by extent the most commonly used method to disinfect water, including turbid water (Agrawal & Bhalwar, 2009). It is a simple method to kill microbial pathogens and to use in the household (WHO, 2007). According to UNICEF (2013) many bacteria, viruses and protozoa are killed already when the water reaches a temperature of 65°C. However, water should be boiled for at least ten minutes at 100°C to make sure all pathogens are killed. Subsequently, it should be consumed within 24 hours to decrease chances of recontamination (UNICEF, 2011; Juran & MacDonald, 2014). Studies in Vietnam showed a

97%-99% reduction in bacterial indicators. This indicated that boiling significantly improves the quality of the water, but does not remove the full risk potential (Clasen, 2008). There are some drawbacks that need to be overcome if households want to use this method. Firstly, a large amount of fuel is needed, which in turn can be costly and create a deforestation risk (WHO, 2007; UNICEF, 2013). For one minute of boiling, one kilogram of firewood is needed, so it should not be promoted in areas that are scarce in wood (IFRC, 2008). Secondly, boiled water can have an unpleasant taste (WHO, 2007; UNICEF, 2013; IFRC, 2008). Third, boiled water can cause harm (burn injuries) and it easily becomes recontaminated if not handled properly (WHO, 2007; UNICEF, 2013). Juran and MacDonald (2014) also address that the time to boil water is a major barrier. This could be overcome by changing the moment of boiling; it is recommended to boil the water in the evening, so that it would be cooled down by morning. In addition to all these factors, adherence to the method can also be a problem. For example, a study in Cambodia by Brown and Sobsey (2012) indicated that only 31% of the households boiled there water during follow up visits, while more than 90% reported they used boiling.

In the context of the Niger Delta, boiling can be a useful method to disinfect water. During the interviews, students mentioned people were aware of this method, but barriers such as the time it takes were reasons to not adhere to this method (table 4). Therefore it would be very important to make people aware of the health risks.

Safe storage

Four of the previously described methods, biosand and ceramic filter, boiling and SODIS, do not offer residual protection of the water, thus safe storage is required to maintain the improved quality of the treated water. If water is not properly stored, the previous efforts to treat the water were useless (IFRC, 2008). Especially putting unclean hands inside treated water is a major risk for recontamination (WHO, 2007). Clasen et al.'s review (2015) found that households are more likely to continue to use of treatment methods if trials also offered storage units in addition to the provided treatment.

UNICEF's *Cholera Toolkit* (2013) describes three options to safely store treated water: narrow-necked containers, covered containers with tap and containers with a lid and abstraction device.

Studies have shown that those types of containers reduce the risk of recontamination and thus reduce the risk of infections with diarrhoeal diseases (WHO, 2007). The narrow-necked container has the benefit that it is not possible to put (dirty) hands inside the storage unit, which limits the opportunity for recontamination, but the drawback is that it is more difficult to clean. The covered container with tap reduced the chance of recontamination because it is not necessary to put hands inside the container due to the lid. However, the tap may break and leak, so additional costs for replacement can be required. It is easier to clean than a narrow-necked container. The covered container with lid and abstraction device also limits the opportunity for recontamination due to the lid and abstraction device (as opposed to no lid and no abstraction device), but runs the risk that the abstraction device is used for other purposes and that increases the chance for recontamination again. This container is also easier to clean than a narrow-necked container. (UNICEF, 2013).

It is important to encourage people to keep the storage unit clean, whichever one the households use. Preferably, households will use different containers for collecting and storing water. Additionally, it is also advised to keep the containers out of reach for children (IFRC, 2008). Within intervention programmes addressing point-of-use treatment methods, safe storage should be incorporated (WHO, 2007).

Table 4. Quotes of the interviewed students about technical interventions.

TOPIC	Student	Quote
Methods used to treat water	Student 1	"You can fetch water and leave it in sun to disinfect water. But does not take care of the medical aspects."
	Student 2	"We do not really have methods to treat contaminated water, maybe minority cooks water."
	Student 3	"Alum is used to get water clean. But not really clean and clear, but still germs in there."
	Student 4	"alum and boiling"
	Student 5	"Boil water. We have no good way for cleaning the water. Some use alum."
	Student 6	"Boil"
	Student 7	"Not really, only boiling, but I don't think that is clean enough. Not everyone does that, you have to drink what you have and hope you don't get sick."
	Student 8	"We do not drink it directly, we boil before drinking to avoid problems, and possibly use

		alum”
	Student 9	“Boiling”
	Local NGO	“Because of boreholes, there is very little presence of waterborne diseases. If they are present, waterborne diseases are mainly spread by food rather than drinking water.”
	Dutch thesis student	“I do not know, but I don’t think they often treat their water.”
Not-used methods by interviewee	Student 1	“You have to buy water to drink clean water.”
	Student 3	“Bottled water very expensive, not for the locals.”
	Student 6	“Bottled water, but it is for the rich. There are no boreholes.”
	Student 7	“Bottled water, but that is expensive.”
	Student 8	“No.”
	Student 9	“Sometimes they use alum or lime (the citrus fruit). They believe lime purifies water. Alum affects the natural taste of water”
	Local NGO	“The problem of waterborne diseases is minimal now, due to good water facilities. Some people still treat water but it is ok, so not everyone. Chlorine treatment for cleaning water, but done by consultant/someone else. In the west, in Lagos, they put filters. But we don’t need that here, because the quality is already good.”
	Dutch thesis student	“Bottled water (in plastic bags) exist and often is distributed for free, I think this comes from the government, but this is not done in the creeks. The creeks are difficult to reach so the availability of all products is less there. In the communities that are accessible, often bottled water is sold or distributed.”
How often water is treated	Student 4	“Most just drink it without cleaning. I use boiling the water most of the time.”
	Student 5	“Sometimes”
	Student 6	“Sometimes boil. Most of us we don’t treat the water, we see that it’s clean than we drink, and fish. I boil it sometimes, but mostly just drink it”
	Student 8	“No, we do not always boil our water, sometimes we do not have the strength to boil”
	Student 9	“No not really, whenever I am in the village, I try to insist that people boil the water”
	Local NGO	“Some people with new-born babies, use the treatment of the boiling method and bottle it, because they cannot afford already bottled water.”

6.2 Hygiene interventions

Handwashing

Handwashing might not necessarily be a *technology* to prevent infection, but it is important behaviour to change, in order to reduce the chances of infection with waterborne diseases. According to Hashi, Kumie and Gasama (2017), promotion of handwashing with soap, improvements of safe excreta disposal, and improvement of the water quality significantly reduce waterborne diseases. They conducted a randomized controlled trial which showed there was a reduction of 35% of diarrhoeal diseases due to the WASH interventions, including handwashing with soap practices. Curtis and Cairncross (as cited by Burns, Maughan-Brown & Mouzinho, 2017) also found that washing hands with soap can decrease incidence of diarrhoeal diseases up to 47%.

Key messages for washing hands are to wash your hands with soap before preparing a meal, before eating a meal, and children's hands need to be washed with soap after defecation, before meal preparation and before eating (Hashi et al., 2017). The most important challenge that comes with handwashing is that it should become a habit to regularly wash hands. Just mass media to increase knowledge and awareness will not be effective. Subsequently, for behaviour change tools are required which need to be consistently available, soap is one of those tools. Promotional activities and educational interventions can foster behaviour change (Burns et al., 2017). An overview of intervention strategies regarding handwashing with soap can be found in table 5.

Table 5. Overview of intervention strategies for handwashing with soap.

Year	Organisation	Project description	Intervention strategy
2012	Centers for Disease Control and Prevention (CDC)	Community Health Worker Training Materials for Cholera Prevention and Control	Trainings to educate people to hand wash with soap and safe water. The trainings should include the transfer of knowledge on: - Why it is important to wash hands - When hands should be washed - How hands should be washed - When people lack access to soap: what can they use instead - Instructing community members on proper handwashing techniques The supplies needed for correct handwashing are safe water (i.e. bottled with unbroken seal or treated water), a basin or container, soap or its replacement and a clean towel if available. (CDC, 2012)

2011	UNICEF	Water, Sanitation and Hygiene for school children in emergencies. A guidebook for teachers.	Trainings to educate children to wash hands with soap. Trainings should include: - Changing old habits - Find reasons to wash hands with soap - Teach children how to wash hands with soap - Create handwashing facilities (such as tippy-tap) - Support children as educators to promote handwashing with soap message. (UNICEF, 2011)
2012	Centre for Affordable Water and Sanitation Technology (CAWST)	Water, Sanitation and Hygiene Poster Set	Key message of trainings to 'stop microbes' by washing hands: washing your hands properly and often will prevent illness. Trainings provide education with reference to a poster about: - Why, how and when to wash hands - 3 x 3 method: three times when you should wash hands and 3 steps that need to be performed to wash hands - Check if audience understands message by asking questions. (CAWST, 2011)

Food handling and preparation

Bacteria like cholera are spread via water and food from the faeces of an already infected person. The local NGO told the interviewers that in his area, most infections with waterborne diseases are spread via food and not water (table 6). Handling and preparing food in a proper way can prevent the spread of these bacteria (CDC, n.d.). Handling food in a proper way is done in multiple steps. First off, hands need to be washed with safe water and soap. If hands are not washed, it could act as a source of pathogens which can contaminate the food. Often raw vegetables are contaminated with pathogens, and via cross contamination, other foods that are not contaminated yet, become contaminated too (Nizame et al., 2016; CDC, n.d.). After this, it should be remembered that safe water has to be used when preparing food. Food needs to be cooked well, and eaten when still hot (CDC, n.d.). However, the storage and preparation of these foods increases the chance of growing pathogens, and thus the chance for contamination. Also, these foods are often added after heating the main meal, which also increases the chance of contamination (Ehiri et al., 2001). In addition, the working space and the kitchenware should be cleaned with safe water and soap. Other things to keep in mind when it comes to safe food handling and preparation is to store it in sealable containers and reheat if well if eaten again. Lastly, fruit and vegetables should be peeled, and people should only eat food prepared by themselves or trusted others (CDC, n.d.). For food vendors it is also important to receive hygiene training (Chukuezi, 2010).

The complexity of the instructions however can hamper the adherence in households. Plus, availability of soap and water is needed as behaviour change needs to be supported by the environment (Nizame et al., 2016). It can have great advantages to increase the knowledge and awareness to better the health of people, but good training and tools are needed to fulfil this completely.

Table 6. Quotes of the interviewed students about food handling and preparation.

TOPIC	Interviewee	Quote
Most important causes of waterborne diseases	Local NGO	Because of boreholes, there is very little presence of waterborne diseases. If they are present, waterborne diseases are mainly spread by food rather than drinking water.

7. Communication Strategies

The problem with WASH related practices is often that vulnerable populations are aware that they need clean water, but the access is lacking (Unicef, 2013). Information, Communication and Education is seen as key to WASH programmes, and is helpful to enable behaviour change among communities. Strategies for ICE should be addressed to all levels of rural communities to create awareness and behaviour change for better WASH practices (Sriram & Maheswari, 2013). The usage of for example mass media, direct communication (which includes activities such as workshops), and printed materials such as pamphlets are important to strengthen the capacity building (Laverack & Dap, 2003). Diffusion of understandable and useable information is thereby needed, so an appropriate communication strategy is necessary (Mboera et al., 2007). Additionally groups need to be identified that need to be the most influenced by the intervention (Sriram & Maheswari, 2013).The ones who suffer the most from WASH problems are often women, girls, children and infants (Sriram & Maheswari, 2013). There has to be an emphasis on enabling groups to take action, rather than only raising awareness about causes of diseases (IFRC, 2008). Other than just the communication strategies, behaviour change should be the starting point. It is essential for the sustainability of interventions, to end open defecation, and improve WASH practices (Unicef, 2016). According to Dreibelbis et al. (2013), to have successful interventions that maintain and foster behaviour change, the individual, household (links to relationship), community and structured (societal) levels should be taken into account. This also refers to the importance of the Ecological Model and viewing a setting as a whole. There are many theories that guide WASH interventions. For example, the Health Belief Model which explains that individual perceptions and behavioural outcomes are linked with modifying factors, such as perceived threat, individual socio-demographics, and cues to action. Another theoretical model is the Risks, Attitudes, Norms, Abilities and Self-regulation (RANAS) model (Mosler, 2010, as cited in Dreibeldis et al, 2013). Dreibeldis et al., (2013) integrated 15 existing behaviour change theories for WASH into a combined model, the Integrated Behavioural Model for Water, Sanitation and Hygiene (IBM-WASH). This model focuses on the contextual dimension, the psychosocial dimension, and the technological dimension which operate on different levels identified; the societal/structural level, the community level, the interpersonal/household level, the individual level, and lastly the habitual level.

This section will shed light on recent (2010 and onwards) best practices regarding for WASH communication strategies in African and Asian countries. Reports of the projects or plans are analysed to find which practice(s) fit(s) best to the Niger Delta context. Findings from the interviews of this current project are also interwoven to indicate whether or not strategies could be applicable in the Niger Delta context. Additionally, an overview will be given to summarize the findings of the best practices, which can be found in Appendix C. The quotes by the students used in this section can be found in table 7.

Capacity building

Capacity building is key in most projects (UNICEF Liberia, 2012; UNICEF Malawi, 2016; UNICEF Kenya, 2016; WSSSRP 2010; WASHplus, 2013; Danish People's Aid 2017; ASAL, 2016). Capacity building refers to building capacity among the locals in communities by training them and increasing their awareness of issues related to waterborne diseases. Increasing their knowledge on prevention and recognition of diseases and promoting ways to have better hygiene practices (that in turn will prevent infections) will build capacity. Building capacity among locals needs to be done in a proper and clear way, otherwise it will not add to the sustainability of technologies such as hand pumps (UNICEF Malawi, 2016). In this current project the students of the Universities in the Niger Delta are the agents of change, who in turn can build capacity among their communities. Additionally, it could be viewed as an overarching strategy, including the other communication strategies which will be further explained in this section.

Committees

Setting up committees is an element that is key in many projects (UNICEF Liberia, 2012; UNICEF Malawi, 2016; WASHplus, 2016; Danish People's Aid, 2017). Committees can be effective because members of the committees need to be proactive to create opportunities for the affected communities, and when community members are empowered committees are likely to continue to exist and be sustainable (UNICEF Liberia, 2012; Danish People's Aid, 2017). According to Partners for Development (2016) there are already 2530 community WASH committees set up in Edo and Delta state.

Evidenced by the interview, students overall seem to be positive about creating committees on local community level (table 7). Student 1 said *"Yes, i think that would be a good way to do it. People would be very willing to help. Women and children are vulnerable, good to focus on in any community.''* And student 3 said *"Yes, would be very effective. In this solution a community leader has to be involved, as these people can really influence the community and spread awareness.''* It did not seem apparent that there are already existing committees, which is contrasting with the information from Partners for Development (2016). This might be due to the big population and many towns in the Niger Delta. Or it might be due to people not being in touch with other clans within communities and not knowing about committees. During the interviews it became clear that some towns are very big and consist out of (40) different clans. People know each other within the clan, but are not in touch with the other clans.

The WHO (as cited by Howard et al., 2002) wrote a chapter on how to establish a committee and what the key roles are. The members of the committee should be people who are influential, have respect, and are able to represent all interests in the community. In addition, because women (and children) are more vulnerable and prone to becoming infected (Williams, & Berkley, 2016) it is very important to make sure they are included as well. A good recommendation for a committee in the Niger Delta region can include a religious leader or village chiefs, these were mentioned by students in the interview (table 7). Student 2 said *''a religious leader could be important''* and student 7 said *''religious leaders do their best [..] but it is not enough''.* They seem aware of the effect religious leaders could have, but are hesitant about their capacities. Electing committee members is the best way to include locals.The role of the student in this could be to initiate a committee (election) on local level. Additionally the student could be part of the committee as well, this could however be difficult since the student is not always present in their hometown but is at his or her university. Transparency and accountability of the committee is important for the community, local governments and possibly NGOs that may provide support. The committee should therefore elect executive officers (e.g. chairperson, treasurer and secretary) (Howard et al., 2002).

Students are convinced that direct contact is a better way to spread information (table 7). Student 1 said ""*You need personal contact, and people in communities have a local dialect. You need to involve the local youth in the community as it is important to present in local*

dialect''. In addition to this, students are positive about the usage of trainings or workshops, student 2 states *''Training or workshops would be very good, but they need to be in local dialect. Mouth to mouth is important. [...] Most effective is one on one conversation, town hall meeting with elders in the community.''*

School curriculum

Many projects involve education about WASH practices in school (primary or secondary) (UNICEF Malawi, 2016; UNICEF Kenya 2016; WSSSRP, 2010; WASHplus, 2013; Danish People's Aid, 2017; ASAL, 2016). Schools are often involved because children can become advocates. They learn about the basic principles related to WASH. According to Sriram and Maheswari (2013) children are important for capacity building because they are the best influencers and messengers for WASH. Child to child, child to parent, and child to community communication can be very effective for approaching a communication campaign. Danish People's Aid (2017) created school advocacy clubs which changed the attitudes in school towards WASH. For example, there was a reduction in cholera, dysentery and diarrhoea. It is important to note that other factors also most likely contributed to this reduction. According to the interviewed students children are taught in school about WASH related practices, they are however not convinced of the impact (table 7). Student 3 stated *''I do not have a lot of confidence in the local capacities''*.

This communication strategy could be viewed in two ways: first a strategy for the children in local schools in communities, and secondly that WASH trainings or projects could become part of the curriculum in the universities of the students in this project. Empowering the students by implementing a mandatory course or project on prevention and recognition of waterborne diseases could be very useful. Additionally they need to learn and be trained, via e.g. workshops, on how to train other people in their community and how they can set up a committee or other initiatives that promote good WASH behaviour.

Theatre for development

Drama or theatre performances can be a strategy to create awareness on WASH behaviours and practices, e.g. stopping open defecation. Out of the selected best practices a few use this strategy (UNICEF Liberia, 2012; Danish People's Aid 2017; ASAL, 2016; WSSSRP, 2010).

Participatory drama is useful for escapism, addressing issues, building a forum to send a message, and additionally it provides an active way for a community to be involved in issues and feel empowered. It should be made for and by the community, making it a bottom up approach (Sloman, 2011). It can influence their way of thinking which might lead to behaviour change. To keep it sustainable, there is constant need for trainings to build capacity (Epskamp, 2006). According to Eskamp, the National Policy on Education (1981) of Nigeria states that pre-primary education has to include development of creative expressions. At primary level Nigerian students' arts education includes drama to form cultural and creative arts. This is done so that the student creates creative and communication skills. At university level, the Ahmadu Bello University offers a Fine Arts degree, performances are often also used to promote better sanitation among other goals. These students are sent in to other areas near the universities to discuss WASH practices among other things, and form the resources for writing a play (Epskamp, 2006).

Posters/pamphlets

Communication material such as posters, pamphlets, stickers, leaflets, banners and wall paintings are used as part of a strategy (UNICEF Liberia, 2016, WASHplus, 2013; Danish People's Aid, 2017; ASAL, 2016). Chances are that these will not guarantee change, but are rather part of the means to reach the end (UNICEF Liberia, 2016).

During the interviews it became clear the students did not get very excited for the usage of pamphlets (table 7). Student 1 stated *"The effectiveness of posters is dependent on the level of education, this information may not reach everyone".* In line with this student 2 and 3 stated *''Flyers would not work because of the different dialects, I would be more active and want to give trainings''* and *''flyers are okay, but they need to be in dialect.* The main reasons are the issue of local dialect and additionally many people are illiterate. Student 3 said *''illiterates are often in communities, literate grown ups outside community''.* A solution for this is to visualize messages about the prevention, recognition and treatment of waterborne diseases. Student 5 mentioned *''Leaflets with pictures would be most useful''*, this could overcome the barrier of the local dialect. The Centre for Affordable Water and Sanitation Technology (CAWST) provides a free to use document with posters/pamphlets with a range of topics to prevent waterborne diseases. They are without text, so they are also appropriate for illiterate people. There is text

included that gives a deeper description about the poster. The reference to the document can be found in Appendix D.

Radio and television for development

A tool that can contribute to the mass communication of prevention and treatment of waterborne diseases are the radio and television. Design of messages for the radio about risk and prevention practices can for example be done with an entertainment-education baseline and is weekly broadcasted (UNICEF Liberia, 2012; WSSSRP 2010; Danish People's Aid, 2017). There is a historical philosophy that community radio is a medium to give the voiceless a voice, a mouthpiece for the oppressed and generally it can be a tool for development (AMARC, 1981 cited in Wabwire, 2013). Community radio is radio that is non profit, and intends to communicate messages that benefit the community (Wabwire, 2013).

In the Niger Delta, according to student 1 (table 7), there are already jingles in place on the radio that promote healthy behaviour, this is however not the case in the whole of the Niger Delta. And according to the students most people in communities have a radio. This is not always the case, according to student 3 *''Local government uses radio but not enough electricity. Only the rich can afford.''*

Other ways, such as internet and push sms messages, can promote healthy behaviour (UNICEF Liberia 2012; ASAL 2016), however in the context of the Niger Delta this does not seem applicable as many people are illiterate, do not have access or connection with the internet and have very old fashioned mobiles. Student 6 said *"There is a poor phone connection, only a particular place where there is connection. You can use radio, in local dialect''* and student 2 said *"There are no jingles on the radio. We have radio and television. The majority cannot get information from the internet. We all have cellphones, but we do not have internet on our phones''*. In addition to this, student 7 stated *''No television, yes radio, yes telephone, but bad signal and connection.''*

Celebration of events

The celebration of hygiene practices could also be a tool to spread awareness and communicate about prevention and treatment practices (WASHplus 2013; ASAL, 2016). For example Global Handwashing Day. This is an annual international advocacy day to promote handwashing and increase the awareness of the importance of handwashing and the usage of soap to prevent diseases (Global Handwashing, 2017a). According to Global Handwashing (2017b) Nigeria is already involved in the celebration of this day, engaging thousands of school children in a mass handwashing activity. Another international celebration is Sanitation Month. In Bangladesh community based organisations celebrate the commitment there is to reach water and sanitation goals, as part of the Sustainable Development Goals (SDG) (Practical Action, 2016). One student was asked about this, but the student did not seem aware of these types of celebration days.

As mentioned in the beginning, below in figure 6 the filled in capacity framework can be found in which the relevant for the Niger Delta discussed facets of a communication strategy are placed. This gives a clearer insight in where in the whole process of capacity building these facets are important.

Table 7. Quotes of the interviewed students about communication strategies.

TOPIC	Student	Quote
WASH related projects in hometown	Student 1	"I don't know about the, or if there are any.''
	Student 2	''No.''
	Student 3	''There are clean up of oil spills projects locally, but there are no WASH projects present. Water should be implemented in the outcome.''
	Student 4	"No NGOs, we teach our people to wash their hands, but we cannot do much. A petroleum company was written to by the community to ask for clean water, but no results for twenty years.''
	Student 7	''Once an NGO, and the local government. About handwashing and mosquito nets, but that is not tackling the major problem.''
Creating WASH committees on local community level	Student 1	"Yes, i think that would be a good way to do it. People would be very willing to help. Women and children are vulnerable, good to focus on in any community.''
	Student 2	"Depends on how you tell them, lot of them on their feet before they can do something.''

	Student 3	“Yes, would be very effective. In this solution a community leader has to be involved, as these people can really influence the community and spread awareness.’’
	Student 4	“There are no committees.’’
WASH education in school	Student 2	‘’Children are taught in school about waterborne diseases and hygienic behaviour.’’
	Student 3	“I do not have a lot of confidence in the local capacities.’’
(Existing) communication methods	Student 1	“The effectiveness of posters is dependent on the level of education, this information may not reach everyone. You need personal contact, and people in communities have a local dialect. You need to involve the local youth in the community as it is important to present in local dialect.’’
	Student 2	“‘Flyers would not work because of the different dialects, I would be more active and want to give trainings. A religious leader could be important.’’
	Student 3	“Training or workshops would be very good, but they need to be in local dialect. Mouth to mouth is important. Flyers are okay, but they need to be in dialect. Most effective is one on one conversation, town hall meeting with elders in the community. Illiterates are often in communities, literate grown ups outside community.’’
	Student 5	“Leaflets with pictures would be most useful. An awareness programme is necessary.’’
	Student 6	“You can go to the local church to get awareness.’’
	Student 7	“Religious leaders do their best and government teachers do what they can but it is not enough. It is difficult to bring people together and create awareness on how to keep clean.’’
Internet/television/radio/phone	Student 1	‘’Jingles can be used to present certain information. Internet is very bad, but television is available.’’
	Student 2	“There are no jingles on the radio. We have radio and television. The majority cannot get information from the internet. We all have cellphones, but we do not have internet on our phones.’’
	Student 3	“Only the rich have radio and television. People do usually have a phone, but no internet. Local government uses radio but not enough electricity. Only the rich can afford.’’
	Student 4	“The internet connection is very poor, only the office of Shell has internet connection. When there is a boat close to Shell there is sometimes a signal. No internet connection in the residential area, you need to hang your phone somewhere to get connection.’’
	Student 6	“There is a poor phone connection, only a particular place where there is connection. You can use radio, in local dialect’’
	Student 7	“No television, yes radio, yes telephone, but bad signal and connection.’’
Celebration of WASH days	Student 9	‘’No’’

8. Collaboration Student Network

Two strategies for the usage of the collaboration of the student network could be the obtaining a course at university level to promote community engagement, and the usage of student associations. Both have advantages and disadvantages. The dependency of the NUC is a disadvantage of the establishment of a course at university level. The establishment of a programme via student associations might be less depended on the NUC, but is also less formalised. Establishing a course is more formalised and could therefore be more sustainable on the long term.

Literature based analogy

Willingness of students

The ICC has access to a network of students in the different Niger Delta Universities, which can be used to for spreading the information on pathologies of waterborne diseases, existing technologies, and communication strategies as explained in the previous chapters. This collaboration has the objective to spread awareness on the prevention and recognition of waterborne diseases in the Niger Delta region. It became apparent in in the interviews that students in the Niger Delta are very willing to be an advocate for their communities. All six students who were asked about their willingness (was not possible to ask all due to bad connection/time) reacted positive. For example student 3 said *"Of course, I would be very willing"* and student 1 said *"Yes I am. There are quite some restraints on health facilities. I would be in favor of practical training in the community''* (table 8). On the other hand, they also indicated that it can be difficult, *"When students go home, we do what we can, but we cannot do much. We cannot really do something''* (student 7) and *"People need to be trained to use plans, but we also need financial power''* (table 8, student 4).

The strategy of accessing student as social agents of change that engage with the community has been applied in previous practices. The following paragraphs will contain a scientific literature review of student engagement projects. The students think that their universities would be willing to engage in such a collaborative project. According to student 1 *"they would be very willing. They would be more than willing to help with water''* and student 3 said *"University would*

be willing to take on this kind of thing.''. More similar comments were made by other students (table 8).

Positive impact

Jung (2011) focuses on the positive impact that a community engagement project can have on students; students on two Universities in the UK can obtain academic credits for work done within the local community, including giving English classes to refugees. In her article, Jung (2011) mainly focuses on the advantages for students that this possibility provides; students can develop among other things their skills concerning self-awareness and reflection, communication, team-working and planning and organising. The students also need to make assignments to reflect upon their learning experiences. In the conclusion, Jung (2011) states that students can learn from this engagement, and hopefully also give back to the community. On the other hand, Boyle and Silver (2005) state the advantages for universities to engage in such a partnership with localities; universities need to continuously remain their legitimacy in order to stay relevant, and this can be created by joining this participation model with other organisations. In this way, universities show their relevance and moral legitimacy in society.

There are multiple studies that go into detail why and in what way such a collaborative network between students/universities and communities can be useful. Moore (2014) discusses the importance of *place*, in both the social and geographical sense. For this current project this can be interpreted that students in the Niger Delta can fill in community WASH projects in various ways, ways that are relevant and fitting for that certain *place.* In the Niger Delta, there are many ethnic groups, and ethnicity can differ between communities (Table 8, dutch thesis student), making *place* important. The inclusion of students gives a sudden degree of local context that is taken in to account. Additionally, Moore (2014) emphasizes that engagement of universities and communities is a process, rather than simply an outcome; it is seen as interactions between different actors on and off campus. In addition to this, reciprocity is fostered by sharing information that goes both ways. The students in the Niger Delta can bridge this gap further as local knowledge and networks are combined with information from the university.

McNall, Reed, Brown and Allen (2008) discuss the relationship between universities and communities as *engaged scholarship.* This refers to scholarly engagement activities that can benefit external audiences. This applies to this current project as well, engaging both sides (university/students and communities), students undergo scholar activities that can be used to spread information about waterborne diseases and create awareness, which can benefit the local communities. Universities need to form generations of students that will be prepared to contribute positively to the world around them (Beaulieu, Breton & Brouselle, 2017). In this case the world around them are there hometown communities. This project believes that engaging students in their original hometowns by having them spread awareness and initiate projects can impact. The interviews also gathered information reflecting this, the students were very willing to put effort in such a project.

Benefits and drawbacks

Putting such a collaboration construct in context, the research by Kolk and Lenfant (2013) can help. They discuss a focus on conflict settings and how it is important to have innovative partnerships, mainly focussing on NGOs and multinational corporations, which could engage in partnerships with the students. This article is relevant because the Niger Delta is also an unsafe place, characterized by conflict. In an interview with an NGO (table 8, local NGO), it was claimed that Unilever was helpful in providing awareness on waterborne diseases. Perhaps local students or universities can see what there is to offer locally and try to make such innovative partnerships. Student 4 (table 8) also stated this *''government or NGO should give us pipe water, and how to manage the plan and use it, they should be employed in the plan. We need a partnership with an NGO for cleaning water, to buy the equipment''.*

One possible downside of such a collaboration is that that it might be viewed as an elite-initiated strategy for community empowerment, subsequently it is debatable whether an elite-initiated strategy is empowering communities (Boyle & Silver, 2005). When reflecting upon the interviews, the students at the Niger Delta States Universities may have a privileged position. This becomes somewhat evident for example with their levels of literacy, while there is much illiteracy in the Niger Delta according to the students. Further, one student also indicated during the interviews when asked about the access to go to university; “If you have not enough money,

you can not go" (table 8, student 8), which further underwrites the critique of Boyle and Silver. On the other hand however, during the interviews, multiple students indicated that they get their water out of the river (table 2, student 1, 2, 3, 4, 5, 6 and 7). These water practices are viewed as worst condition and bring along health risks (WHO, 2015). This might indicate that the students, although they might have an elitist position to some extent, are an equal member in their communities. With this criticism of Boyle and Silver (2005), it is important to incorporate different local levels within the planning of the usage of the student network. This can be done by taking into account and applying the ecological framework, as introduced in the theoretical framework.

One possible advantage of the usage of students who have already established local networks, is that it could enable these social networks of local students can be used to promote more awareness for the prevention and recognition of waterborne diseases. The students can use their local social network to spread a message of awareness. Gush (2017) states that this message of awareness that can be spread by local students, can lead to the local community starting to identificate more with such awareness, which can increase the trust in group members as well as social pressure.

NUC

The influence of the government on society becomes evident within the National Universities Commission (NUC); this commission has the task to approve courses and programmes at all universities in Nigeria (Agboola and Elinwa, 2013). This commission is parastatal to the Federal Ministry of Education (FME) (NUC, 2018a). Based on the article of Agboola and Elinwa (2013), which stated that the NUC also approves on the level of courses, it can be important to go cooperate with the NUC to get a course or academic credits for a community engagement project. To get such a community engaged project incorporated in the curriculum of Niger Delta State Universities, this has to be approved by the NUC, and live up to its standards (NUC, 2018).

Strategies for collaboration

There are different strategies for collaboration with students and student network that ICC can apply. A possibly promising option is the establishment of a course in the curriculum of students focused on community engagement for WASH related practices. There are some pro and cons concerning this strategy. Another strategy could be the usage of existing student organisations, which also has certain advantages and disadvantages. These different sides of both strategies are introduced in the upcoming paragraphs.

A focus on waterborne diseases is important, as the ICC stated that multiple students from the Niger Delta in their student network had stated that waterborne diseases are a major problem in the Niger Delta. As this study focuses on waterborne diseases in the Niger Delta, the strategies as proposed below could provide options to empower the local population regarding the prevention of infections with and recognition of symptoms of waterborne diseases in the Niger Delta.

Community engagement course at university level

One option to increase capacity building and empower the local community regarding prevention and recognition of waterborne diseases, is the establishment of a course at university level that encourages or ensures community engagement (WASH) projects. This has been established at multiple universities, although it is differently organised at different universities (Jung, 2011; WUR study guide, 2018; Guilen & Zeichner, 2018). Jung (2011) describes the course or scheme that has been in action since 1993 at the Newcastle University and Northumbria University, both in the UK. These universities have formalized a programme that encourages students to engage in the local community, by offering academic credits for this community engagements of student, as part of a module that focuses on career development. Grades for the total module are partly decided upon by a personal supervisor on placement/within the community, and partly from an academic framework.

Benefits and drawbacks

The benefits of such a course are twofold; it is both beneficial for students and communities. For the students it can be beneficial, as it can help them develop certain practical skills, which could

help students be more prepared for a workplace. Further, community engagement may also help student learn to reflect more upon themselves (Jung, 2011). In addition,the students are already embedded in the local situation, both socially and geographically, and this is rather important according to Moore (2014). Kolk and Lenfant (2013) emphasize this need to take the local situation into account even more in conflict situations. Because the students know the local situation, they are aware of what would be appropriate and therefore could be efficient. Another possible benefit of the formalization of a community engagement course at university level, is that it is quite formalized, and therefore it could be more sustainable or endurable. This because when it is achieved, it would be a fixed arrangement with the NUC and therefore also with government. This differs from an agreement with a student association, which could have different board members every year. And if such a course is more formalized, it could possibly help more people over a longer period of time. One drawback of this strategy, is the dependency on the NUC; the NUC is the authority concerning the validity of universities in Nigeria, if they state that this is not allowed to do it via universities, this should not be done. The NUC also can shut down illegal universities, which shows their extensive power (Agboola and Elinwa, 2013; NUC, 2018a). It is actually a condition for the establishment of a formalized course that the NUC agree (Agboola and Elinwa, 2013).

Shaping the collaboration

An important first step that ICC could take towards the establishment a formal community engagement course, would be contacting (already established contacts at) Niger Delta states universities. The universities can, in collaboration with the ICC, explore the possibilities for the development of a course at university level that encourages community engagement of students. These first plans can be presented to the NUC, and be further developed and elaborated on as a collaboration between the universities, NUC and ICC. The consent of the NUC to develop a formal course at university level is crucial, as the NUC is rather powerful and also has the power to close down illegal universities, that were not officially licensed by the Federal Government (NUC, 2018b).

If the NUC approves or agrees the development of such a course at the Niger Delta states, it is important that such a course is developed in a way that the students can learn from this course, but also are provided with resources and tools to contribute to their communities (Jung, 2013).

As based on the previous chapters, the inclusion of trainings for the students prevention and recognition of waterborne diseases, technological intervention and the communication strategies. This is elaborated upon in the paragraph “Topics to be included in the training”.

During the development of the course, it is important to include the students and teachers from the Niger Delta state universities, in order to engage the place based knowledge not only in the implementation, but also in the development of the course, as Moore (2014) discusses the major importance of place based tactiques. This local knowledge or local networks may also be relevant for the appointment of certain trainers. Further, in consultation with the NUC, university and students, the ICC can perhaps play a role in selecting and looking for the different trainers.

For the establishment of a set-up for the course, an assessment is relevant as well. Multiple possible assessment strategies can be applied to the outcomes of the students. The skill framework that has been used at Newcastle and Northumbria universities, as identified by Jung (2011, pp. 156) is shown in figure 15. In the case of Newcastle and Northumbria, different reflection strategies were employed, such as a reflective portfolio, which includes among others learning logs, action plans, and evaluations from the community organisation and an assessment interview organised from the counsellor from university (Jung, 2011).

Table I.
Graduate Skills Framework for students completing work experience for academic credit at Newcastle and Northumbria universities

Skill	Definition
Self awareness and reflection	Engage in reflective activities in order to understand own knowledge, values, qualities and skills and to inform and guide personal and professional development
Planning and organising	Set objectives, plan actions and manage time and resources effectively in order to achieve personal and organisational goals
Personal enterprise	Respond to opportunities and initiate change in order to drive continuous improvement
Communication	Effectively use speech, writing, technology and behaviour in order to present and exchange opinions, ideas and information
Team-working	Work with others in order to establish and achieve common goals

Figure 17. Graduate Skills Framework (Jung, 2011, pp. 156)

At WUR, this is organised differently; students work together in a project, but also have to hand in individual assignments as part of an assessment file, which among others include an expectation paper, a mid-term reflection paper and a final reflection paper, on which they receive feedback from their coach. So the grade exists partly of the outcome of the group work in which the students participated, and partly on the individual reflection exercises.

Besides evaluation and monitoring the actions of students, it is also important to evaluate the progress that the project has made in the communities. This monitoring provides a long term perspective on the sustainability and effectiveness of the projects. ICC is responsible to ensure that this monitoring takes place, whether ICC ensures this monitoring themselves or outsources it to another actor, such as the university. In chapter 6, a reference is made to an already existing toolkit for monitoring and evaluating certain programmes, made by WHO & UNICEF (2012).

Student associations

Another option would be to collaborate with student associations to empower the local population regarding prevention and recognition of waterborne diseases. Within this strategy, ICC could ask students of their student network if there are suitable student organisations that could incorporate such a programme or workshops in their activities. Although the different possible student organisations were not taken into account within the interviews, some student associations can be found online. For example concerning medical students, the following organisations were named, linked to the Niger Delta University; African Medical Students Association (AMSA), Niger Delta University Medical Students Association (NDUMSA), Medical Students, Nigerian Medical Students Association (NMSA). These different organisations organise different activities, for example concerning World Antibiotics Awareness week, or HIV/AIDS week (Odiegwu, 2017). While there are different organisations active at the Niger Delta University, it is also important to take the university into account as an actor of influence; in April 2018, the student's unions' activities were suspended (Tega, 2018).

Benefits and drawbacks

One possible advantage of the appealing students via student associations, is that the NUC does not formally have to approve the structure of how the student network is used, so there would be less formal dependency on other organisations. On the other hand, the suspension of the student's unions at the Niger Delta University may indicate the involvement of the university in the student associations. It might still be important to also involve the university in the establishment of a collaboration between ICC and the students. For the collaboration to work, there are no big adjustments needed compared to a collaboration with the university. A difference is that when the collaboration is based with student associations, the academic part is left out.

Disadvantages of the usage of student associations compared to formalizing a course at the Niger Delta Universities, could be the availability of less resources or financial constraints, as was the case at the AMSA (Odiegwu, 2017). Another possible disadvantage could be less continuity in the programme, as students or prospective active member are only around for a limited amount of time, while a formalized course that is taken up in the curriculum of the universities might offer more stability (Brooks, 2017).

Shaping the collaboration

Once collaborations with student associations are realised, the structure of the collaboration has to be agreed upon by the different stakeholders, such as the students, student associations, ICC, communities, and other actors involved. Including trainings on prevention and recognition of waterborne diseases, technological intervention and communication strategies, which is elaborated on below, will increase the capacity of the students to act to empower the local population regarding prevention and recognition of waterborne diseases. The way this collaboration between students in student associations and the ICC is shaped, is in a more voluntary way; there are less consequences for the students for stopping their participation, it is more a volunteering programme. An example of a student volunteer programmes that is/has been quite effective, is the Student Volunteer Army (SVA) in New Zealand. Their tasks include mobilising volunteers who can help with cleaning up after an earthquake, and checking up with the 'victims'. The SVA, as established by university students, coordinates it's volunteers in the

case of a disaster (Carlton & Mills, 2017). The way that the actual interventions take place, are place specific, and should be established as a collaboration between the student, providing knowledge and understanding of the local situation, supported by the trainings they have had, and the ICC, which provides ways to obtain certain resources needed at local level. ICC could provide such resources by working together with other organisations. In this way, investments can be done in local communities, by organisations who have the capacity and knowledge to provide such resources, still be locally appropriate, and that the needed resources are provided.

Also, in this structure that uses the student associations, evaluation and monitoring the actions of students is important. Such monitoring can ensure the sustainability of the projects and evaluate on the intended goals and the practical outcomes (IFRC, 2008). ICC is responsible to ensure that this monitoring takes place, and can outsource this monitoring perhaps to locally active organisations.

Topics to be included in the training

Prevention and recognition of waterborne diseases

Students need a certain knowledge base of prevention and recognition of waterborne diseases, in order to transfer knowledge to their fellow-community members. As identified in the previous chapter 5, the students lack some of the information of the most prevalent diseases. Therefore, training is needed to increase the knowledge level on pathology for prevalent waterborne diseases in the Niger Delta, with a focus on typhoid fever and the diarrhoeal diseases cholera and dysentery. Elements about the diseases to be included in this training would at least be: causes, transmission, symptoms and diagnosis and treatments of waterborne diseases.
This necessary relevant information about pathology is provided in chapter 5.

Information and education on these topic to the students could be provided in different ways.
Some examples are:

- Professors employed by the universities in fields related to pathology, that already have knowledge on these topics.

- NGOs that have experience with fieldwork concerning waterborne diseases could also provide trainings. However, we have not found NGOs in the region that focuses on this.
- Health care workers could also perhaps give this lecture about pathology. It is however important that they have a sufficient knowledge level to teach these student proper information, as student 2 indicated a knowledge gap of health care workers (table 8). Thus, when health care workers are chosen to give these lectures, a strict selection might be needed, in order to ensure that the students are provided with the right information.

Technological intervention

Available and suitable technological interventions are also relevant for the students to know more about. This includes information on different treatments to clean the water, with a focus on the following items, so the students can make a decision based on what they deem locally the most appropriate solution: biosand filter, ceramic filter, chlorination, flocculant-disinfectant powder, solar disinfection, boiling, safe storage, hand washing with soap and safe food handling/preparation.

Of these different possible solutions, the following information needs to be included in the training, as is all argued and elaborated upon in chapter 6.

- Information on time to treat water
- Effectiveness of technology
- Costs of technology

Education on this topic could be provided by:

- People working at local NGOs in the realm of water and water treatment, that have knowledge on the functioning and the application of the different water filter/treatments.

Communication strategies

How the information on recognition of diseases and different prevention methods are brought to the local communities is of major importance. That is why a training should prepare students on the most effective ways to inform, communicate and educate the people in local communities. Students should be introduced to training skills, different strategies, and judge themselves what will best fit on the local level.

Elements that should be included in this training to build capacity for both the student and his/her community, as elaborated upon in chapter 7, includes setting up local committees, theatre for development, posters/pamphlets, radio and television for development and the celebration of WASH related events.

These trainings for the students could be perhaps be provided by:

- Independent skills trainers
- People who work at local NGOs that have practical experience in the application of the ICE methods or communication strategies.

Table 8. Quotes of the interviewed students about collaboration students network.

TOPIC	Student	Quote
Willingness student to be advocate	Student 1	"Yes I am. There are quite some restraints on health facilities. I would be in favor of practical training in the community.''
	Student 2	"Yes I would be willing to state to community.''
	Student 3	"Of course, I would be very willing."
	Student 4	"Yes. We have done so much research, but it costs money. People need to be trained to use plans, but we also need financial power. Government or NGO should give us pipe water, and how to manage the plan and use it, they should be employed in the plan.''
	Student 7	"When students go home, we do what we can, but we cannot do much. We cannot really do something.''
	Student 8	"Yes"

Willingness university to start practical project according to students	Student 1	“Yes they would be very willing. They would be more than willing to help with water.’’
	Student 2	“Yes, not yet in programme really.’’
	Student 3	“University would be willing to take on this kind of thing.’’
	Student 4	“We need a partnership with an NGO for cleaning water, to buy the equipment.’’
	Student 6	“Yes, they can do that, but you have to pre-phone them and train them.’’
	Student 8	“University would be willing to provide trainings”

8. Discussion

Figure 18 below presents a way of capacity building that fits with this project. It has been based on the found literature and gathered results from the interviews. There are important conditions for a structure to have a chance of succeeding, these are described in the conduciveness of sociopolitical-environment, efficiency of policy instruments (in this case the policy instrument is the course implementation), and lastly the effectiveness of organizational arrangements. In addition the adapted Local Ecological Framework (figure 19) is filled out based on the results. This provides insight in factors of the insiders perspective and how interventions need to take these into account for contributing to the recognition and prevention of waterborne diseases. Of course, there are limitations and strengths to this project, and thus also for this construction, these are explained below. In appendix E an even more detailed description is provided.

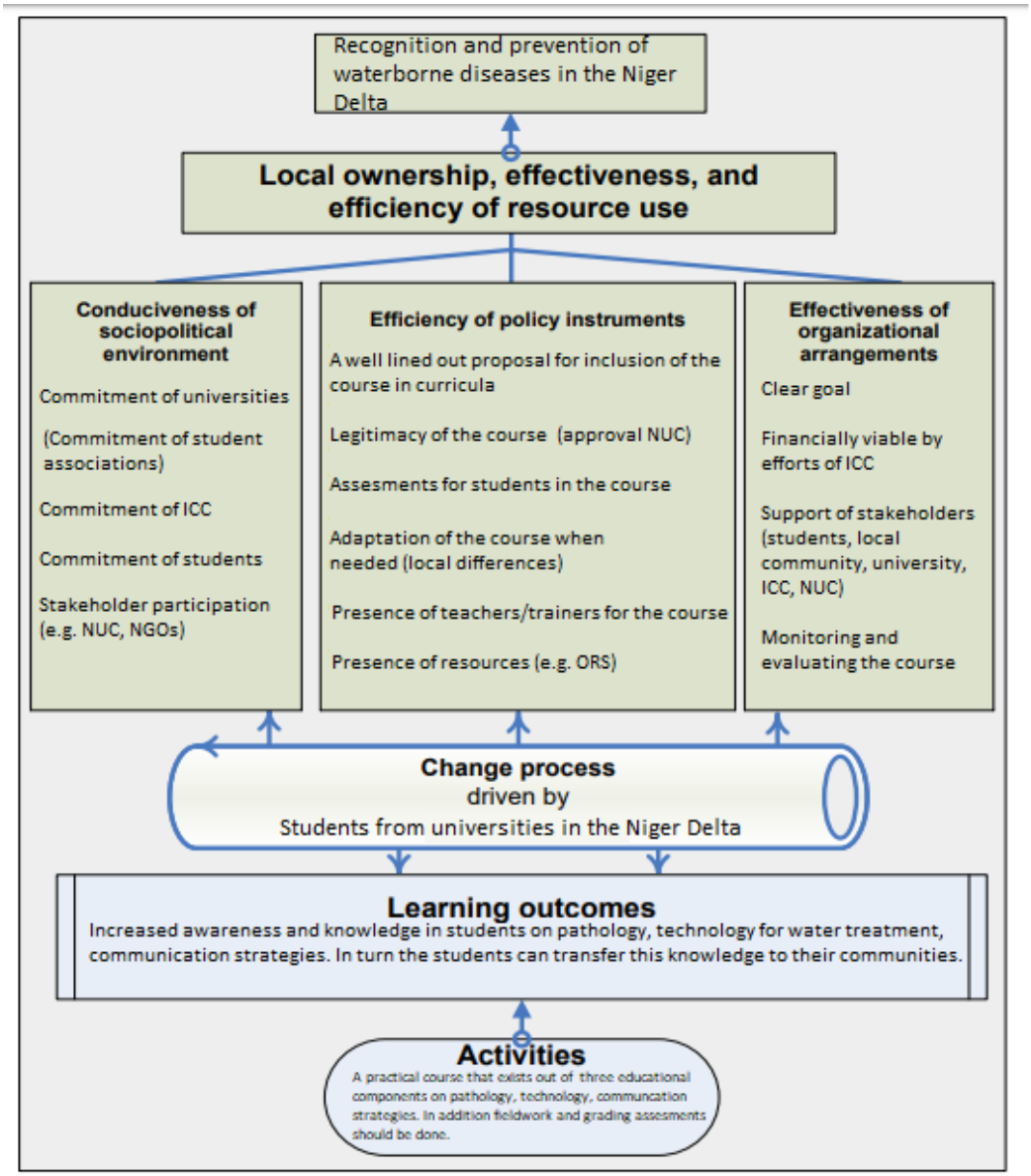


Figure 18. Filled out Capacity for Development Framework (adapted from World Bank, 2009).

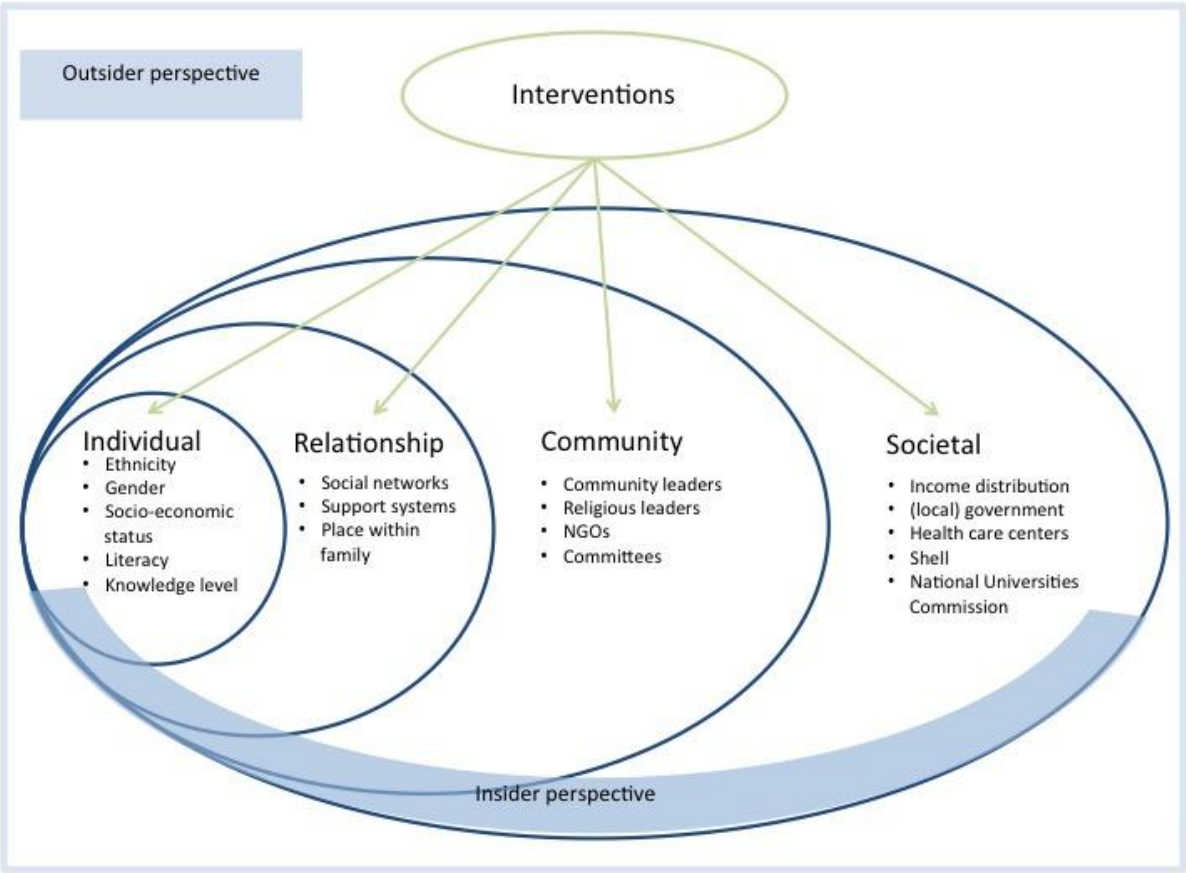


Figure 19. filled out Adapted Local Ecological Knowledge Framework (Adapted from WHO, 2018a)

Time limitations and the choice to select multiple relevant topics at the start of the project did not allow a systematic best practise analysis of all existing best practises on HTWS and communication strategies for the Niger Delta. However, there was still an extensive literature search which made it possible to include many aspects and thereby covering a broad range of topics.

Because physical presence in Nigeria was not possible, the held semi-structured interviews had to be done via internet, which unfortunately brought some connection difficulties. In addition, misinterpretations and misunderstanding for both the interviewer and interviewee could have resulted in incorrect results. The context of the interviews might have evoked bias answers, as students were not alone in the room. Even though there are limitations, and the students might not a representative group for whole of the local population, their answers were very valid to

gain more inside in the local situation. The held interviews with the students, NGO and Dutch thesis student gained valuable insights in the local situation and were a necessary source due to the lack of specific data on the Niger Delta (especially the prevalence, incidence and mortality of waterborne diseases, as well as current water practices). Contacted INGOs were unable to provide the missing sufficient data. Another strength is that the interviewed students came from different areas in the Niger Delta. The establishment of community engagement course at university level, as well as a collaboration with student associations, can make it possible to reach the more inaccessible areas, where the need for intervention is high. In these inaccessible areas, this programs could provide the opportunity to break through the societal structures that maintain and reproduce poverty; culture of poverty (Lewis, 1966). Also, students seemed very willing; positive engagement seems crucial for the success of these interventions as they can be the advocates spreading awareness and knowledge on waterborne diseases to their communities. Proper execution of the different trainings as part of a university-course, or volunteering work is a sustainable way to create a lasting effect over generations and to have a positive impact on behaviour change. Important to note, all implemented strategies will require follow-up and monitoring to see if adaptation is needed and to measure impact. The prefered option is the development of the university course, as the formalization of this project in a university course ensures its sustainability as more long term, and student associations have less continuity, and might have less resources. This project emphasizes that there is no one-fits-all solution due to the heterogeneity of the Niger Delta and strategies need to be context specific.

This project was unable to contact the universities themselves to confirm their willingness to engage in a plan where a course can be implemented that focuses on community engagement for WASH interventions. Furthermore, permission of the NUC is needed to include the project in the universities' curricula. Another option to train the students would be the organisation of volunteering by student organisations. Financing needs to be considered to set up this programme and the provision of treatment and communication interventions, this is where ICC can come in.

The need for a complete intervention on the sanitation level can have a major positive impact on spread of waterborne diseases. Because this project focused on interventions on the household

level, and not the root of the problem necessarily, this was not included in this project.

There are two main suggestions that can improve the completeness of the insight in the Niger Delta. First, there is a need for improved data collection and research in the region as complete data is lacking to make a clear estimation of the current situation regarding prevalence, incidence, and mortality of waterborne diseases. Second, it would be very useful to adapt the trainings to each specific area; however more research needs to be done to determine the local practices concerning water, sanitation and hygiene.

9. Conclusion

For this consultancy project the main research question was:

Which strategies are best suited for ICC to promote prevention of infections with and recognition of symptoms of waterborne diseases of the population in the Niger Delta region through ICC's existing student network?

This project proposes two options for the ICC to promote recognition and prevention of infections with waterborne diseases; the establishment of a community engagement course at universities, or, using student associations for a volunteering programme. The preferred option is the development of a course implemented in the universities' curricula, as it is a possibly more sustainable way to set up a formalized project within the Niger Delta Universities then the students associations could be. This is because the student associations could have less continuity, as the students are only students for a limited amount of time. Within the university curriculum, a course will be set up that can provide the students with the tools they need, to eventually act as advocates to their communities. This course will consists of water, sanitation and hygiene practices, pathology, technological interventions, communication strategies and training skills. This setup requires monitoring and evaluation, to ensure that the course is effective in empowering the local population.

As part of WASH practices, students will be taught about the different actions that people can take regarding water, sanitation and hygiene. The education requires that students will receive the knowledge what the consequences of those actions are (e.g. open defecation will lead to contaminated water). As part of the pathology, students will receive information on the different waterborne diseases, what their causes are, what the transmission routes are, what the symptoms are and which treatments are available for the diseases. For the different technological interventions, students will be trained and learn what each method entails, how it should be used and how the treated water should be stored. Additionally, students need to be trained in handwashing with soap and safe handling of food. As part of the communication strategies and training skills, students will be taught how they can provide the information they have received in the course to their communities. They will learn different communication

strategies and how they can use those to act as advocates to their communities. Concerning the student collaboration, there are two proposed options to shape the collaboration with the student network. The first option is the community engagement course at university level. The second option is collaborating with student associations to establish a volunteering programme. Both options however have certain benefits and drawbacks. In both options, students would be participating in trainings and executing projects in their local communities, which would be monitored on effectiveness.

As a prospective outcome of this programme, students will be able to take the most important aspects of the training sessions and implement that in their own communities.

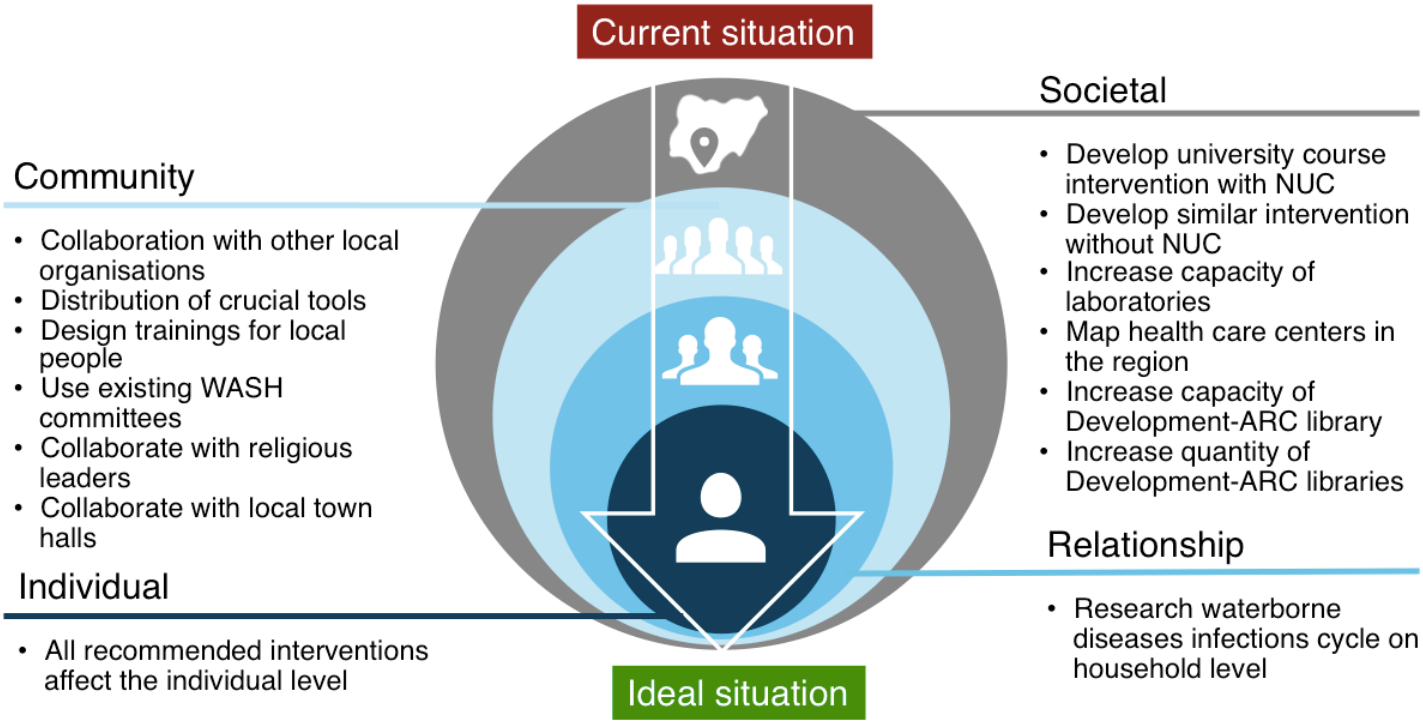
To ensure a successful implementation, the following conditions have to be met:

- Both students and local communities need to be willing and have the necessary intrinsic capacity to learn and apply the obtained knowledge on waterborne diseases.
- Organisations concerning the student collaboration have to be willing and need to have the capacity to start the implementation of training programs in universities and communities. These organisations include:
    1) The ICC needs to be willing and have the capacity to take the lead to start this project.
    2) The state universities, who possibly offer the community engagement course.
    3) The NUC, as their approval is needed to include the student training in the curriculum of the university.
    4) The student associations themselves need to be willing to participate in the organisation of student trainings.
    5) Health care centers, as they can collaborate with the universities in providing knowledge and training on waterborne diseases.
    6) Collaboration between local organisations and actors and university students can have added value to upscale the project.
- Implementation of the training into the universities' curricula as well as communicating and applying this knowledge to the local communities needs monitoring and evaluation, in order to:

    - See if interventions are successful and sustainable over time;
    - See progress over time. This can be motivational for the local people, and;
    - Notice points of improvement and propose possible alternatives or changes of the training.
- Sufficient financial support
- Communication should be locally culturally appropriate, taking into account local language, religion and habits.
- Social structure, such as the social institutions that exist within the communities, like councils and associations, need to be cooperative.
- A stable situation inside the country is a prerequisite for this project; if students or local organisations are brought in danger, this project cannot continue.

10. Recommendations

Based on the literature studies and the interviews recommendations can be made for ICC on how to increase the prevention and recognition of waterborne diseases in the Niger Delta. The recommendations are structurally established by giving an objective, strategy and the corresponding activities. These activities entail the what, for who, by whom, where, when and how. In addition, conditions are given for the recommendation to have more chance of succeeding. The recommended interventions are placed on the different levels or the Ecological Model, which is shown below. These recommendations are explained in more detail in the table below.



Society level interventions

1. Develop a university course

Objective	Strategy	Activities	Conditions
Step 1 Promote prevention of infections with and recognition of symptoms of waterborne diseases of the population in the Niger Delta via student network	Collaboration with ICC and universities: set up a course that is included in the curriculum of students at universities in the Niger Delta	*What:* an obligatory practical course in which students learn about prevention and recognition of waterborne diseases. In addition they develop training skills and communication strategies and the best practices technologies for household water treatment *For who:* students (and in turn their hometown communities) *By whom:* ICC, university, students *Where:* at the universities in the Niger Delta *When:* during the academic year *How:* ICC and universities have to contact National Universities Commission (NUC) to ask if they allow a curriculum change (http://nuc.edu.ng/contact-us/)	Universities have to be willing to implement such a programme NUC needs to accept the proposal
Step 2 Capacity building for the students at universities in the Niger Delta to create local community changes	Education on pathology waterborne diseases	*What:* part of the obligatory course where students learn about transmission routes and symptoms of waterborne diseases. *For who:* students (and in turn for their hometown communities) *By whom:* local NGOs, teachers who have knowledge about this topic possibly teachers or professors who teach medicine, and health care workers. *Where:* universities in the Niger Delta *When:* during the academic year *How:* ICC (and the university) has to find teachers or professionals that are willing to teach this part of the course	Step 1 should be carried out and approved by the NUC for step 2 to be possible. To keep it sustainable and improve the course, monitoring and evaluation is important. Assessing if the students are happy with the course and what possible improvements can be done in multiple ways.
	Education on communication strategies	*What:* part of the obligatory course in which students develop training skills for committees, workshops/trainings, radio for development, and theatre for development. Additionally they receive pamphlets that they can hand out in their hometown *For who:* students (and in turn their hometown communities) *By whom:* local NGO workers or people who have knowledge on how to develop training skills *Where:* universities in the Niger Delta *When:* during the academic year *How:* ICC (and the university) has to get in touch with local NGOs or other organisations to find people who are able to give lectures and trainings to the students	
	Education on technologies to filter water	*What:* part of the obligatory course in which students learn about different relevant water treatment technologies (biosand filter, ceramic filter, chlorination, flocculant-disinfectant powder, solar disinfection, boiling) and choose a fitting technology for their community. *For who:* students (and in turn their hometown communities) *By whom: local* NGO workers that have knowledge about the different technologies *Where:* universities in the Niger Delta *When:* during the academic year *How:* ICC has to get in touch with local NGOs or other organisation to find people who are able to give lectures and	

		trainings to the students. For the students who need to decide on a technology: the WASHtech project developed the Technology Application Framework (TAF) and the Technology Introduction Process (TIP) frameworks, which implementers can use to find out which technology fits best in which situation in order to tackle WASH related problems. (https://technologyapplicability.wordpress.com/home/get-started/)	
Step 3 Capacity building for the communities in the Niger Delta (students go back to their hometown community to spread awareness and knowledge on prevention and recognition of waterborne diseases as part of the obligatory course)	Set up committees	*What:* committees on local community level that create opportunities *For who:* local community *By whom:* it can be initiated by the student, but he/she does not have to part of it for the long term. Members of the committee should be influential people that are respected and represent all interest in the community. Including a (religious) leader or village chiefs is useful. *Where:* in the local community *When:* start during the academic year, but to keep it sustainable it should be continued throughout time by at least the community and perhaps also the student *How:* members can be elected for the committee	Step 1 and 2 need to be carried out for step 3 to be possible. Students have to be aware that they keep their local context in mind when building capacity in their communities. Sanitation and hygiene practices differ among communities. Local people need to have influence and be empowered. Women and children are more vulnerable because they are more in touch with water when they are in the household. Therefor it is important to emphasize that especially women need to be included in the activities.
	Set up of theatre groups	*What:* setting up theatre groups for educational purposes to spread awareness and knowledge on recognition and prevention of waterborne diseases *For who:* local community *By whom:* initiate by student, local community committee *Where:* in the local community *When:* start during the academic year, but to keep it sustainable it should be continued throughout time by at least the community and perhaps also the student *How:* a bottom up approach in which the committee can either be part or create a separate committee for theatre. To keep it sustainable there is a constant need for trainings	
	Set up of radio jingles	*What:* most people in communities have a radio, these can be a tool for mass media communication of prevention and recognition of waterborne diseases. *For who:* local community *By whom:* initiate by student, (if existing) radio workers, local community, committee, *Where:* in the local community *When:* start during the academic year, but to keep it sustainable it should be continued throughout time by at least the community and perhaps also the student *How:* Wabwire (2013) gives examples on how to set this up (see reference list)	
	Promotion of WASH related celebration days	*What:* Create awareness by celebrating WASH related days *For who:* Niger Delta communities *By whom:* on a larger scale by government, on smaller scale by communities *Where:* communities in the Niger Delta *When: e.g.* Global Handwashing Day is this year (2018) on the 15th of October *How:* national implementation or local implementation of celebration of WASH related days.	

	Distribution of pamphlets	*What:* distribution of visualized (no text) pamphlets in communities to spread awareness and knowledge about the prevention and recognition of waterborne diseases *For who:* local communities *By whom:* initiated by student, continued by committee *Where:* local community *When:* start during the academic year, but to keep it sustainable it should be continued throughout time by at least the community and perhaps also the student *How:* ICC has to provide the students with printed pamphlets that the student can hand out and hang in his/her local community (examples can be found in Appendix D)	

2. Recommendation when the upper is not possible (e.g. NUC does not give permission)

Objective	Strategy	Activity	Conditions
Promote prevention of infections with and recognition of symptoms of waterborne diseases of the population in the Niger Delta via student network	When it is not possible to implement a course in the curriculum of students, it is important to find other doorways that can still use the upper recommendations. The objectives remain the same, except the academic component and the approval of NUC disappears.	*What:* find other doorways to implement a collaboration with students *For who:* students *By whom:* ICC *Where:* Niger Delta *When:* as soon as possible *How:* ICC needs to contact existing student organisations or committees to see if this can offer a doorway to still be able to implement the initial recommendation.	Student organisations need to be willing to incorporate such a project

3. Other recommended interventions on societal level that are separate from the course implementation

Objective	Strategy	Activities	Conditions
Increase knowledge of health care center abilities	Map number, capacity, and knowledge of health care centers	*What:* design a map of all health care centres in the different Niger Delta states, which provides information on the number of people the health care centre serves, the capacity of the health care centre (laboratory, number of practitioners, budget …) For who: people in the community By whom: ICC or collaboration with other organisation Where: Niger Delta states When: as soon as possible How: ICC would most probably need to go to the field to do this research, or they need someone else to do this research in the field for them.	The Niger Delta is marked with 'red' (do not travel) by the Ministry of Foreign Affairs, ICC needs safe conditions to be physically present in the Niger Delta
Ability to identify waterborne diseases of people	Find access to laboratories	*What:* the ability in laboratories to identify waterborne diseases via blood samples for typhoid, and via faecal	Tools and financing are needed to increase the ability of laboratories to

in communities		excretal disposal for diarrhoeal diseases (cholera and dysentery) For who: people in communities in the Niger Delta *By whom:* ICC, universities, health care centres *Where:* the Niger Delta *When:* always *How*: ICC should contact medical schools and healthcare centres to see what is already possible and could be increased, and what needs attention	identify waterborne diseases
Increase the capacity and quality of the existing Development ARC library	Usage of Development-ARC library	*What:* the Development ARC library can be used (more extensively) to increase knowledge of health care practitioners *For who:* health care practitioners (and possibly health care students) *By whom:* ICC *Where:* Development ARC library *When:* as soon as possible *How:* ICC collaborates with Dutch universities who donate books.	Maintenance of relationship between ICC and donating Dutch universities
Increase the quantity of libraries	Set up new collaborations with universities to place libraries like the Development ARC library	*What:* If there are more libraries (at other universities) more people (health care practitioners) can benefit from this For who: health care practitioners (and possibly health care students) By whom: ICC Where: Universities in the Niger Delta *When:* as soon as possible *How:* ICC should collaborate with all universities within the Niger Delta and set up a library similar to the existing Development ARC library.	Dutch universities have to be willing to donate books and knowledge.

Community level interventions

Other recommended interventions to possibly create even more impact

Objective	Strategy	Activities	Conditions
Free distribution of tools	If ICC does not have the capacity, ICC has to find a financer or free distributer	*What:* to distribute tools such as pamphlets, water treatment technologies, ORS, ICC has to find a financer *For who:* students and communities *By whom:* ICC *Where: To start with the local communities of the students interviewed* *When:* at the beginning of the course all tools need to be set to give out *How:* ICC has to get in touch with organisation that distribute these tools	Willingness of organisations to be a financer or distributer
Collaboration of ICC with other organisations (NGOs/IOs)		*What:* collaborating with existing organisations can facilitate the process. ICC should find people who can distribute knowledge, ways to distribute tools. *For who:* ICC *By whom:* ICC *Where:* in the Niger Delta and the Netherlands *When:* before the start of the course *How:* ICC has to use its existing network with organisations to get in touch with organisations and explain the proposal and project	
Higher knowledge and awareness	Trainings	*What:* Design trainings for local people (a committee) so they can increase the knowledge level of the whole	

level of WASH practices on community level		community on safe WASH practices *For who:* people in the community *By whom:* ICC *Where:* communities in the Niger Delta *When:* as soon as possible *How:* ICC should contact local NGOs, health care centres so they can provide trainings for the people in the communities.	
Do not re-invent the wheel and combine strengths	Increase use of existing committees in the Niger Delta	*What:* There are already 2530 existing WASH committees in Edo State and Delta State *For who:* people in communities *By whom: ICC* *Where:* Edo and Delta State *When:* as soon as possible *How:* ICC should get in touch with the existing committees and collaborate	The existing committees want to collaborate with ICC
Increase knowledge of religious leaders and religious groups	ICC should get in touch with important religious leaders and religious centres as a way to communicate the prevention and recognition of waterborne diseases	*What:* ICC can approach important religious leaders and centres to collaborate with to spread the message of the recognition and prevention of waterborne diseases in the Niger Delta region. When religious leaders are better informed of the situation of waterborne diseases in their communities, they can address these issues during their religious meetings with the local population. *For who: l*ocal community *By whom:* ICC and religious leaders *Where:* communities in the Niger Delta *When:* as soon as possible *How*: via the students network, ICC could get in touch with their religious leaders	There are enough religious leaders to work with.
Increase capacity of town hall meetings	ICC should get in touch with organisers of town hall meetings to communicate about prevention and recognition of waterborne diseases	*What:* Many communities organise town hall meetings these can be used for communicating about WASH practices *For who:* local community *By whom:* ICC and town hall organisers *Where:* communities in Niger Delta *When:* as soon as possible *How:* via the student network ICC can get in touch with town hall organisers	There are town hall meetings

Relationship level intervention

Objective	Strategy	Activities	Conditions
Identify waterborne disease infection cycle	ICC should undertake a research to understand the relationships people in communities have with each other. For example on family level to understand the infection cycle.	*What:* people can infect each other and some might be more in contact with diseases than others *For who:* people in the communities *By whom:* ICC *Where:* households in the Niger Delta *When:* as soon as possible *How:* a field research has to be undertaken to understand the relationship dynamic that contribute to the prevalence of waterborne diseases	The Niger Delta is marked with 'red' (do not travel) by the Ministry of Foreign Affairs, ICC needs safe conditions to be physically present in the Niger Delta

Other recommendation for ICC relating to this current project

Objective	Strategy	Activities	Conditions
Observations in the field communities living in the Niger Delta	ICC should go into the field (Niger Delta) to fill in the physical presence gap of this project and gather more information on current WASH practices in communities	*What:* physical presence can give more insight in the situation and WASH practices in communities *For who:* ICC *By whom:* ICC *Where:* Niger Delta communities *When:* as soon as possible *How:* by flight	The Niger Delta is marked with 'red' (do not travel) by the Ministry of Foreign Affairs, ICC needs safe conditions to be physically present in the Niger Delta

11. Bibliography

Abdu, A., Aboderin, A. O., Elusiyan, J. B., Kolawole, D. O., & Lamikanra, A. (2014). Serogroup distribution of Shigella in Ile-Ife, southwest Nigeria. *Tropical Gastroenterology*, *34*(3), 164-169.

Adagbada, A. O., Adesida, S. A., Nwaokorie, F. O., Niemogha, M. T., & Coker, A. O. (2012). Cholera epidemiology in Nigeria: an overview. *Pan African Medical Journal*, *12*(1).

Adebayo-Tayo, B. C., Onilude, A. A., & Etuk, F. I. (2011). Studies on microbiological, proximate mineral and heavy metal composition of freshwater snails from Niger Delta Creek in Nigeria. *AU Journal of Technology*, *14*(4).

Adehor, A. B., & Burrell, P. R. (2008). An Intelligent Decision Support System for the Prompt Diagnosis of Malaria and Typhoid Fever in the Malaria Belt of Africa. In IFIP International Conference on Artificial Intelligence in Theory and Practice (pp. 287-296). Springer, Boston, MA.

Agboola, O. P., & Elinwa, U. K. (2013). Accreditation of Engineering and Architectural Education in Nigeria: the way forward. Social and Behavioral Sciences, 2013, 83, 836 – 840. doi: 10.1016/j.sbspro.2013.06.157

Agrawal, V. K., & Bhalwar, R. (2009). Household water purification: Low-cost interventions. *Medical Journal Armed Forces India*, *65*(3), 260-263.

Akeju, D. O., Vidler, M., Oladapo, O. T., Sawchuck, D., Qureshi, R., von Dadelszen, P., Adetoro, O. O., Dada, O. A., & the CLIP Nigeria Feasibility Working Group (2016). Community perceptions of pre-eclampsia and eclampsia in Ogun State, Nigeria: a qualitative study. Reproductive Health, 13, 17-26. DOI 10.1186/s12978-016-0134-z

Akpabio, E. M. (2012). Water meanings, sanitation practices and hygiene behaviours in the cultural mirror: a perspective from Nigeria. *Journal of Water Sanitation and Hygiene for Development*, 2(3), 168-181.

Akpabio, E. M., & Subramanian, S. V. (2012). *Water supply and sanitation practices in Nigeria: applying local ecological knowledge to understand complexity* (No. 94). ZEF Working Paper Series.

Ali, M., Nelson, A. R., Lopez, A. L., & Sack, D. A. (2015). Updated global burden of cholera in endemic countries. *PLoS neglected tropical diseases*, *9*(6), e0003832.

Arnold, B. F., & Colford Jr, J. M. (2007). Treating water with chlorine at point-of-use to improve water quality and reduce child diarrhea in developing countries: a systematic review and meta-analysis. *The American journal of tropical medicine and hygiene*, *76*(2), 354-364.

ASAL (2016). *Communication Strategy and Field Implementation Plan for ASAL.* Retrieved on 15-06-2018 from http://www.umcasia.org/UserFiles/umc/file/ASAL%20Communication%20Strategy%20_addendum_UMC.pdf

Beaulieu, M., Breton, M. & Brousselle, A. (2018) Conceptualizing 20 years of engaged scholarship: A scopingreview. PLoS ONE 13(2): e0193201.https://doi.org/10.1371/journal.pone.0193201

Boyle, M. E., & Silver, I. (2005). Poverty, Partnerships, and Privilege: Elite Institutions and Community Empowerment. City & Community, 4. 3: 233-253. https://doi.org/10.1111/j.1540-6040.2005.00115.x

Brooks, R. (Ed). (2017). Student Politics and Protest: International Perspectives. Abingdon, Oxon, UK, and New York, NY: Routledge, 2017.

Brown, J., & Sobsey, M. D. (2012). Boiling as household water treatment in Cambodia: a longitudinal study of boiling practice and microbiological effectiveness. *The American journal of tropical medicine and hygiene*, *87*(3), 394-398.

Bruederle, A., & Hodler, R. (2017). The effect of oil spills on infant mortality: Evidence from Nigeria. *CEFISO Working Papers*.

Burns, J., Maughan-Brown, B., & Mouzinho, Â. (2017). Washing with Hope: Evidence from a hand-washing pilot study among children in South Africa. *A Southern Africa Labour and Development Research Unit Working Paper Number 199.*

Carlton, S. & Mills, C. E. (2017). The Student Volunteer Army: a 'repeat emergent' emergency response organisation. Disasters 41 (4): 764-787. https://doi.org/10.1111/disa.12225

CAWST. 2012. *Water, Sanitation and Hygiene Poster Set*. Retrieved on 05-222018, from https://resources.cawst.org/poster-set/f7050959/water-sanitation-and-hygiene-poster-set.

CDC. (2012). *Community Health Worker Training Materials for Cholera Prevention and Control*. Retrieved on 06-13-2018, from: https://www.cdc.gov/cholera/pdf/chw_trainingmaterialsforcholera_v2.pdf.

CDC (2013) Global Health - Nigeria - Why We Are Here. Retrieved on 29-05-2018 from https://www.cdc.gov/globalhealth/countries/nigeria/why/default.htm

CDC. (2014, May 02). *Safe Water System.* Retrieved on 06-20-2018, from Centers for Disease Control and Prevention: https://www.cdc.gov/safewater/flocculant-filtration.html.

CDC, (2018). Cholera - Vibrio cholerae infection. Retrieved on 29-05-2018 from https://www.cdc.gov/cholera/index.html

CDC, (n.d.) Retrieved on 20-06-2018 from https://www.cdc.gov/cholera/pdf/chw_trainingmaterialsforcholera_v2.pdf.

Centre for Affordable Water and Sanitation Technology (2011). *Water, Hygiene and Sanitation Presentation.* Retrieved on 20-06-2018 from https://giftofwater.org/wp-content/uploads/2016/08/WASH-Training-Guide-with-posters.pdf

Chen, Q., Acey, C. & Lara, J.J. (2014). Sustainable futures for Linden Village: A model for increasing social capita land the quality of life in an urban neighborhood. Sustainable Cities and Society, 2014, 14, 359-373. dx.doi.org/10.1016/j.scs.2014.03.0082210-6707/

Chukuezi, C. O. (2010). Food safety and hyienic practices of street food vendors in Owerri, Nigeria. *Studies in sociology of science, 1*(1), 50.

Chinwendu, O. (2008). *The fight against fake drugs by NAFDAC in Nigeria*. Royal tropical institute (KIT).

Clasen, T. F., Alexander, K. T., Sinclair, D., Boisson, S., Peletz, R., Chang, H. H., Majorin F. & Cairncross, S. (2015). Interventions to improve water quality for preventing diarrhoea. *The Cochrane Library*.

Colindres, R. E., Jain, S., Bowen, A., Mintz, E., & Domond, P. (2007). After the flood: an evaluation of in-home drinking water treatment with combined flocculant-disinfectant following Tropical Storm Jeanne—Gonaives, Haiti, 2004. *Journal of water and health*, *5*(3), 367-374.

Crump, J. A., Otieno, P. O., Slutsker, L., Keswick, B. H., Rosen, D. H., Hoekstra, R. M., Vulule, J.M. & Luby, S. P. (2005). Household based treatment of drinking water with flocculant-disinfectant for preventing diarrhoea in areas with turbid source water in rural western Kenya: cluster randomised controlled trial. *BMJ*, 331(7515), 478.

Cunha, B. A. (2004). Osler on typhoid fever: differentiating typhoid from typhus and malaria. Infectious disease clinics of North America, 18(1), 111-125.

Danish People's Aid (2017). *Evaluation of Citizens' Action on Water, Sanitation and Hygiene (CA-WASH) Project in Nakawa Municipality, Kampala Uganda.* Retrieved on 15-06-2018 from https://www.folkehjaelp.dk/wp-content/uploads/2017/09/CA-WASH-Evaluation_Final-report_juni-2017.pdf

Doughari, J. H., Elmahmood, A. M., & Nggada, H. P. (2007). Retrospective study on the antibiotic resistant pattern of Salmonella typhi from some clinical samples. African journal of microbiology Research, 1(3), 33-36.

Douglass, M. (1966). Purity and Danger. *An Analysis of Concepts of Pollution and Taboo*.

Dreibelbis, R., Winch, P. J., Leontsini, E., Hulland, K. R., Ram, P. K., Unicomb, L., & Luby, S. P. (2013). The integrated behavioural model for water, sanitation, and hygiene: a systematic review of behavioural models and a framework for designing and evaluating behaviour change interventions in infrastructure-restricted settings. *BMC public health*, *13*(1), 1015.

Edwards, R., & Holland, J. (2013). *What is qualitative interviewing?*. A&C Black.

EFSA Panel on Contaminants in the Food Chain (CONTAM). (2015). Risks for public health related to the presence of chlorate in food. *EFSA Journal*, *13*(6), 4135.

Ehiri, J. E., Azubuike, M. C., Ubbaonu, C. N., Anyanwu, E. C., Ibe, K. M., & Ogbonna, M. O. (2001). Critical control points of complementary food preparation and handling in eastern Nigeria. *Bulletin of the World Health Organization*, *79*(5), 423-433.

Ehwarieme, D. A. (2011). Multidrug resistant Salmonellae isolated from blood culture samples of suspected typoid patients in Warri, Nigeria. *African Journal of Clinical and experimental microbiology*, *12*(2).

Epskamp, K. (2006). *Theatre for development: An introduction to context, applications and training* (Vol. 1). New York: Zed Books.

Evans, P. B. (1977) 'Multinationals, State-Owned Corporations and the Transformation of Imperialism' Economic Development and Cultural Change, Vol. 26, No. 1, October, pp. 43-64.

Frynas, J. G. (2000) Oil in Nigeria. Hamburg: LIT VERLAG.

Gasa, N. (2000). Democracy in Nigeria: continuing dialogue (s) for nation-building. International Institute for Democracy and Electoral Assistance, Stockholm, Sweden

Global Handwashing (2017a). *About Global Handwashing Day.* Retrieved on 13-06-2018 from https://globalhandwashing.org/global-handwashing-day/about-ghd/

Global Handwashing (2017b). *United Purpose & PZ Cussons celebrate Global Handwashing Day 2017 in Nigeria.* Retreived on 13/06/2018 from https://globalhandwashing.org/global-handwashing-day/get-involved/submit-events/view-events/united-purpose-pz-cussons-celebrate-global-handwashing-day-2017-in-nigeria/

Gore, C. and Pratten, D. (2003) 'The Politics of Plunder: The Rhetoric of Order and Disorder in Southern Nigeria', African Affairs, 102: pp. 211-240.

Graf, J., Meierhofer, R., Wegelin, M., & Mosler, H. J. (2008). Water disinfection and hygiene behaviour in an urban slum in Kenya: impact on childhood diarrhoea and influence of beliefs. *International journal of environmental health research, 18*(5), 335-355.

Grugel, J. (2002) Democratization: A Critical Introduction. New York: Palgrave.

Guillen, L. and Zeichner, K. (2018). A University-Community Partnership in Teacher Education From the Perspectives of Community-Based Teacher Educators. Journal of Teacher Education, 69 (2): 140-153. http://journals.sagepub.com/doi/10.1177/0022487117751133

Gush, C. (2017). The Intsomi Project: using a communicative ecology approach to create literacy activists. Journal for New Generation Sciences, 15 (1): 94-107. http://hdl.handle.net/10520/EJC-c85848577

Hakanen, A., Kotilainen, P., Huovinen, P., Helenius, H., & Siitonen, A. (2001). Reduced fluoroquinolone susceptibility in Salmonella enterica serotypes in travelers returning from Southeast Asia. *Emerging infectious diseases*, *7*(6), 996.

Halvorson, S. J., Williams, A. L., Ba, S., & Dunkel, F. V. (2011). Water quality and waterborne disease in the Niger River Inland Delta, Mali: a study of local knowledge and response. *Health & place*, *17*(2), 449-457.

Hashi, A., Kumie, A., & Gasana, J. (2017). Hand washing with soap and WASH educational intervention reduces under-five childhood diarrhoea incidence in Jigjiga District, Eastern Ethiopia: A community-based cluster randomized controlled trial. *Preventive medicine reports*, *6*, 361-368.

Heri, S., & Mosler, H. J. (2008). Factors affecting the diffusion of solar water disinfection: a field study in Bolivia. *Health Education & Behavior, 35*(4), 541-560.

Hellweger, F. L., & Masopust, P. (2008). Investigating the Fate and Transport of Escherichia coli in the Charles River, Boston, Using High□Resolution Observation and Modeling. *JAWRA Journal of the American Water Resources Association*, *44*(2), 509-522.

House, S., & Reed, B. (2004). *Emergency water sources: Guidelines for selection and treatment*. WEDC, Loughborough University.

Howard, G., Bogh, C., Goldstein, G., Morgan J., Prüss, A., Shaw, R. & Teuto, J. (2002, pp. 97-102). *Healthy villages, Establishing committees for implementing Healthy Villages Programmes*. World health organization. Geneva.

Ibekwe, A. C., Okonko, I. O., Onunkwo, A. U., Donbraye, E., Babalola, E. T., & Onoja, B. A. (2008). Baseline Salmonella agglutinin titres in apparently healthy freshmen in Awka, South Eastern, Nigeria. *Scientific Research and Essays*, *3*(9), 425-430.

ICC-EDU (2018). Retrieved on 23-05-2018 from http://icc-edu.nl/about-us/

IFRC. (2008). *Household water treatment and safe storage in emergencies, a field manual for Red Cross/Red Crescent personnel and volunteers.*Geneva: International Federation of Red Cross and Red Crescent Societies.

Joseph, R. (1987) Democracy and Prebendal Politics in Nigeria: The Rise and Fall of the Second Republic. Cambridge: Cambridge University Press.

Jung, J. (2011) "Assessing learning from a student community engagement project", Education + Training, Vol. 53 Issue: 2/3, pp.155-165, https://doi.org/10.1108/00400911111115690

Juran, L., & MacDonald, M. C. (2014). An assessment of boiling as a method of household water treatment in South India. *Journal of water and health*, *12*(4), 791-802.

Kidgell, C., Reichard, U., Wain, J., Linz, B., Torpdahl, M., Dougan, G., & Achtman, M. (2002). Salmonella typhi, the causative agent of typhoid fever, is approximately 50,000 years old. *Infection, Genetics and Evolution*, *2*(1), 39-45.

Kolk, A. and Lenfant, F. (2013). Multinationals, CSR and Partnerships in Central African Conflict Countries. Corporate Social Responsibility and Environmental Management, 20: 43-54. DOI: 10.1002/csr

Kraemer, S. M., & Mosler, H. J. (2010). Persuasion factors influencing the decision to use sustainable household water treatment. *International Journal of Environmental Health Research, 20*(1), 61-79.

Kuru, A. (2002) 'The Rentier State Model and Central Asian Studies: The Turkmen Case'. Alternatives: Turkish Journal of International Relations, 1/1, pp. 51-71.

Lantagne, D. S., Quick, R., & Mintz, E. D. (2006). Household water treatment and safe: storage options in developing countries. *Navig.*, 17-38.

Laverack, G., & Huy Dap, D. (2003). Transforming information, education and communication in Vietnam. *Health Education*, *103*(6), 363-369.

Lazzerini, M., & Ronfani, L. (2011). Oral zinc for treating diarrhoea in children. *Sao Paulo Medical Journal*, *129*(2), 118-119.

Le Billon, P. (2017). Resource Curse? Governmentality, Oil and Power in the Niger Delta, Nigeria. In *The Geopolitics of Resource Wars* (pp. 56-86). Routledge.

Lewis, O. (1966). The Culture of Poverty. *Scientific American*, 215(4). 19-25. https://www-jstor-org.ezproxy.library.wur.nl/stable/24931078

Mboera, L.E.G., Rumshia, S.F., Senkoro, K.P., Mayala, B.K., Shayo, E.H. & Kisinza, WN. Knowledge and Health Information Communication in Tanzania. *East African Journal of Public Health, 4*(1), 33-39.

McNall, M., Reed, C.S., Brown, R. et al. Innov High Educ (2009) 33: 317. https://doi.org/10.1007/s10755-008-9086-8

Mondiale de la Santé, O., & WHO. (2018). Weekly Epidemiological Record, 2017, vol. 93, 01 [Full issue]. *Weekly Epidemiological Record= Relevé épidémiologique hebdomadaire*, *93*(1), 1-8.

Moore, T. L. (2014). “Community-University Engagemenet: A Process for Building Democratic Communities”, ASHE Higher Education Report, 40:2. DOI:10.1002/aehe.20014

MSF. (2018) Cholera. Retrieved on 29-05-2018 from http://www.msf.org/en/diseases/cholera

Mweu, E., & English, M. (2008). Typhoid fever in children in Africa. Tropical Medicine & International Health, 13(4), 532-540.

UNDP Nigeria, (2006). Niger Delta human development report. *Abuja: UNDP*.

Nizame, F. A., Leontsini, E., Luby, S. P., Nuruzzaman, M., Parveen, S., Winch, P. J., Ram, P.K. & Unicomb, L. (2016). Hygiene practices during food preparation in rural Bangladesh: opportunities to improve the impact of Handwashing interventions. *The American journal of tropical medicine and hygiene*, *95*(2), 288-297.

NUC (2018a). Retrieved 06-25-2018, from http://nuc.edu.ng/about-us/

NUC (2018b). Retrieved 06-25-2018 from http://nuc.edu.ng/2224-2/

Nwidu, L. L., Oveh, B., Okoriye, T., & Vaikosen, N. A. (2008). Assesment of the water quality and prevalence of water borne diseases in Amassoma, Niger Delta, Nigeria. *African Journal of Biotechnology*, *7*(17).

Ochiai, R. L., Acosta, C. J., Danovaro-Holliday, M., Baiqing, D., Bhattacharya, S. K., Agtini, M. D., Bhuttav, Z.A., Canh, D.G., Ali, M., Shin, S., Wain, J., Page, A-L., Albert, M.J., Farrar, J., Abu-Elyazeed, R.A., Pang., Galindo, C.M., Seidlein, L. von & Clemens, J.D. (2008). A study of typhoid fever in five Asian countries: disease burden and implications for controls. *Bulletin of the world health organization*, *86*(4), 260-268.

Odiegwu, M. (2017, December 22). African students take medical rhapsody to Dickson's community. The Nation. Retrieved on 06-04-2018 from http://thenationonlineng.net/african-students-take-medical-rhapsody-dicksons-community/

Okeke, I. N., Laxminarayan, R., Bhutta, Z. A., Duse, A. G., Jenkins, P., O'Brien, T. F., Pablos-Mendez, A. & Klugman, K. P. (2005). Antimicrobial resistance in developing countries. Part I: recent trends and current status. *The Lancet infectious diseases*, *5*(8), 481-493.

Olawoyin, R., Oyewole, S. A., & Grayson, R. L. (2012). Potential risk effect from elevated levels of soil heavy metals on human health in the Niger delta. *Ecotoxicology and environmental safety*, *85*, 120-130.

Olopoenia, L. A., & King, A. L. (2000). Widal agglutination test− 100 years later: still plagued by controversy. *Postgraduate medical journal*, *76*(892), 80-84.

Ordinioha, B., & Brisibe, S. (2013). The human health implications of crude oil spills in the Niger delta, Nigeria: An interpretation of published studies. *Nigerian medical journal: journal of the Nigeria Medical Association, 54*(1), 10.

Papagrigorakis, M. J., Yapijakis, C., Synodinos, P. N., & Baziotopoulou-Valavani, E. (2006). DNA examination of ancient dental pulp incriminates typhoid fever as a probable cause of the Plague of Athens. International Journal of Infectious Diseases, 10(3), 206-214.

Partners for Development (2016). *2016 Annual Report.* Retrieved on 15-06-2018 from http://pfd.org/wp-content/uploads/Partners-for-Development-2016-Annual-Report.pdf

Petersen, T. M., Rifai, H. S., Suarez, M. P., & Stein, A. R. (2005). Bacteria loads from point and nonpoint sources in an urban watershed. *Journal of Environmental Engineering*, *131*(10), 1414-1425.

Pérez-Vidal, A., Diaz-Gómez, J., Castellanos-Rozo, J., & Usaquen-Perilla, O. L. (2016). Long-term evaluation of the performance of four point-of-use water filters. *Water research*, *98*, 176-182.

Practical Action (2016). *Celebrating sanitation month.* Retrieved 13-06-2018 from https://practicalaction.org/blog/news/campaigns/celebrating-sanitation-month/comment-page-1/

Reller, M. E., Mendoza, C. E., Lopez, M. B., Alvarez, M., Hoekstra, R. M., Olson, C. A., Baier, K.G., Keswick, B.H. & Luby, S. P. (2003). A randomized controlled trial of household-based flocculant-disinfectant drinking water treatment for diarrhea prevention in rural Guatemala. *The American Journal of Tropical Medicine and Hygiene*, *69*(4), 411-419.

Rossi, L. (2014). Report on The Nutrition and Health Situation of Nigeria. Retrieved on 12-06-2018 from www.nigerianstat.gov.ng

Saltmarsh, J. , Giles, D. E., Ward, E. and Buglione, S. M. (2009), Rewarding community□ engaged scholarship. New Directions for Higher Education, 2009: 25-35. doi:10.1002/he.355

Showler, A. J., & Boggild, A. K. (2013). Entamoeba histolytica. *Canadian Medical Association Journal*, *185*(12), 1064-1064.

Skat Foundation. (2018). [TAF] Technology Applicability Framework. Retrieved on 06-06-2018, from: https://technologyapplicability.wordpress.com.

Small, M. L., Harding, D. J., & Lamont, M. (2010). Reconsidering culture and poverty. *The Annals of the American Academy of Political and Social Science, 629*, pp. 6-27

Smith, S., Bamidele, M., Goodluck, H., Fowora, M., Omonigbehin, E., Oper, B., & Aboaba, O. (2009). Antimicrobial susceptibilities of Salmonellae isolated from food handlers and Cattle in Lagos, Nigeria. *International Journal of Health Research*, *2*(2).

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. *Environmental science & technology*, *42*(12), 4261-4267.

Sriram, A., & Maheswari, U. (2013). Integrated communication strategy for creating awareness on sanitation and hygiene behavior change. *International Journal of Communication and Health*, *14*, 1.

Stakeholder Democracy (2018). *The Niger Delta.* Retrieved on 28-05-2018 from https://www.stakeholderdemocracy.org/about-the-niger-delta/

Stauber, C. E., Kominek, B., Liang, K. R., Osman, M. K., & Sobsey, M. D. (2012). Evaluation of the impact of the plastic BioSand filter on health and drinking water quality in rural Tamale, Ghana. *International journal of environmental research and public health*, *9*(11), 3806-3823.

Stauber, C. E., Printy, E. R., McCarty, F. A., Liang, K. R., & Sobsey, M. D. (2011). Cluster randomized controlled trial of the plastic biosand water filter in Cambodia. *Environmental science & technology*, 46(2), 722-728.

Tamunobereton-ari, I., Uko, E. D., & Horsfall, O. I. (2013). Correlational analysis of sewage disposal methods and incidence rates of typhoid fever and cholera in Port Harcourt metropolis, Nigeria. Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS), 4(1), 16-23.

Tega, M. (2018, April 28th). Breaking: NDU Suspend Students' Union Activities Indefinitely. Myscholarshipsgist. Retrieved on 06-13-2018 from https://www.myscholarshipgist.com/ndu-suspend-students-union-activities/

Tiwari, S. S. K., Schmidt, W. P., Darby, J., Kariuki, Z. G., & Jenkins, M. W. (2009). Intermittent slow sand filtration for preventing diarrhoea among children in Kenyan households using unimproved water sources: randomized controlled trial. *Tropical Medicine & International Health*, *14*(11), 1374-1382.

Todd, E. C., Greig, J. D., Bartleson, C. A., & Michaels, B. S. (2009). Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 6. Transmission and survival of pathogens in the food processing and preparation environment. *Journal of Food Protection*, *72*(1), 202-219.

Turner & Terisa (1978) 'Commercial Capitalism and the 1975 Coup'. K. Panter-Brick (ed.) Soldiers and Oil: The Political Transformation of Nigeria. London: Frank Cass.

Udo, S. M., & Eja, M. E. (2004). Prevalence and antibiotic resistant Shigellae among primary school children in urban Calabar, Nigeria. *Asia Pacific Journal of Public Health*, *16*(1), 41-44.

UNICEF. (2011). *Water, Sanitation and hygiene for schoolchildren in emergencies. A guidebook for teachers*. New York: Unicef.

UNICEF. (2013). Cholera toolkit. *New York: UNICEF*.

UNICEF (2018) Diarrhoeal Disease - UNICEF DATA. Retrieved on 20-06-2018 from https://data.unicef.org/topic/child-health/diarrhoeal-disease/

UNICEF Kenya (2016). *End of Programme Evaluation - UNICEF Kenya WASH Programme 2008-2014 LRFP-9120544-2015. End of Programme Evaluation Report Final Report.* Retrieved on 15-06-2018 from https://www.unicef.org/evaldatabase/files/UNICEF_Kenya_WASH-evaluation-report-final_with_TORs_Kenya_2016-014.pdf

UNICEF Liberia (2012). *Communication Strategy on Water, Sanitation & Hygiene for Diarrhoea & Cholera Prevention.* Retrieved on 15-06-2018 from https://www.unicef.org/cbsc/files/WASH-Cholera-Diarrhoea_Comms_Strategy_2012_.pdf

UNICEF Malawi (2016). *Evaluation of the Water and Sanitation (WASH) Programme in Malawi (2007-2013).* Retrieved on 15-06-2018 from https://www.unicef.org/evaldatabase/files/Evaluation_of__Malawi_WASH_Programme_Malawi_2016-001.pdf

UNICEF Philippines & Luis Gatmaitan (2014) The F diagram showing pathways of fecal-oral disease transmission Retrieved on 28-05-2018 from https://www.flickr.com/photos/gtzecosan/17125224489/in/set-72157648282032913)

Van Halem, D., Van der Laan, H., Heijman, S. G. J., Van Dijk, J. C., & Amy, G. L. (2009). Assessing the sustainability of the silver-impregnated ceramic pot filter for low-cost household drinking water treatment. *Physics and Chemistry of the Earth, Parts A/B/C*, 34(1-2), 36-42.

VON (2018). *Nigerian Government unveils $10bn investment initiative for N-Delta.* Retrieved on 28-05-2018 from https://www.von.gov.ng/nigeria-government-unveils-10bn-investment-initiative-n-delta/

Wabwire, J. (2013). The role of community radio in development of the rural poor. New media and Mass Communication (Online), 44-45.

WASHplus (2013). *WASHplus Behaviour Change Strategy: Hygiene Promotion Guidelines for Bangladesh.* Retrieved on 15-06-2018 from http://www.washplus.org/sites/default/files/bangladesh-behavior_change.pdf

WASHplus (2016). *Assessing Water, Sanitation, and Hygiene (WASH) in Southwestern Bangladesh. Project Compilation Report April 2012-March 2016.* Retrieved on 15-06-2018 from http://www.washplus.org/sites/default/files/Bangladesh%20EOP%20Report.pdf

Wasiu, J., Akintayo, C. O., & Popoola, O. O. (2014). Review on prevalence of waterborne diseases in Nigeria. Journal of Advancement in Medical and Life Sciences, 1(2), 1-3.

WaterAid, (2016) Nigeria's sanitation crisis 2016 World Toilet Day Nigeria supplement, Compiled by Oluseyi Abdulmalik Reviewed by Tolani Busari & Michael Ojo. Retreived from: https://washmatters.wateraid.org/publications/nigerias-sanitation-crisis-world-toilet-day-supplement-2016

WHO (2006). Oral rehydration salts: Production of the new ORS.

WHO (2007). *Combating waterborne diseases at the household level.* Geneva: WHO Document Production Services.

WHO (2017). *Atlas of the African Health Statistics*. Retrieved on 4-06-2018 from http://file:///C:/Users/Sara/Documents/school/WUR/ACT/altas%20of%20health%20Africa.pdf

WHO (2018a). *The Ecological Framework.* Retrieved on 06-01-2018 from http://www.who.int/violenceprevention/approach/ecology/en/

WHO (2018b) Typhoid. Retrieved on 05-28-2018 from http://www.who.int/immunization/diseases/typhoid/en/

WHO (2018c). What is multidrug-resistant tuberculosis (MDR-TB) and how do we control it?, Retrieved on 13-06-2018 from http://www.who.int/features/qa/79/en/

WHO (2018d). WHO recommends use of first typhoid conjugate vaccine. Retrieved on 13-06-2018 from http://www.who.int/immunization/newsroom/press/who_recommends_use_first_typhoid_conjugate_vaccine/en/

WHO (2018e). Diarrhoeal disease, key facts. Retrieved on 29-05-2018 from http://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease

WHO (2018f), Cholera , retrieved on 06-07-2018 from http://www.who.int/en/news-room/fact-sheets/detail/cholera

WHO & UNICEF. (2012). *A toolkit for monitoring and evaluating household water treatment and safe storage programmes*. Geneva: WHO.

WHO/UNICEF Joint Water Supply, & Sanitation Monitoring Programme. (2015). *Progress on sanitation and drinking water: 2015 update and MDG assessment*. World Health Organization.

Williams, P., & Berkley, J. A., (2016). Dysentery (Shigellosis) current WHO guidelines and the WHO essential medicine list for children. Retrieved on 13-06-2018 from http://www.who.int/selection_medicines/committees/expert/21/applications/s6_paed_antibiotics_appendix5_dysentery.pdf

World Bank; Otoo, S., Agapitova, N. & Behrens, J. (2009). *The capacity development results framework: A strategic and results-oriented approach to learning for capacity development*. Available at: http://siteresources.worldbank.org/CSO/Resources/228716136924154503 4/The_Capacity_Development_Results_Framework.pdf

World Bank (2013). "World Development Indicators 2013." Washington, D.C.: World Bank. http://data.worldbank.org/data-catalog/world-development-indicators Accessed at June 22, 2018

World Bank (2018). Population Growth (annual %). retrieved on 28-05-2018 from https://data.worldbank.org/indicator/SP.POP.GROW on June 20, 2018

WSSSRP (2010). *WASH (Water, Sanitation & Hygiene) Communication Strategy.* Retrieved on 15-06-2018 from http://wsssrp.org/wp-content/uploads/2016/02/WASH-Communication-Strategy.pdf

Wur study guide (2018). Retrieved 06-26-2018, from https://ssc.wur.nl/Studiegids/2016/Vak/YMC-60809

Zaki, S. A., & Karande, S. (2011). Multidrug-resistant typhoid fever: a review. *The Journal of Infection in Developing Countries*, *5*(05), 324-337.

12. Appendices

Appendix A. Interview Guide

Explain our project and who we are
Mention that it is important to just be honest because this way we can find the best fitting solution for your situation. There are no right or wrong answers. The interview will be anonymously processed in the project.

General questions

1) Is it okay if we record this conversation (if you want to record the conversation)
2) What is the name of your hometown and in which state? (spelled out)
3) How often do you go back to your hometown?
4) How big is your community?

Questions about local context in general

5) What is your network like in your community? → how many people do you know, do people know you?
6) How would you describe your local community / How is the local community connected?
7) Do you think there are differences between ethnic groups? / are there inequalities within the community? (If they do not talk about women/girls ask, '' Do you think there needs to be more emphasis on women and children during interventions?''
8) Are there health care centres closeby?

Water situation and diseases

9) How do people use water? (e.g. drinking, food preparation, sanitation, hand washing, bathing, laundry, playing (children))
10) Do people have access, and how (e.g. in their homes (pipelines), supermarket, wells, toilets?)why not (e.g. too expensive, community pit is too far away?)
    a) Where do people get their water from (e.g rivers, ponds, leaking pipes, tanks and wells)? Are these sources damaged or contaminated to the best of their knowledge?
11) Do people have access to water, and how (e.g. in their homes (pipelines), supermarket, wells, toilets?)why not (e.g. too expensive, community pit is too far away?)
12) Are you aware if waterborne diseases are present in your community? Do you know which ones are most present?
    a) If yes, Do you know if all people in your community are aware like you are?
13) What do you think are the most important causes of waterborne diseases in your community?
14) What do you think are ways that waterborne diseases spread in your community?
15) What do you think are good ways to prevent waterborne diseases in your community?
16) How do you recognize the symptoms of waterborne diseases in your community?
17) What do you do if someone has symptoms of waterborne diseases?
18) Do you know if the (local) government is involved in prevention of waterborne diseases?
19) Are there epidemiological data on waterborne diseases available in the universities?

<u>Methods of communicating information about waterborne diseases and treatment that fits into daily lives</u>

20) Do you know if projects relating to WASH are going on in your hometown? By whom/which organisations?
    a) Do these projects also take place in local schools (e.g. curriculum)?
        i) What do children learn concerning hygiene?
    2) Are there local community WASH committees in your area?

a) If yes: What do they do, is it useful/effective?
b) If no: Do you think committees can be effective?

3) Are trainings and workshops relating to WASH given in your community?

21) Are there already communication tools implemented that discuss the promotion, prevention and treatment of hygiene practices relating to waterborne diseases? If they do not understand give examples: you can think of posters, wall paintings, radio/television spots, SMS..
    a) If yes, ask how these are implemented/executed and if they think it is fitting for their community context. If no, ask what could be done better and why?
    b) if no, ask what type of communication tools he/she thinks are useful in the Niger Delta context (give examples)
22) Does your community celebrate days that advocate good WASH? Such as the Global Handwashing day?
23) Is there communication about other diseases such as AIDS or Ebola and how is this communicated? Would those strategies work with waterborne diseases? Why (not)?
24) Are there people in your community that are involved in being advocates for prevention of waterborne diseases?
    a) E.g. religious leaders
    b) Teachers
25) Is there access to internet connection, cellphones and radio/television?
    a) Is this the same for all community members?
26) Would you be willing to be a (key) advocate to transfer knowledge you got at University about waterborne diseases, to your hometown? What would this look like? And how would you keep it sustainable? Active (e.g. start committees/trainings) / passive (hand out flyers).
    a) Do you think your university would be open to exploring the possibilities to include projects in the curriculum in which students become advocates in their hometowns?

Prevention methods regarding direct contact with water (point-of -use water treatment, safe storage and handwashing with soap)

27) Are there practical barriers to perform good WASH practices?
    a) Examples are not enough clean water, soap, technologies
    b) If yes, do you have an idea of how you could tackle availability and accessibility issues to these practical tools?
28) Is there a demand/need for a certain kind of technology? (e.g. soap, tippy tap, well, pit)
29) Is there supply? If so is this accessible? If accessible, do people purchase and use it? If not accessible, would people want to have access? What are barriers to access of prevention methods? (e.g. filters, soap)?
30) Do you think the population would be willing to pay for (new) (e.g. filters, soap)?
31) Are there any practical prevention methods already available?
    a) Do people know how to use the prevention methods that are already available (this is a barrier if the answer is no)
    b) Do you think the already existing prevention method is suitable for the local context / culture?
32) How frequently are WASH practices performed?
    a) e.g. need to wash hands after latrine use, playing outside (children),
    b) use filters, sun disinfection, chlorine
33) What do the students think would be the best prevention method that is applicable is this context (or a combination)?

34) Do you have any remarks or questions about the interview?
    a) no? -- then these were all the questions

Appendix B. Overview of interview respondent participants

Interviewee	Gender	State	Community size	# go home
Student 1	Female	Edo state	1,000 inhabitants	2/3 times a year, during holiday
Student 2	Male	Edo State	700,000 inhabitants	2 times a year, during holiday
Student 3	Male	Bayelsa State	250,000 inhabitants	14 times a year, holiday and weekends
Student 4	Male	Akwa Ibom State	480,000 inhabitants	20 times a year, holiday and weekends
Student 5	Male	River State	222,000 inhabitants	16/17 times a year, holiday and weekends
Student 6	Male	Delta State	260,000 inhabitants	During holidays
Student 7	Male	Cross River State	190,000 inhabitants	12/14 times a year
Student 8	Male	Bayelsa State	5,000 inhabitants	During holidays
Student 9 (via text messaging)	Male	Delta State	3,000 inhabitants	5 times a year during holidays
Local NGO director	Male	Imo State	-	-
Dutch thesis student	Female	Total Niger Delta region	-	-

Appendix C. Overview of best practices communication strategies

Country	Year	Organisation	Project description	Communication strategy to empower local population	Impact and feasibility
Liberia	2012	UNICEF	Communication Strategy on Water, Sanitation & Hygiene for Diarrhoea & Cholera Preventions created a framework to contribute to behaviour change among communities and families in Liberia	1. *Communication for promoting social and behavioural change among families and communities:* radio/television spots on WASH, positive and motivational to address knowledge gaps an increase self-efficacy; radio soap based on entertainment-education, a weekly 52 episode; cellular service providers, SMS; outdoor media, wall paintings, posters, pamphlets; video clubs; community drama; town criers; beauty parlours talk to customers about WASH; gospel/popular singers about WASH themes; communication through health professionals, teachers; working with children, community influencers, religious leaders, food and water vendors; showcasing of positive deviance at community level. 2. *Communication for creating a positive programme and policy environment*: advocacy through media, celebrities, policy makers, county/district administrators/relevant authorities for WASH, partners such as NGOs, market owners/vendor associations; sensitization/training of County/District Level staff; setting up/strengthening coordination mechanisms for health promotion at National/County and District level. 3. *Communication for ensuring community participation and ownership*: rapport building with the community; participatory community needs assessment; development of community work plan; capacity building; formation of a community level committee on WASH; ensuring community participation in the rollout; creating new social norms; engaging women.	Because this project provides a framework rather than a carried out project there is no impact and feasibility. However, the report elaborates on how to monitor and evaluate when using this approach.
Malawi	2007-2013	UNICEF	The UNICEF project in Malawi (2007-2013) was focused on the provision of safe drinking water, hygiene practices, advocacy and capacity building among communities, centres and schools, with an emphasis on women and children. It was implemented through NGOs and the local government.	A communication strategy to empower the local population was training and capacity building and increasing awareness. Capacity building needs to be properly and clearly designed, as this will also add to the sustainability of interventions like hand pumps. Key stakeholders need to be engaged through the process, especially schools and health centres, as they can in turn train other children/people and WASH practices are supported at community level. There is no elaborate explanation on	There were improvements in hygiene and health in schools and villages. There was a reduced waterborne disease incidence. It also promoted rural education, especially among girls.The handwashing practices impact is

				the strategies.	weak because of unavailability of soap and other facilities for both schools and households. This project achieved good impact on water availability, but the health impact could have been bigger if there was more emphasis on hygiene promotion. It did not leave effective community structures, and the committees at local level were likely to disappear.
Kenya	2008-2014	UNICEF	The UNICEF Kenya programme was an integrated WASH project to bring safe and sustainable sources of drinking water and hygienic sanitation.	New water development;Rehabilitation of existing schemes; School WASH; Health facilities WASH; Household sanitation; Hygiene education promotion;Institutional capacity building.	The impact had effect on economic, social and knowledge, attitude, and practice components. These were visible in the behaviour change. Health got better, there was more time, better incomes, strong sense of dignity and enabled individuals widened their worldview and created broader visions for life.
Nigeria	2010	Water Supply and Sanitation Sector Reform Programme (WSSSRP)	The WASH Communication Strategy in Nigeria report focuses on promoting WASH practices with appropriate methods, supporting communities and increasing the capacity of locals and other stakeholder such as the government.	Activities to communicate about good WASH on community level (hygiene and sanitation promoters, community members, teachers, and school children) were: design and producement of posters, handbills, pamphlets and banners in the local acceptable language and expressions; scheduling of capacity building workshops, town hall meetings and interactive sessions; the design of media messages such as radio and television about risk and prevention practices; involvement of religious leaders and groups to advocate, preach, and model on the benefits of good WASH practices (through interactive sessions and town hall meetings), promotion of teaching WASH components in school curriculum to ensure children understand the basic	No report was found that discussed the impact and feasibility

				principles of hygiene and can become advocates; create clubs in school so children can participate in behaviour change activities both within the school and wider community.	
WASHplus	Bangladesh	2010-2015	The WASHplus project in Bangladesh (2012-2016) aimed to address underlying causes of inadequate WASH conditions. A baseline report showed that there was almost universal access to tube wells, but there were still high rates of diarrhoea (19%). One of the main objectives of the project was capacity building at the local and district level.	WASHplus trained 386 community volunteers to support project activities by encouraging households to adopt small but doable WASH behaviours. The promoters and outreach workers negotiate these small doable action using techniques to help overcome barriers for WASH practice. Activities at school were aimed at building management capacity skills at community level to ensure facilities are maintained over time. Partner non-governmental organisations (PGNOs) worked with teachers and management committees to manage school-based WASH facilities as well as spreading proper hygiene behaviours and messages in school. To support community volunteers and teacher messaging efforts, WASHplus encouraged participation in events (Sanitation Month and Global Handwashing Day).	At present, community people, through media publicity or discussions and rallies organized by different government and NGOs, have learned that it is necessary to wash hands with soap or ash before and after eating and after defecation. Community people maintain and repair household tube wells according to the knowledge acquired through a WATSAN committee. http://www.washplus.org/sites/default/files/bangladesh-baseline_final.pdf
Danish People's Aid	2017	Uganda	The Danish People's Aid project aimed to contribute to increased local community engagement and duty bearer's responsiveness for better WASH services in Uganda. It was a participatory project to bridge ''the gap in government service delivery through resource provision, capacity building, advocacy, policy influencing and implementation reinforced by best practices of community participation and involvement'' (pp. iv).	The activities held relating to ICE were trainings for personal empowerment, review meetings, radio programmes, materials: posters, board, playing cards, dialogue meetings, forum theatre use, formation of school advocacy clubs, training of children in WASH rights, trainings with duty bearers (local councillors).	The project achieved an improved capacity to work together at ward and division levels, committees that were set up function. Waterborne diseases such as cholera, diarrhoeal, typhoid and dysentery decreased. The part of capacity building seems to be sustainable because the activities carried out have a low cost. Committees can ensure that empowered members will continue, even when funding stops. Partnering with with other organisations made it possible to

					provide water purifiers and accessible water borne toilets.
Ahmedabad Sanitation Action Lab (ASAL)	2014-2017		Ahmedabad Sanitation Action Lab (ASAL) held a three year (2014-2017) action research to find innovative solutions to school sanitation and sanitation issues in slums and slum like settlements in India. But because often there is a focus on constructions and lesser on behaviour change they created a campaign based on motivations of the priority groups.	They created communication strategies for schools and communities. For both mass media campaigns were used to create awareness on different aspects of WASH behaviour and practice (e.g. proper and regular use of toilet, hand washing, stop open defecation, break myth about menstrual hygiene). Activities and tools for this are wall paintings, use of social media and SMS campaign, workshops and student theatre performances, communication on sanitation through folk songs, celebrating WASH related days, hands on demonstration workshops, leaflets and posters created by NGOs. The communication strategy was based in successful implementation worldwide (ASAL, 2016).	No report was found that discussed the impact and feasibility

Appendix D Source to find posters and pamphlets and one example poster

There are many examples to visualize transmission routes of diseases. An example of a poster is shown in figure 19.

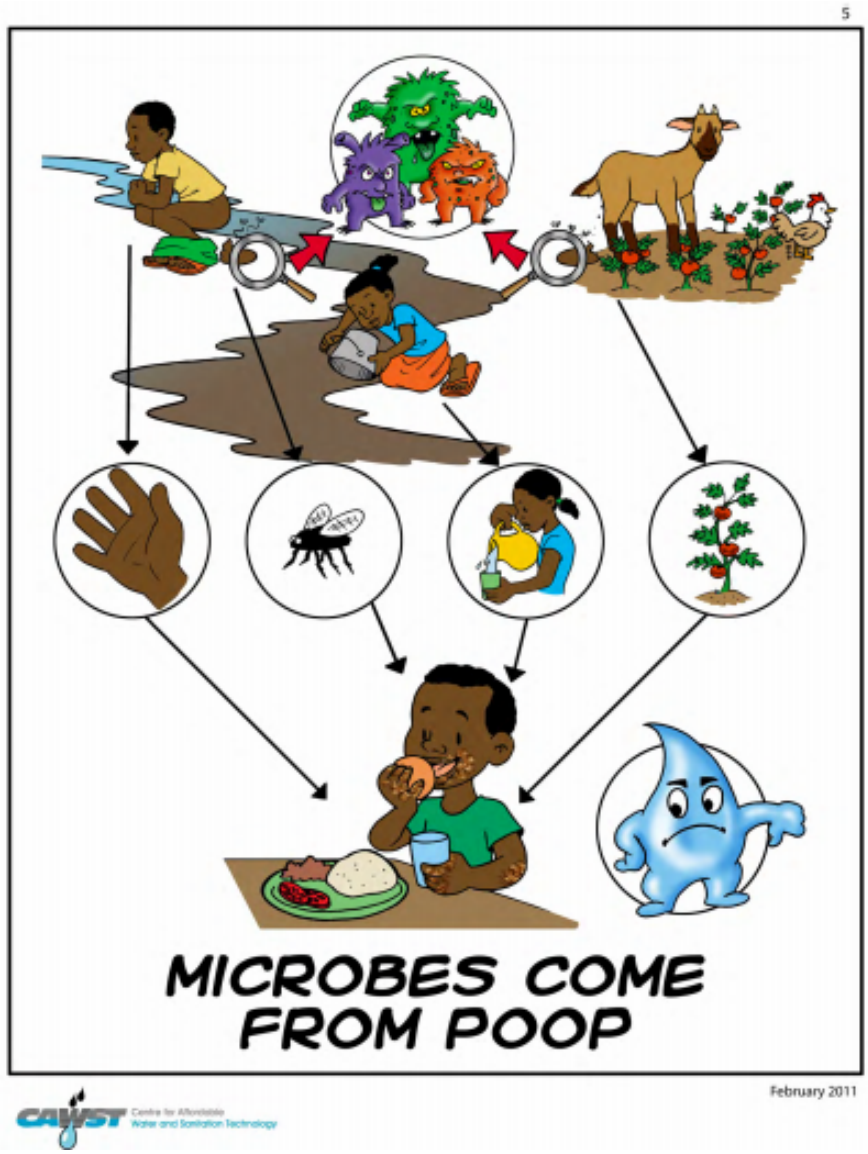


Figure 19. Faecal-oral transmission route of waterborne diseases (Centre for Affordable Water and Sanitation Technology, 2011)

Other examples can be found in Centre for Affordable Water and Sanitation Technology (2011): Centre for Affordable Water and Sanitation Technology (2011). *Water, Hygiene and Sanitation Presentation.* Retrieved on 20-06-2018 from https://giftofwater.org/wp-content/uploads/2016/08/WASH-Training-Guide-with-posters.pdf

Appendix E. Detailed Discussion

Methodology

The scope of this ACT project did not allow physical presence in the Niger Delta area. In order to compensate for this to the best of our abilities, semi-structured interviews were conducted with students from six universities in the Niger Delta to overview the current situation and to gain information on the current practises, local knowledge and contextual factors concerning waterborne diseases in the Niger Delta. However, there are some limitations to this project and its execution.

Due to the short time and poor internet connection, only nine interviews could be conducted with the students, of which only one was a female student. All together, this made it difficult to make a clear view the general knowledge level of students of the Niger Delta state universities. The students are not representative for the population in the Niger Delta, as students can only enter university if they can financially afford it. Also, the general knowledge level of university students is assumed to be higher compared to the general population. Finally, the students most likely have a different socio-economic background than their constituency, e.g. the students are able to read while they have stated that the illiteracy-rate is generally high. This needs to be taken into account when when implementing the interventions.

A private conversation was not guaranteed during the interviews, because students could hear each other doing interviews and therefore it must be considered that they could have been influenced by each other's answers. Also, the context in which the interviews were conducted must be considered as a possible factor affecting the outcome. Students were answering the questions via someone else's phone. At times when the students did not fully understand the question (due to the inadequate connection), it could be heard by the interviewers that they were conferring to the owner of the phone and discuss together what the possible answer could be. Furthermore, it is not known who selected the students and on which criteria the interviewed students were selected, and how students were informed about the interview. Therefore, it cannot be excluded that the context could have provoked suggestive answering.

As was briefly mentioned, the poor quality of internet connection did not allow to conduct interviews over skype. Not being able to see the interviewees is a limitation of the used method (WhatsApp calling), as this does not allow non-verbal interpretation, potentially introducing bias during interpretation of the answers. The ninth interview that was conducted ended preliminary due to bad internet connection.

A different pronunciation of English and different choice of words, together with a limited internet connected sometimes made it hard to understand the interviewed students. It is also possible that there is a different interpretation of words (e.g. hygiene) between Nigerians versus the Dutch and Belgians. Questions and answers can therefore be interpreted in different ways from both sides. It cannot be excluded that cultural differences were overlooked when conducting the interviews, or that some discussed topics like sanitation are still taboo and therefore could have evoked suggestive answering. The interviewers didn't ask question about menstruation for this same reason. Therefore, no data on this topic could be collected.

To get a broader view on the situation in the Niger Delta, additional interviews were conducted with a local NGO and a Dutch student who did her thesis in the Niger Delta. These two additional informants provided information about the local context.

WASH practices

There is limited data on current water, sanitation and hygiene practices in the Niger Delta. In order to make an estimation of the current situation, a combination of literature study and interviews was performed. The literature that was used to analyse the WASH practices was only applied to Akwa Ibom state, but the students were from other states as well, thus the project was able to provide a more general overall picture.

Pathology

Due to lack of specific data on the prevalence, incidence and mortality of waterborne diseases in the Niger Delta region, emails were sent to INGOs (Red Cross - Dutch and international, MSF - Dutch, United Kingdom and international, Oxfam - Dutch and international, Save the Children -

Dutch). However, no INGOs could provide sufficient data of waterborne diseases in the Niger Delta. None of these organisations are currently active in the Niger Delta region, and none of them provided us with data from previous projects. Existing data is scarce, from different years, places and only limited amount of places were reported per health care centre. This makes is hard to get a clear views on the severity and progress in time as well as geographic differences and doesn't allow to get an accurate view on the current situation.

Technology interventions

None of the articles used in the analyse HWTS analysis researched the effectiveness of the treatment methods regarding typhoid fever. Most studies measured the presence of *E. coli* or bacteria in general, and field studies looked at reductions in the presence of *E. coli* and the occurrence of diarrhoeal diseases. The studies only mentioned diarrhoeal diseases, this encompasses cholera and dysentery but both were not explicitly mentioned. It can therefore not be stated with certainty that the methods discussed in this project will tackle all problems with typhoid fever, cholera and dysentery.

Several studies have shown that choosing the right type of technology depends on several factors. Amongst others, it is important to take community preferences, availability and affordability of the methods and the quality of untreated water into account. The Niger Delta area covers nine states and houses about 30 million people, and it was beyond the scope of this project to identify the factors for each community. If it is preferred to determine beforehand which method would be most effective and feasible in a community, the TAF and TIP frameworks can be used to determine this.

It was beyond the scope of this project to look at interventions that do not take place at the household level. This had as a result that an important prevention method, safe excreta disposal, was thus not discussed. The project took the contaminated water as a context factor, and the treatment methods that were discussed are able to largely overcome the issue of contaminated water.

Each of the methods discussed, requires that individuals perform certain actions to properly use one of the treatment methods. Training, monitoring & evaluation is required to ensure behaviour change and correct, sustainable use of the treatment method. However, during the interviews it was determined that some treatment methods are already used by the households, (e.g. the use of alum to decrease the turbidity of water). To overcome the difficulty of behaviour change to some extent, already used treatment methods can be incorporated into the trainings.

Communication strategies

In the result section, a best practice analysis was done, while simultaneously applying this the context of the Niger Delta with the information gained from the interviews with students from universities in the Niger Delta. Due to time limitations of the project, it was not possible to conduct a systematic best practice analysis. Out of all of the strategies, a selection can be made of what could possibly be effective and feasible for students of the universities and communities in the Niger Delta. As situations differ per community in the Niger Delta, the Niger Delta context is not limited to one situation. Therefore, it is difficult to apply the best practise analysis completely to a general Niger Delta context. Moreover, not all reports had impact or effectiveness or feasibility outcomes.

Setting up the communication methods for a development project in the Niger Delta needs multiple aspects. In the end, capacity building should be the outcome, and this can be done with a combination of multiple methods. Firstly, the students in the student network need to be trained by the university about the prevention and recognition of waterborne diseases, secondly they need to be trained to become ‘’expert’’ advocates. The students are willing to become active in such a project. The second step in this communication strategy is that students bring back their new knowledge and skills to their communities in the Niger Delta. They can then start to spread awareness and knowledge. It is important that this is done in a proper way, so it can become sustainable (UNICEF Malawi, 2016). Committees are a key method to involve community members. The Niger Delta often has leaders (e.g. religious) which are important for creating awareness, and students are convinced a committee can be effective. Students can initiate the committee, without actually being in the committee itself, as they are not always present in their community because they go to university somewhere else. For everything that is

done, follow-up and monitoring should be done to understand if the people involved and the people who are influenced by the intervention are still satisfied, if usage of technologies and hygiene practices is still done correctly (International Federation of Red Cross and Red Crescent Societies, 2008). Additionally, educational and promotional efforts need to be positive. It has to be clear, tasteful, focused on good health, affordable and easy of use (WHO, 2007).

Collaboration with student network

The student network of ICC is the cornerstone of this project. The interviewed students indicated to be willing to serve as advocates in the education and communication of waterborne diseases to their local communities. Additionally, they indicated their universities would be willing to support projects on education of waterborne diseases. However, due to the limited timespan of this project, no direct contact with the universersities was made to confirm their willingness to be engaged in training students.

Furthermore, as the National Universities Commission (NUC) has saying in the universities' curricula, their permission is needed to integrate the project into the universities' curricula. Therefore, their approval or disapproval can impact the entire project. Including trainings in the curriculum would be a sustainable way to transfer knowledge over generations, making lasting impact. If the NUC would not approve, the trainings could be organised by student associations. Enthousiast students can introduce a positive impact which potentially can have lasting influences. Every implementation needs evaluation to monitor effectiveness and to strive for improvement over time.

General

A possible limitation of this entire project is that it is difficult to reach the ones who live in somewhat inaccessible areas, the ones who most likely need the interventions the most. To use the student network may be the most convenient way to reach those people, as the areas are very difficult to reach and outsiders may not have a way in. The programme reaches students who come from the creeks to the university, and when they return they provide a way to to reach those who live remote.

The implementation of this programme has a high chance of succeeding, due to the use of the ecological framework. The comprehension of this framework has lead to a bottom-up approach and provided a more complete picture of the situation, instead of focussing solely on the technological interventions.

This project has aimed to provide the ICC with a strategy to empower the local population to recognise and prevent infections with waterborne diseases. The suggested approach is to set up a course within the universities' curricula. The students in turn can then empower their communities. The setting up of this programme and the provision of treatment and communication interventions will require financing. It is unknown to the consultancy team whether the ICC has the capacity to finance the trainings and interventions. If ICC is unable to finance this programme themselves, this can be overcome if the ICC finds other financial backers for the implementation of the programme.

Finally, the programme will be implemented in the Niger Delta, an area with a complex political situation, where oil spills occur and militants also have influence. When implementing the programme, this complicated context should be taken into consideration.

Further research

Students have told the interviewers that people go to hospitals or health centres when symptoms occur, while simultaneously they have stated that there is a shortage of health centres in the region. The symptoms of the different diseases are similar, and in order to diagnose the disease, laboratory equipment is necessary. Further research in the area is necessary to investigate where the health care centres are, and what equipment they posses to determine the cause of illness.

A more complete intervention can take place if the sanitation level is also included. The *Cholera Toolkit* (UNICEF, 2013) can be used as a starting point, but before this can properly be included in the trainings, further research needs to be done to discover the local sanitation practices in each specific area, and methods to overcome open defecation in general. Additionally, to adapt

the trainings to each specific area, more research needs to be done to determine the local practices concerning water, sanitation and hygiene.

The methods discussed have aimed to prevent infections from direct contact with water. There are other methods to prevent outbreaks, such as safe care of the dead and safe menstrual hygiene practices. Further research in these areas are also necessary to create a more complete overview of how people can become infected and what they can do to prevent this. This can then also be included in the trainings, if research has proven this to be necessary.