The introduction of a water filter in rural Malawi:

An analysis of changing drinking water practices

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Preface

First of all, I would like to thank the CCAP SMART Centre team, and especially Rianne and Reinier Veldman, for making me feel at home in Malawi. My stay in Malawi, and particularly in Livuwu, was a whole new experience for me. While adjusting to a new culture, the SMART Centre team was there for me when I needed them. I am also grateful to the Temwa team for helping me practice my interviews and making me one of the team during visits in Usisya. Most thankful am I for the help of my translator Ruth Mhone. We had our ups and downs, but in the end we worked together as a team and this research could not have been conducted without her. Staying together in Livuwu we encountered many obstacles, for example crossing a crocodile river every day, but I am proud of Ruth that she concurred her fears and helped me day after day.

Special thanks goes to my supervisor Bas van Vliet. Thank you for providing me with valuable feedback and motivating words during our meetings every two weeks. Finally, I would like to thank my father. We spent several afternoons together discussing this research and structuring my thoughts.

Abstract

Many people in the remote area of Usisya in Malawi drink water straight from Lake Malawi and the Livuwu river. This water is highly contaminated and this has serious consequences for people's health. After the Cholera outbreak of 2015, two local NGOs decided to introduce a water, sanitation and hygiene (WASH) project in the village of Livuwu. Using a practice-based approach, this study examines the changes in drinking water practices after the introduction of the Safi T9 table top filter and the sustainability of these practices. The results are based on 79 interviews with inhabitants of Livuwu and 2 expert interviews. Conceptualisation of the water filter as an artefact, using the theory of social construction of technology (SCOT), gives insights into the design process of the filter and implementation of the project. This study links the expectations embodied in the water filter to the researched changes in drinking water practices. This linkage has provided useful information for development organisations when creating new WASH projects. Results show that the design phase of the project was mainly expert driven. The Malawian context was taken into account which resulted in a well-designed filter: easy to use, pleasant taste and smell, and a good appearance. In the subsequent phases of the project users were involved. The involvement of users in these phases resulted in additional knowledge about the water source that could be taken into consideration when preparing the introduction of the water filter. However, the NGOs did not respond to some major suggestions of villagers during the implementation phase because they were out of scope or forgotten - and this impacted the project negatively and therefore the sustainability of the drinking water practices in Livuwu.

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Abbreviations

DHS   Demographic Household Survey

HSA   Health Surveillance Assistant

HWTS   Household Water Treatment and Safe storage

NGO   Non-Government Organization

SCOT   Social Construction of Technology

SODIS   Solar Disinfection

SWS   Safe Water System

WASH   Water, Sanitation and Hygiene

WHO   World Health Organization

Introduction

More than 40 percent of people around the world are affected by water scarcity and nearly 1,000 children die each day due to preventable water and sanitation-related diseases. These are only two of the many alarming facts that the United Nations Development Programme share on their website to explain the need for Sustainable Development Goal 6: clean water and sanitation (Progress towards the Sustainable Development Goals, 2017). Access to clean water is a severe global problem - nearly 2.1 people lack the access to safe drinking water, putting them in risk for diseases (Water and Sanitation USAID, 2018). Malawi is an example of a country with many people suffering and dying from waterborne diseases. This African country is ranked one of the poorest countries in the world on the Human Development Index (Human Development Index, 2015). In 2010 the DHS showed that the under-five mortality rate was 112/1,000 live births (Schlanger, 2012), and approximately 18% of under-five children had suffered an episode of diarrhoea in the two weeks prior to the survey. The transmission of diarrhoea and other diseases like cholera, dysentery and hepatitis A is directly linked to contaminated water and poor sanitation (Rijsdijk & Mkwambisi, 2016).

Many different Non-Governmental Organisations (NGOs) contribute to the national efforts of the Malawian government to improve the quality of water through health programs. Safe water projects are often part of a larger Water Sanitation and Hygiene (WASH) programme. These programmes focus on these three aspects - improving sanitation, providing safe drinking water and effective hygiene education (Rijnsdijk & Mkwambisi, 2016). Most research concerning these projects is focused upon the direct influence on health. Additionally, when evaluating projects, the design process of the artefact, and the proposal process of the project are rarely taken into account. To shed a different light on the evaluation of WASH projects, it is important to zoom in on the design process of the project and the new technology that is being introduced. If one understands these processes, the expected influence can be understood. The researched influence of the project can be linked back to the design phase, and recommendations can be made for possible adjustments. To research the influence of a project, many studies analyse personal motives and attitudes towards the usage of a new technology. Explaining behavioural change based on individual actions and choices neglects the social structures in which human beings move (Maller, 2015).

Therefore, I propose to analyse the influence of a WASH project by zooming in on the change in practices. A practice approach takes into account both human agency and social structures. In the field of health, the use of a social practice perspective is not very common. However, Maller (2015) argues for a social practice approach when researching health issues. She explains in her research that 'viewed from the outside by other disciplines public health is often lauded as being highly successful in regard to changing individual behaviours to produce positive outcomes, namely reductions in rates of illness and disease' (p.5). She criticizes this narrow theoretical framing of behaviour, because it derives from rationalist choice models and it reduces what people do to conscious choices and largely ignores the complexities of daily life. By using social practice theory, social environments (context) are also included and it eliminates the idea that individuals are solely responsible for their own health status.

Researching the influence of a WASH project by zooming in on changed practices will be applied in the context of the WASH pilot project in Livuwu, Northern Malawi. Two NGOs, the CCAP SMART Centre and Temwa, have implemented this project in January 2017, by introducing a water filter into the village of Livuwu. This project will be the case study to research the influence of this new technology - to research the changes in drinking water practices.

Another important aspect of development projects is the sustainability. Sustainability in this thesis refers to long-term duration. Investing in the sustainability of a project is of great importance to prevent it from abandonment. It still often happens that after the deliverables have been distributed to the user for whom the project has been undertaken, the project closes, after a few years these deliverables fail and will be abandoned (Okereke, 2017). Researching the sustainability of this project can possibly be linked back again to the design processes, which can create a better understanding of possible failures, or successes.

Research goal

The aim of this study is to explore whether and how drinking water practices have changed after the introduction of a WASH project and if these changes are sustainable. In search for possible explanations for these changes, the design process of the water filter and the project development process are analysed to identify possible linkages. NGOs or other relevant stakeholders might be able to learn from these results when creating and implementing WASH projects. From an academic perspective, this thesis aims to contribute to the relatively small body of research on WASH project implementation. Furthermore, it is

the intention to show how theories of social practice and social construction of technology can be integrated and how each of these theories can serve as an analytical tool to understand behaviour change.

Research questions

This study seeks to answer the following question:

What are the influences of a ceramic candle water filter on drinking water practices after the implementation of a WASH project, and what explanations for these influences can be given?

The following sub-questions are developed to answer the main question above, and have been divided into three themes:

Theoretical questions

What added benefit does the application of social practice theory bring to the analysis of behaviour change?

What added benefit does the conceptualization of the water filter, using the theory of social construction of technology, have?

Empirical questions

How can the drinking water practices before the introduction of the WASH project be described?

Which social relevant groups are involved in the development of the filter and what role do they play?

Which factors influenced the decision making processes regarding the design of the water filter and the project proposal?

How have drinking water practices changed after the implementation of the WASH project?

What factors explaining the changes of drinking water practices, can be retraced to the design process of the water filter and the proposal process of the project, respectively?

Which aspects of the water filter project can be improved in order to make the practices more sustainable?

Outline

The next chapter will outline the conceptual framework for this research, explaining the different theories that are part of the approach that will be taken in this thesis and the most important concepts. Following this chapter, the methodological chapter describes the research design, the methods used during my fieldwork, and how the acquired data is analysed. After these chapters, three empirical and analytical chapters follow. Chapter 4 goes into the history of drinking water practices in Livuwu - a description of these practices step by step before the introduction of the water filter. This is followed by the chapter 'unravelling the black box of the water filter', in which I analyse the design process of the water filter using the social construction of technology. Subsequently, the proposal -and implementation process of the project are examined in order to understand the possible influence. The last empirical chapter zooms in on the drinking water practices after the introduction of the WASH project into Livuwu - how do these practices change, and are these changes sustainable? This chapter is followed by a discussion of the key theoretical and practical issues encountered during this research. Finally, in the conclusion the link between the fifth and sixth chapter will be made, and therefore answering the research questions of this study.

2. Conceptual framework

This chapter answers the theoretical questions of this research. Social practice theory is introduced, as well as the relevance of this approach for this study and the link to change. Additionally, the social construction of technology and its three research steps are explained. This conceptual framework will be concluded with the operationalisation of these theories within the research. Using both these approaches gives the opportunity to analyse the influence of the water filter project. This influence will become visible in the changes in practices, and the conceptualization of the water filter gives us the opportunity to link these changes back to the design process of the filter and the project.

2.1 Social practice theory

Following Nicolini (2012) I choose not to define social practice theory. There are so many different practice theories and no unified practice approach. For that reason, I could choose to select one of these and use in this study, but this would narrow my view and as Nicolini puts it: 'this would amount to a sort of betrayal of the ethos of most practice approaches which strive to make the world richer' (p.10). Therefore, I choose to combine different theories. This is possible because the theories are all connected based upon their similarities (p.10). Nicolini mentions several elements that are often discussed by authors explaining practice theory. I will not go into detail about all these elements, but some examples of these elements are the understanding that practices are mutually connected and constitute a network, practices cannot be understood without the reference to a specific place, time and historical context, and the idea the practices are social accomplishments. Because of all these similarities, social practices theories can be combined to enrich the understanding of the practice (p. 215). In this conceptual framework I will introduce several approaches to social practice theory and argue which approach is appropriate for this study.

What connects all these theories of practice is the unit of analysis: the practice. This is different from the dominant way of theorising human activity based on individual attitudes and behaviour (Shove, 2010). Practice theory takes into account the 'context' of behaviour: it focuses on the actual doings of the practitioner, which includes the materials and artefacts constituting an activity, but also the motivations and reasons for an individual to perform the practice (Spaargaren et al., 2016). This way, the theory bridges the divide between human actors and social structures (Shove et al., 2012). In this perspective, human beings are the carriers and informants of the practices. They reproduce these practices drawing upon sets of virtual rules and resources which are connected to situated social practices (Spaargaren,

2011). In other words, by repeatedly performing a practice, the practice keeps on existing. The actors are able to perform these practices because they are familiar with the sets of rules and resources essential for the practice. The emphasis of the practice is on the shared behavioural routines - therefore practices instead of individuals become the unit of analysis.

2.1.1 Three elements - Shove

The types of elements that constitute a social practice are *materials, competences* and *meanings*. Materials indicate things, technologies, the body itself, infrastructures and other physical entities. Competence is know-how, skills and technique; and meaning includes values, aspirations, ideas and symbolic meaning (Shove et al., 2012).

An example will show that each practice consists of these three elements. For example, field-hockey: this practice includes materials (stick, ball), competences (the ability of the players to dribble, shoot the ball) and meaning (the emotional engagement of the players, the rules in the field). However, the existence of the three elements does not necessarily lead to the practice of field-hockey. The practice only exists when the elements are integrated - when they are combined.

The combination of these elements figures as an entity: the practice can be spoken about, and drawn upon as a set of resources when 'doing' field-hockey. Practices also exist as performances: through the performance, the practice becomes visible. This way the practice of field-hockey becomes visible in the performance: players in the field who use their sticks (material) to hit the ball (competences), while following the rules of the game (meaning). In short, a practice as an entity provides the 'pattern', that is filled out and reproduced by the practice as a performance. Field-hockey as a practice continues to exist over time because of the endless re-enactments of the combination of elements of which the practice is composed (Shove et al., 2012)

2.1.2 Zooming-in and Zooming-out - Nicolini

Spaargaren et al. (2016) take Shove as an example of a researcher, next to Schatzki, who explain social practice theory based on a flat ontology. This implies that the social is being approached as one of a kind - there are no levels which represent different dynamics of social change. Often practice theorists study everyday life; 'small' social phenomena. In the case of Shove, Spaargaren et al. (2016) use her examples about 'doing the laundry, taking a shower and going for a Nordic walk, as an example of these small social phenomena. However, Shove is also one of the theorists who is now aiming to invent other concepts that can include the 'large' phenomena in practice theory. Schatkzi and Nicolini are two other

theorists who try to find out what 'small' is and what 'large' is in social practice theory, working with the fact that it is 'ontologically inadequate to distinguish between different levels or layers within the social' (Spaargaren et al., 2016:12).

Nicolini introduces the idea of 'zooming in' and 'zooming-out'. *Zooming in* on a practice refers to taking a closer look at the doings and sayings of a specific practice, and as a researcher getting engaged and understand the details of the practice (Nicolini, 2012). He mentions different strategies to zoom in. One of these implies that practice is always involved with the lived-in body, and through the body materiality enters the practice. Investigation of materials and artefacts used in a practice, and the influence of relationships between practices is therefore necessary when zooming-in (Nicolini, 2012:224). The meaning practitioners attach to a certain practice and the knowledge needed to perform the practice are also mentioned in several of the possible ways to zoom-in on a practice. These match with the three elements a practice consists of explained above: meaning, materials and competence. Therefore, in this study, *zooming in* on practices will entail identifying these three elements mentioned.

However, a practice does not exist in isolation, but daily life consists of different related practices: the practice of doing groceries is, for example, often related to the practice of cooking. Looking at this totality of connected practices is Nicolini's way of *zooming-out*. Through zooming out it becomes possible to understand how a specific practice relates to relevant contextual variables. Nicolini stresses the necessity of zooming-out by explaining that practice can only be studied relationally and understood as 'part of a nexus of connections' (Nicolini, 2012:229). The introduction of the water filter in Livuwu will have an influence on a variety of practices - and these practices might be linked together. In this thesis, the interconnectedness of the practices linked to the water filter will be examined. To explore this, questions posed by Nicolini can be useful: 'How is the practice under consideration causally and materially connected with other practices?' and 'Which other practices affect, constraint, conflict, interfere, etc., with the practice under consideration?'.

Zooming-out thus helps to create a better idea of the 'wider picture': 'an understanding of the association between practices and how they are kept together'. But one can keep on zooming-out and provide a wider picture. Nicolini explains that stopping to zoom-out is constrained by practical circumstances of the research and if one can provide a convincing explanation to the research question. This research concentrates on practices directly related to the introduction of the water filter. This choice is made in order to keep a clear focus and because of limited time.

2.1.3 A new contextual approach - Spaargaren

Instead of zooming-in or zooming-out, Spaargaren (2003) argues for a contextual approach: 'a conceptual model that combines a focus on the central role of human agency with proper treatment of the equally important role of social structure' (p. 687) - this social practices model combines small and larger phenomena. When placing practices in the middle of agency and structure, Spaargaren introduces two concepts: *'lifestyle'* and '*system of provision*' (see Figure 1). This figure shows that the social practices are surrounded by 'knowledgeable and capable agents' and their lifestyle on the one side, and on the other side by the rules and resources these agents make use of: the system of provision.

He argues that lifestyle can be seen as the connection between the narratives of self-identity and the diverse set of practices we engage in. For example, a person might identify as adventurous - having an adventurous lifestyle - because he/she practices climbing, bungee jumping and snowboarding. In this example the practices of climbing, bungee jumping and snowboarding are bundled together in a 'narrative about oneself'. Lifestyle and practices are linked both ways: a lifestyle has an influence on certain practices, and the other way around is it possible for social practices to change a form of lifestyle as new practices are adopted or current practices change. It is possible that an actor's lifestyle conflicts with the actual behaviour. Individuals can state it is their intention to behave following certain values, a certain lifestyle, but act against these rules (p.689). To operationalise *lifestyle* one can concentrate on the elements that form a lifestyle and influence the interaction with a social practice: underlying reasons, interests, motives and values and beliefs human agents adhere to (Spaargaren et al. 2006).

Spaargaren eliminates social structure as an external variable and brings it into the analysis by adding a focus on the system of provision: actors 'make use of the possibilities offered to them in the context of specific systems of provision'. (Spaargaren, 2003:688). These are sets of rules and resources (structures) that enable (instead of constrain) agents to carry out their practices: they apply these rules and make use of the resources. Accordingly, the agent and his/her practices are influenced by the system of provision - by doing this, they reproduce the system (Spaargaren et al., 2006). Therefore, the arrows in Figure 1 should go both ways.
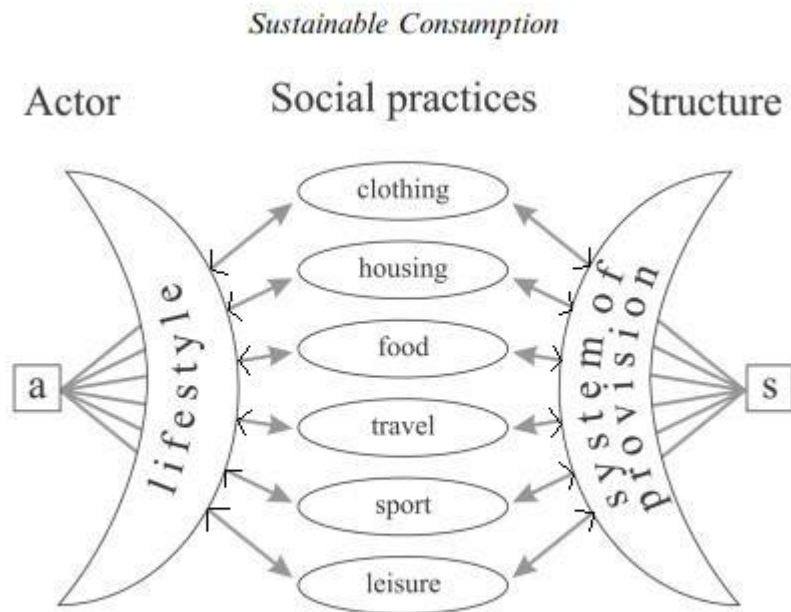
Sustainable Consumption

FIGURE 1 The social practices model.

Figure 1 Adapted from Spaargaren 2003

2.1.4 Changing practices

In this study we focus on the change of social practices. When discussing change, Nicolini (2012) emphasizes several factors. First of all, it is important to know the *history* of a practice. The history of a practice takes into account all three elements; the material, competences and meanings, as a whole. We should focus on the change of these elements over time. In order to do this in Livuwu, information on the history of drinking water practices is based on the baseline, half year evaluation and an interview with Temwa's senior project officer. The 79 inhabitants were also interviewed on their water drinking practices before the introduction of the water filter - the combination of this data should provide an understanding of the history of water drinking practices in Livuwu.

Moreover, it is also valuable to investigate how a practice has influenced other practices at a specific location, because practices are historically and culturally bound: the way elements are integrated and practices are linked, is different for each setting (Shove and Pantzar, 2005). Additionally, by researching how the practices are linked and influenced by each other, one can follow the path of change.

Hence, the source of change and stability is - according to social practice theory - to be found in the elements of the social practices and the way these are linked to each other. Social practices always hold the potential for change. This change can be the result of the

introduction of, for example, a new technology, or new knowledge. If people adapt this new technology, we can analyse the practices to identify possible behavioural change (Shove et al., 2012). In this study we will research the change after the introduction of a new technology: the water filter. Research shows that the provision of a new technology on its own is no guarantee for change - the effective use of the technology and a change in meanings and competences respectively, can lead to a change in practice (Shove & Pantzar, 2005). Additionally, a change in one practice might lead to changes in another practice: in everyday life a practitioner performs several practices which will often share equal elements. For example a new technology, as the material element of a practice, can belong to different practices at the same time and therefore transfer change between practices (Warde, 2005).

In 2014, Blue et al. conducted a research into the unhealthy practice of smoking. They found that a change in practice is also related to the demands of a certain practice. 'The structuring of opportunities and access to requisite elements' is not random: unequal social distribution has an effect on the possibility to practice healthy practices (p. 41). Social inequalities become clear in the practice: which practices do or don't social groups become carriers of. Within Livuwu, social inequality could possibly also influence the practice of drinking water.

This section discussed the benefits of applying a social practice in this study. The changes in drinking water practices after the implementation of the water filter project will be analysed using this approach. In order to understand these changes and provide recommendations for future projects, these changes should be linked to the composition of the project. Therefore, it is of importance to zoom in on the water filter that is introduced in Livuwu, conceptualize the filter as an artefact, and examine the expected consequences of its introduction. In the next section I will answer the second theoretical question of this research: 'What added benefit does the conceptualization of the water filter, using the social construction of technology, have?'

2.2 Theorizing technology - The Social Construction of Technology (SCOT)

2.2.1 Introducing SCOT

The Safi water filter that was introduced in Livuwu is a new technology that should be theorized in order to understand its influence; the success of the water filter also depends on

how, by whom, with which intentions etc. the water filter was introduced into the village. This can be linked to the idea of Spaargaren (2003) of the system of provision: the water filter is introduced into Livuwu as part of a system of provision. But before one can theorize, the concept of technology should be defined. Technology is often viewed as simple materialism, but there are many more possibilities to scrutinize technology since artefacts are never separated from 'human desires, needs and passions' (Braudel in Matthewman, 2011:9). Matthewman (2011) summarizes the different ways in which technology can be defined as objects, activities, knowledge, and modes of organization or sociotechnical systems - there is no single definition. Similar, there is not one approach to theorizing technology. Technology has been theorized in three broad ways:

- By privileging technology (anti-humanist approach or technological determinism)
- By privileging society (humanist approach or social constructionism)
- By privileging neither technology nor society (post humanist approach)

In this chapter these three schools will not be further analysed, but following Matthewman (2011) I distillate the most important issues that these schools teach us: one should be mindful of ownership, control, access, use and unintended consequences of technology. This research takes on a social constructionism perspective (the idea that technology does not determine human action, but the other way around) and therefore investigates the ways in which social groups construct technological objects. This is because we are interested in uncovering how the water filter was constructed by different social groups. The Social Construction of Technology (SCOT) is a theory that was mainly developed to deal with the design stage of technologies (Kline and Pinch, 1996) and thinks of innovation as non-linear, contingent and multidirectional: 'Invention is the result of contestation and negotiation between the relevant social groups that shape technology' (Bijker, 1987; Bijker,1992 in Matthewman, 2011:94). Instead of being interested in what technology exactly is, and what it entails, Bijker explains that SCOT concentrates on 'the making, use and study of technology''. SCOT shows that we should open up the black box of technology. By doing this and looking at the social world, SCOT can help us understand the reasons why the water filter is being accepted or rejected. Because it is the social world - particular social groups and stakeholders - that defines what is successful (Klein & Kleinman, 2002). Therefore it is not sufficient to state that a technology is 'good' - it should be accessed who defines this technology as good and how 'good' is defined to begin with.

SCOT also provides research steps - a methodology - to analyse the causes of a technological success or failure. These steps can be used to analyse the design process of

the water filter and understand how this technology became. The three steps and the concepts they include are explained in the next section.

2.2.2 Three research steps

SCOT's aim is to create a theoretical model which accounts for technological change and stability, for actors and structures. The unit of analysis is the singular artefact (technical system) - this way the analysis is not only technological but also institutional, social, economic and political. SCOT uses several concepts in when analysing the design process of technological artefact. In the following three steps mentioned by Bijker (2010), the concepts and their role in the analysis will be explained.

1. Identify *relevant social groups.* The key question that needs to be answered in this first step is: which social groups define a problem with an artefact?

Different social groups are connected to the same artefact and decide and define problems: 'a problem is defined as such only when there is a social group that constitutes a problem' (Bijker et al. 1987, in Matthewman, 2011:96). Different interpretations of an artefact thus result in different problems and therefore different solutions. Pinch and Bijker (1987) also state that all members of a social group share the same set of ideas attached to a specific artefact. I believe this undermines the individual agency, and follow Klein and Kleinman (2002) who explain that within these different social groups, people also have different meanings; they have to get together and negotiate the artefact design and this development process will continue until every individual comes to a common agreement on the artefact (this already links to step 2).

Many different relevant social groups can be identified, but Humphreys (2005) divides these into four groups: producers, advocates, users and bystanders. Producers are engineers, designers, marketers, and financial investors - those who have a direct relationship with technology and develop the artefact. The advocates are policymakers and lobbyists - those who are indirectly related to technology. The third group are the users: this group talks about, buys and uses the artefact; they have a direct and individual relationship with the technology. Finally, bystanders: neighbours, family members and friends. In the *Operationalisation* section it will be discussed how to use these in research.

2. Technology achieves *closure* and *stability*. The key question that needs to be answered in the second research step is: how is closure achieved?

The relevant groups identified in step 1 all have different meanings concerning the artefact, this is called *interpretative flexibility.* In Matthewman (2011) Bijker (1995) explains this concept with an example of the development of the bicycle. One step of this development was the design of the tire. When the air tire was developed, many people were satisfied because this meant a more convenient mode of transportation, however others focused on the traction problems or ugly aesthetics. This shows that there are different groups with different meanings. What should be prioritized? Traction or aesthetics?

Besides these different meanings within the groups, there are also different ways in which the technologies can be constructed: *design flexibility.* The different relevant groups in different societies construct different problems, which leads to different designs. A particular design of a technology reflects the interpretations of the relevant groups. Over time, as different technologies are developed, interpretative flexibility and design flexibility diminish and reach *closure*: all members of the different social groups come to a common agreement on the artefact. This happens through *closure mechanisms*, for example *rhetorical closure*; a declaration is made that the artefact is approved and the need for alternative design diminishes. Another closure mechanism is *closure by redefinition:* When problems are not solved, they can be redefined and cease to exist (Klein and Kleinman, 2002). When using the example of the air tires again, it becomes clear how the latter mechanism can be used: Air tire bikes started to win bike races, and because of this the aesthetic and technical problems diminished. The tires still looked the same and could be still considered ugly, but the 'speed problem' (did not exist before) was solved and this was considered more important. However, closure is never permanent: new social groups might come to exist with new meanings which leads to interpretative flexibility again, which will lead to a new conflict about a technology.

3. From closure to a *technological frame*

Bijker (1995) added a new concept to the original presentation of the SCOT framework, which is also the third step of the research process: the technological framework (or a frame with respect to technology) (Klein and Kleinman, 2002). This is a shared frame that can include problems, strategies to solve them, requirements to do so, theories, tacit knowledge, testing procedures, design methods, user practices and exemplary artefacts (Bijker 1995 in Matthewman, 2011). All these elements can define a relevant social group and the members' common understanding of the artefact. Bijker (1995) explains that these elements

can both be constraining and enabling because they provide specific contexts within which actors interact with the technologies. He also adds the idea of *inclusion* to the framework: this describes the actor's level of involvement with a frame and allows actors to be part of multiple frames simultaneously, since they might belong to several relevant social groups at the same time.

2.3 Operationalisation

It might seem that these two different theories, social practice theory and the social construction of technology, are difficult to combine - for example, both work with a different unit of analysis. However, this will not be a problem as I will alternate between the two theories depending on the unit of analysis: thus within this one research two units of analysis will be adopted. In the chapters handling the history of water drinking practices and the influence of the water filter on practices, the unit of analysis will be the practice, whereas the chapter analysing the introduction of the water filter project with SCOT will integrate the water filter as the unit of analysis.

In this section the key concepts explained in the sections above will be operationalised - the concepts are linked to questions asked in the interviews.

The three elements - practice theory

The first part of this research focuses on the history of water drinking practices in Livuwu (before the introduction of the water filter) and in the final part the influence of the water filter on drinking water practices is examined. Therefore, the three elements a practice consists of will be researched: material, competence and meaning. Nicolini (2012:220) provides us with generic questions which can be used to identify these elements. These questions are the base of the interviews, however they were modified to the specific topic and adjusted to the understanding of the respondents.

These are examples of questions which are used to examine the *material* elements of a practice: "What artefacts are used in the practice? How are the artefacts used in practice? What visible and invisible work do they perform? In which way do they contribute to giving sense to the practice itself? Which type of practical concerns or sense do artefacts convey to the actual practicing?" An important aspect of social practice theory is observation, therefore the respondents were asked to show the materials that are part of the practice.

Secondly, *competence* is operationalised. Knowledge is considered a central aspect of competence (Reckwitz, 2002; Shove et al., 2012). This is related to the capacity to carry out a certain practice. Therefore the following questions are asked 'What kind of knowledge

is present? Which skills are present?' and the respondents will be asked to show how they use this knowledge to perform the practice. This links to Nicolini's (2012: 221) questions: "What are people doing and saying? Through which moves, strategies, methods, and discursive practical devices do practitioners accomplish their work? How is knowledge shared between practitioners?'

Finally, the third element *meaning* helps to create an understanding of *why* it is important to perform a practice a certain way - it makes us aware of the reasons behind the practice. Questions proposed by Nicolini (2012:221) are: "What are the mundane practical concerns which ostensibly orient the daily work of the practitioners? What matters to them? What do they care about? What do they worry about in practice? What do they see as their main object of activity? When would they say the practice has been accomplished?"

Lifestyle and systems of provision

Spaargaren (2003) introduces the concepts of *lifestyle* and *system of provision*. Social practices are 'surrounded' by practitioners with their own lifestyle on the one side and on the other side are the rules and resources they make use of. To operationalise lifestyle one can concentrate on the elements that form a lifestyle and influence the interaction with a social practice: underlying reasons, interests, motives and values and beliefs human agents adhere to (Spaargaren et al. 2006). This also links to the 'meaning' aspect of a practice, however, researching lifestyle relates to more 'general' values of the respondents, not necessarily linking this to the drinking water practice. This way it is possible to determine whether 'the narratives of self-identity' are in line with the practices one engages in. For example, how concerned are people with health? Is a healthy lifestyle something they value and how can we observe this in the actual behaviour - the practice?

The second concept introduced by Spaargaren (2003) is the system of provision: these are sets of rules and resources (structures) that enable (instead of constrain) agents to carry out their practices: they apply these rules and make use of the resources. What systems of provision are identified in Livuwu? Where do these rules and resources come from? To research this, the WASH training and the water filter will be examined. This also links to the next part in which the main concepts of SCOT will be operationalised and the focus will be on the development of the water filter.

The artefact - SCOT

The second part of this research zooms in on the artefact that is being introduced: the Safi water filter. The design process will be investigated and the following concepts will be

operationalised: relevant social groups, interpretative flexibility, stabilization, closure and technological framework. Furthermore, as a lesson learnt from different theoretical schools, I take into account ownership, control, access, use and unintended consequences of technology, when analysing the water filter.

As mentioned in the section above, SCOT considers all groups equal and assumes that all relevant social groups are present in the design process. Therefore, power asymmetry between groups is not being acknowledged adequately, because not all groups are always present and involved in the development of an artefact (Klein & Kleinman, 2002). When identifying the *relevant social groups* this will be based upon Humphreys' (2005) four groups: producers, advocates, users and bystanders (taking into account that it is possible not all groups are involved/existent.) Questions to be answered are: Who are part of which group? Are all groups involved? What are the relations between these groups?

Following the three research steps (Bijker, 2010), the concepts of *interpretative flexibility*, *stabilization* and *closure* are examined next. Therefore the following questions will be answered: 'What are the different meanings of the relevant social groups, what are their interests and concerns? How was closure reached through stabilization?' Bijker (1995) describes closure as consensus but he does not focus on how this consensus developed; why did the meanings of some groups have greater relevance than others? This will be examined in Chapter 5.

3. Methodology

The following chapter outlines the methodological approach of this research. First, the case study and the sampling method are described. In the second section, I focus on the data collection methods used - semi-structured interviews, observations, expert interviews and a focus group discussion.

3.1 Research design

This thesis presents a qualitative case study that aspires to attain an in-depth perception of the change in drinking water practices after the introduction of a water filter. The case study this research focuses on is the pilot WASH project in Livuwu, Malawi. This project was created by two local NGOs: the CCAP SMART Centre and Temwa.

Research area

Livuwu is located in the North of Malawi at Lake Malawi, in an area called Usisya. This is a very remote area and can only be reached by four wheel drive or boat. The first option of transportation takes 2,5-3 hours from the nearest city Mzuzu, and taking the boat will take up until 8 hours. From the centre of Usisya, it is only possible to reach Livuwu by boat or walking. In the rainy season, the river has to be crossed to reach the village.

In Livuwu live an estimated 130 families, who mainly rely on the lake as their source of income. Most men are fisherman and women take care of the children and work on the land. On the land cassava is grown, which is ground into flour and used to make nsima, the staple food in Malawi. The majority of the village received education until Form 8 (primary school), but there are also inhabitants who never went to school. Because of Livuwu's remoteness, there is limited access to piped water - the main water sources are Lake Malawi and the Livuwu river.

The NGOs who created the pilot project believe that Livuwu's remoteness and frequency of recorded cases of water related diseases like cholera and diarrhoea, makes it an ideal study site for health interventions. The NGO initiating this clean water project, Temwa, has worked in Usisya for the past 13 years and therefore has a lot of experience and knowledge on project development and implementation within the different villages. The CCAP SMART Centre was approached because of its knowledge on clear water solutions.

Sampling

This thesis involves random sampling: a sampling technique were respondents are chosen entirely by chance and each inhabitant has an equal chance of being included in the sample. This method was chosen because previous research on this project in Livuwu was also based on random sampling. This study researches the changes in drinking water practices. To investigate change I have to compare data about practices in the past with the collected data of this study. The two NGOs have conducted a baseline survey before the implementation of the project and a half year survey to evaluate the project. This information is used to describe the history of drinking water practices. To be able to integrate this data in my research, the same sampling method should be applied.

3.2 Data collection

The research of this thesis is based on ethnographic methods. Nicolini (2012:221) proposes to use an ethno-methodology to study practices, because this can 'truly capture and convey the actual work that goes into practice': it is a great tool to zoom-in. The goal of an ethnography is to develop a rich understanding of how people think, interact and behave, and what this means to the population studied. Ethnographers will situate what they find in a local and historical context, and connect their findings to the larger social structures of society. There are several different ethnographic methods – my main data collection methods involved semi-structured interviews, observations, expert interviews and a focus group discussion.

3.2.1 Semi-structured interviews and observations

The most important source of information for this thesis are the 79 semi-structured interviews I conducted with the inhabitants of Livuwu. The list of informants can be found in Appendix 1. The identities of the informants will stay anonymous; I decided to allocate numbers to the respondents.

Semi-structured interviews allow for a focused two-way communication with the possibility to stray from the topic list when appropriate. Informants are allowed the freedom to express their views which leads to additional information compared to structured interviews. Using this approach gave me opportunity to prepare topics and related questions ahead of time; therefore I was able to structure the interviews and keep track of the common thread in the conversations. The topic list is provided in Appendix 2.

The data of these interviews was collected with the mWater application and note-taking. Each interview was concluded with observation of the water filter, the kitchen, bathroom and toilet. This gave us a greater understanding of the other health practices of the households, and the opportunity to confirm or question the answer of the respondent on the water filter use. During our time in Livuwu observation was an important tool to identify discrepancies between the 'doings' and the 'sayings' of the participants.

To avoid socially accepted answers, we decided to go into the field as independent researchers instead of explaining our involvement with the NGOs who introduced the water filter. After our first interviews we reflected on the questions, because it became clear that some questions were too difficult and people did not understand how they were supposed to answer. Practising with more experienced researchers working for Temwa, helped us adjust the questions to make them more understandable for the inhabitants of Livuwu.

3.2.2 Expert interviews

For this research two experts were interviewed who could provide more information about the set-up of the project, the NGOs views on the project and the future of the project.

Before I travelled to Malawi, the CCAP SMART Centre had provided me with project documents: the proposal, notes of meetings with Livuwu representatives, the baseline results and the half-year evaluation report. These documents were studied and used as a source for questions during the interviews with NGO employees. Alongside in depth interviews, there was also room for more informal conversations when working in the Mzuzu offices. These conversations mainly helped me to prepare and practice the interview questions for the inhabitants of Livuwu.

I interviewed the NGO employees who were responsible for this project: Rianne Veldman (Project assistant at the CCAP SMART Centre) and Fishani Msafiri (Senior project officer at Temwa). The interviews were recorded and the information that would be included in the research was transcribed.

3.2.3 Focus group discussion

Besides the interviews with inhabitants, it was also of importance to interview the committee members. Employees from both the CCAP SMART Centre and Temwa had mentioned that the committee members were not all actively involved and motivated, however they would never admit to this. We therefore expected that interviews with the members individually

might lead to conflicting stories and decided to organize a focus group to encourage discussion. Besides this, a discussion of this nature is often less time consuming, hence this meeting provided us with broad information in a very short period of time as well as feelings, perceptions and opinions of the committee members. The meeting also helped the committee members explain issues and seek clarification and consultation together as a team. We did not want to influence the pace of the discussion and therefore decided to have my translator lead the group discussion. I recorded the meeting and she translated it for me afterwards. This meant that secure preparation was necessary, since I was not able to interfere and ask additional questions.

4. The history of drinking water practices in Livuwu

In this chapter I will discuss the different drinking water practices that were practiced by the inhabitants of Livuwu before the implementation of the pilot water filter project. By presenting the situation before the project, it is possible to identify changes after the project. My approach comprises three components - first I will give a chronological description, because a drinking water practice includes several different steps (also practices on their own). The practices start with collecting the drinking water, to transporting it, possibly purifying it to the action of water drinking. In other words, drinking water practices consist of a bundle of different practices. This chapter will follow these practices step by step until the purifying practices. These different purification methods will be identified and analysed. Finally, the last practice of drinking the water is discussed. Secondly, I will analyse practices with the three elements approach created by Shove (2010). The practices consist of these three elements: the material, competence and meaning. This element approach will be the common thread used to unravel the practices and gives us the possibility to identify change in chapter 6. Third, I am aware that reducing a practice to three elements can be seen as oversimplification. If there are other observations, not directly part of these elements but important, I will mention them.

4.1 Walking to a water source

The first part of the drinking water practice is the collection of the water. Women and girls walk from their houses to a water source to collect water. This has always been a female task. During the interviews women explained that it is their duty as a woman to provide water for the family. In my time in Livuwu my observations confirmed this. This is not solely related to water: all practices including carrying heavy loads (on the head) are carried out by women. This requires certain competences: the skills to balance the bucket on the head and the strength to lift it and transport it. The moment of collection is not depended on a certain time during the day but will be performed when the family is almost out of water - this relates to the meaning of the practice or in other words: the reason why people start walking to a water source. Additionally, water is often collected when other practices at water sources are performed. For example, when people go to the lake to bath, they will take a bucket with them to fill with water for drinking. I often observed mothers and/or children washing clothes at the lake and filling an extra bucket of water to bring home. This is more practical and

saves time. The bucket is the first material artefact that is part of the practice of collecting water. These are often 30 to 50 liter buckets, used to collect water and sometimes also store water.

Playing the main part in the drinking water practice is the material element 'water'. Water is a vital part of life and used in many practices in daily life. The importance of water also reflects the relationship people have with the lake. The lake is a very important part of people's life; their lives depend on it. This shows in the daily practices like cooking, cleaning and drinking but the lake is also the main source of income in Livuwu. Almost all men are fishermen and therefore incomes and the availability of food depend on the lake (Interview Rianne Veldman). Providing food for the family is the task of the men. This has changed through the years, and nowadays women often contribute as well. But the dominant idea is still that men should provide food for his wife and children.

There are different sources the water can be collected from. Which source they go to often depends on the distance from their houses. They either go to the lake, the river or to a nearby tap. During government interventions people were taught that the water from the lake should not be drunk. If the distances between the river and lake are comparable, this will convince some to choose to walk to the river to collect water. Health workers would inform the inhabitants of Livuwu on the dangers of drinking contaminated water and advise them to purify the water. I will go into this in the next sections on the purification of water. There are others who believe that the water of the lake is drinkable during the night. The water seems clearer during these hours and is therefore considered drinkable (Ruth Mhone, Temwa field worker). Besides distance and warnings from government health workers, is the season also a determinant. During the rainy season people prefer to drink from the lake, because the rivers are muddy and taps often get clogged.

4.2 At the water source: Collecting water or drinking water

When the people have arrived at the water source, they will fill their buckets with water, drink water straight from the source or perform both practices. Most people who do not drink water straight from the source do this because they desire to be healthy. This signifies that they will bring the water home to purify it. However, for others health is not a reason, or it is considered too expensive or time consuming to purify and these people will therefore drink straight from the lake. Whether people purify their water or not, they will bring some water back home with them in the buckets in order to have drinking water nearby. Filling the buckets with water requires certain skills. The people scoop the water into the bucket and

when it is full put it back on their head. The actor performing this practice needs great strength and balance.

As explained in the previous sector, the reason to 'start' the practice is often related to other practices. For example, because people want to bath in the lake they take a bucket with them to fill afterwards because this is more time efficient. This means that while people are filling their buckets or drinking water from the lake, others are bathing, cleaning clothes or use the lake as their toilet. People who do not purify their water therefore drink highly contaminated water.

4.3 Transporting the water home

The third part of the bundle of practices called 'drinking water' is the transportation of the water from the water source back to the house. The practice is a natural consequence of the previous practice. If the buckets have been filled with water, they should also be transported back to the houses. This requires certain competences. Mothers teach their children how to put heavy buckets on their heads and balance these filled buckets while walking. Because a child needs to possess enough body strength to do this, younger girls cannot be practitioners of this practice. Some houses are very close to a water source, others further away. People have to walk a maximum of 15 minutes to reach a water source. This signifies that for some women it takes at least 30 minutes to share water with their families.

Once the water has arrived at the family's house, the actor will first purify the water (practice 4) or immediately store it (practice 5). The baseline survey conducted in January 2017 shows that 55% of the respondents purify their water before storing it. During my fieldwork I found similar results (57%), which confirm that approximately half of the inhabitants declare to purify their water before drinking it.

4.4 Purifying the water

The respondents, who reported to purify their water before drinking it, used different methods. Before discussing the different methods, it should be explained why people decide to purify their water instead of drinking water straight from the source. Most answers connect to the idea of healthy living. People do not want to get sick and stay healthy. It was often mentioned that HSAs have taught the people of the Livuwu community to purify their water, which leads to a feeling of responsibility towards these officials to use the methods. Advice from officials seems to have a clear impact on some of the inhabitants. These government

employees also taught the community on the different types of water treatment that can be used. This shows in the knowledge people can share about the different types of treatment. The government can be identified as the system of provision, providing knowledge on water purification to the inhabitants of Livuwu. Besides the provision of knowledge, government officials also provide materials once in a while. The material resource distributed in Livuwu is chlorine. In the section below on chlorine I will go deeper into this. During the research people mentioned the usage of water guard and chlorine as separate methods, however Veldman (project assistant CCAP SMART Centre) explained that water guard is the brand name for chlorine in Malawi. This is confusing because the respondents used the terms in different contexts. The committee members explained that the government officials distributed chlorine, however when talking about personal purchase at local stores people talk about water guard. Veldman assumes that the terms water guard and chlorine are both used, but both refer to water guard.

Water guard / Chlorine

The method most used is water guard (chlorine). Water guard is a point-of-use water disinfectant that can be added to the water to make it safe for drinking by destroying the bacteria and germs that cause water-borne diseases. Consistent use of water guard has proven to be effective in controlling water borne diseases like cholera, diarrhoea and typhoid (Mwambete and Manyanga, 2006). Water guard can be bought in the local shop in Livuwu or the neighbouring village. In other words, the inhabitants of Livuwu have access to the purification method water guard. Water guard exists as a liquid or tablet, in Livuwu bottles with liquid are sold. Respondents explain that water guard is easy to use, fast, and practical because one can bring it when going to work. These are reasons why respondents perform this practice of purification. On the other hand, most people do not like the strong smell and taste of water after water guard has been added.

Respondents also explained that they use water guard if they have enough money to be able to buy it or if this is distributed. The committee members explained to us that government officials have been distributing chlorine to the households for many years. However, since 2013 the distribution changed and has not been regular anymore. In 2017 chlorine has only been distributed twice. During these distributions households receive 300-350 ml chlorine which lasts approximately 3 weeks. This implies that households who explained to us that they use chlorine when distributed can only use this method of purification around 6 weeks a year. If no other purification methods were mentioned, these households probably drink contaminated water around 46 weeks a year. In other words, because of the low availability of the material, the practice of purifying with chlorine is rarely

performed. This leads me to believe that a great amount of people who reported to purify their water with water guard, chlorine, or both, do not purify their water every day. This also shows that the distribution of chlorine is not a sustainable solution to help the inhabitants of Livuwu with the purification of water and therefore the possibility to drink safe water.

Boiling

The third method that some participants mentioned to purify their water before drinking is the method of boiling. Three households, which is a small group, use this method. It requires several materials. Most people use firewood and matches to start the fire. Practitioners of this method share that it is easy to boil water after or before cooking when the fire is already burning. However, for most inhabitants boiling is not a popular option because it is perceived as time consuming.

Finally, these methods of purification are not used all year around. Almost half of the respondents who purify their water, explained that they do not perform the practice of purification in the dry season. During the dry season the water is clearer. The clearness of the water portrays safety for them. The practice as an entity always exists for these respondents, but the performance is seasonal and therefore not visible in the dry season.

4.5 Storing the (purified) water

The fifth practice does not necessarily happen chronologically after the purification of the water. It is also possible that the water is directly stored after its arrival at the house and does not get purified, which is the case in almost 50% of the households. Some people might not purify their water before drinking it, but it is also possible that the water is first stored, and only gets purified before the actor wants to perform the practice of drinking the water. The water storage is an important part of safe water as contamination can occur when a person wants to drink this. The water can get contaminated if the cup is not clean, or if dirty hands touch the water. Most people store their water in a clay pot (Picture 1) because this keeps the water cold. They cover the clay pot with a plate or cloth. It is of great importance that the clay pot is cleaned with purified water; otherwise the clay pot might contaminate the water again. Most people are unaware of this and consider the clay pot as a safe place to store their drinking water. The water stored in the clay pot is solely for the practice of drinking. Near the kitchen we can find plastic container filled with water, these are often used to cook or clean.
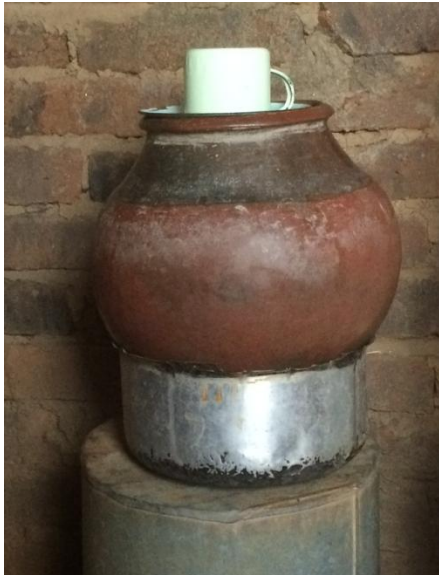
Picture 1 Clay pot

4.6 Drinking the water

This bundle of practices always ends with the actual practice of drinking the water. As described earlier, this practice could be part of practice 2: drinking water straight from the source. The second option is drinking the water after is has arrived at the houses. Finally, 57% of the people claim to drink their water after it has been purified. The water is taken from the clay pot using a cup. This practice has the risk of contamination. The cup is dipped into the water, filled and used for drinking. The cup might not be clean or hands touch the water and contaminate it. This shows that water might be purified, but if it is stored in a clay pot, there is still a high risk for people to drink contaminated water.

4.7 Conclusion

This chapter focused on the drinking water practices before the introduction of the water filter. It is important to zoom in on this bundle of practices because I am researching the change that has taken place. This chapter allows me to compare the before and after situation in the following chapters. The chapter chronologically follows people from the first step of walking towards the water source, to the practice of drinking water. The data shows that these practices are gender specific - it is a woman's duty to provide water for the family. Women possess the skills to balance buckets with water on their head and transport these home.

Inhabitants of Livuwu use the river and lake to collect water, to wash clothes, to bath and as a toilet. The water from these same water sources are used as drinking water by many: these people are drinking highly contaminated water. Therefore, around 50% of the respondents declare to purify their water with water guard/chlorine or boiling. It is questionable whether people use the preferred methods of water guard/chlorine on a daily basis, because it seems that they only purify when these materials are distributed. Since this does not happen on a regular basis, I can reasonably assume that most inhabitants of Livuwu often drink contaminated water. The solution of government health workers to distribute water guard or chlorine from time to time does not seem to be a sustainable solution for the problem of water related diseases. In the following chapters I will explore the expected influence of the water filter and the actual change after the introduction.

5. Unravelling the black box of the water filter

In the previous chapter we have looked at the practices related to drinking water that were performed before the introduction of the water filter. Before examining the current situation and discuss the drinking water practices after the introduction of the water filter, it is of importance to conceptualize the water filter as an artefact in order to understand its influence - how, by whom and with which intentions was the water filter introduced?

The different processes involved, from the creation of the filter to its implementation, will be analysed using the Social Construction of Technology theory. In chapter 2, I explained that this theory is useful when conceptualizing an artefact and analysing its possible influence. This also signifies that the unit of analysis shifts from the practice to the water filter. Whereas in the previous chapter, the main focus was the practice, this chapter will concentrate on the water filter in order to theorize it and understand the influence on the practice. Following this theory, I will identify the relevant social groups involved, what values or criteria these actors use to make their decisions - the interpretative flexibility - and the key moments in the decision making process that led to closure.

The chapter is divided into three sections. The first section explains the design process of the water filter and its main characteristics - we zoom out in order to understand where the filter comes from. In the second section the pilot project will be introduced, focusing on the reasons behind the choice for this water filter and this particular project. This is important because the decisions made in this stage can be of influence on the adoption of the water filter. Finally, the introduction into the village is analysed - in this stage the potential users became involved. Similar to the other phases, this process is of importance because of its possible impact on the adoption of the filter.

5.1 The water filter design process

In the first chapter I emphasized the severity of the safe water problem in Malawi. The Ministry of Health in Malawi is considered a responsible party for dealing with this problem. When searching for suitable solutions and possible new technologies to purify water, they decided to ask professionals for help. An expert in the field of HWTS was approached to develop a sustainable solution to solve the problem. This expert was J. Degabriele, who has over 20 years of experience in water, sanitation and hygiene issues in East Africa. He prepared national policies, strategies and guidelines and has strong relations with local and

National Government, but also NGOs, consulting firms and donors. Commissioned by the Ministry of Health, Degabriele conducted an extended market research and designed the first Safi filter. The Ministry of Health can be considered a relevant social group in the design process of the water filter. Humphreys (2005) would recognize this group as 'advocates' - indirectly related to technology. Whereas Degabriele can be considered a producer; he has a direct relationship with the technology and has developed it.

Many water filters have been designed all around the world in the past decades. This does not automatically signify that these filters should be imported and sold in Malawi. One should look at the wider context; the wider sociocultural and political milieu in which the artefact development has taken place (Pinch and Bijker, 1984). If the development of a water filter would have taken place in the Netherlands, the transferability to Malawi becomes questionable. This is because values and meanings are often inscribed in a technology. Problems regarding drinking water in the Netherlands are different from those in Malawi, which also leads to different solutions to be designed. Designing and producing a technology locally will have a better fit with local beliefs and circumstances which increases the possibility of adoption. Therefore the development of this water filter was kept local, designed by someone who knows the potential users and created with locally available materials.

When designing his first Safi T9 table top filter, the producer was not only concerned with the usage of locally available materials. There are many aspects that need to be considered when designing a water filter. First and foremost, it has to purify the water and make water safe for people to drink. Besides that, it is important that the water is tasteful and smells good. Users will not drink water that does not taste good or smells bad. The product should be affordable, and if people decide to spend money on it they also need it to have a good appearance. These elements should be taken into consideration during the design process to improve the chances of people adopting this new product. Additionally, by providing certificates that state the water filter is safe, the Ministry of Health influences the acceptance rate of this product. This is because these certificates carry a lot of weight. For other organizations working with water filters it is important to have this security about the safety of the product they buy and sell.

The ease of use of these filters was an important element. Everyone should be able to assemble and use the filter. The filter consists of two buckets and lids, a candle and screw, and a tab and rubber ring (Picture 2). A candle is made of clay and removes turbidity, suspended materials and pathogens through mechanical trapping and adsorption in the micro-scale pores of the ceramic candle. The candle needs regular cleaning by scrubbing the surface with a soft brush to remove dirt. This can only be done with clean water - soap or other chemicals should definitely not be used (Shrestha et al., 2018).The candle should be

attached to the top bucket and the tap to the lower bucket. Besides the ease of usage, access is an element considered when theorizing technology. This links to the cost of the product. The aim is to make this product accessible to as many people as possible in Malawi. However the cost of this water filter is 11,000 MK ($15). This is an amount not every Malawian can afford. Accessibility also takes into account the proximity to the product. If a product is sold on the other side of the country, it is not accessible to many. However, this is an issue that becomes apparent after the production of the water filter, but should not be overlooked. Local production was an important factor during the design process; however this was not completely possible. The two buckets the filter consists of and the brush that is included to clean the filter are locally produced. But the candle and the tap are imported. It is not possible yet to produce these in Malawi and they are imported from China.

Picture 2 The Safi T9 table top filter

During the design process the main relevant social groups were the advocate and producer. It does not become clear to which extend the other relevant social group, the user, was taken into account during the creation of the filter. The producer explains that the filter was developed with the end-user in mind, which is necessary for it to become successful. The ease of use, accessibility, appearance, and quality of the water are focused on the Malawian user. However, the process of stability and achieving closure described by Matthewman (2011) is difficult to identify in this case: the idea that all relevant groups have different meanings, and over time all members of these groups come to a common agreement on the

artefact. I believe this is not identifiable yet, because the artefact has only been introduced into the research community for 1 year and 3 months. It is possible that after some more time and based on usage rates and adoption, the users share their meaning, leading to interpretative flexibility again – because closure is never permanent (Matthewman, 2011).

The Safi water filter that was designed is sold in different stores around Malawi. But how does this end-user become aware of this and do they feel the need to purchase the filter? This will be discussed in the next section.

Conclusion

The design process of the Safi water filter shows that two relevant social groups were involved: the Ministry of Health as advocate, and Joe Degabriele (an expert in the field of water sanitation and hygiene solutions) as the producer. It is interesting that the design of a clean water solution is left entirely to the expert and no other relevant groups are directly involved: a case of expert decision making. However, while designing the water filter the user was thought of. This shows in the design criteria: safety of water (proven by certificates of the Ministry of Health), good taste, good smell, affordable, good appearance, ease of use and local production. With these criteria in mind, the producer designed the Safi T9 table top filter.

5.2 From artefact to project

The Safi filters described in the previous section are being sold in stores around Malawi. However, not everyone has the possibility to purchase one of these filters, knows about the existence or understands the usefulness of the product. The product needs to be brought to the people before people might move towards the product. This happened in Livuwu with the SMART Centre and Temwa pilot project. This section focuses on the proposal process of the project - zooming in on the objective of the project and steps towards reaching this objective. What is the plan to make the end-user adapt the artefact? I believe that it is of importance to also take practices into account, because the goal of the introduction of a certain artefact is the performance of a practice using this artefact. Therefore, if during the design process one takes the practice into consideration, the possibility of people adapting the artefact might increase.

The SMART Centre and Temwa started the project to support and study the potential for behaviour change around community health in Northern Malawi. However, the request for a new project came from the inhabitants of Livuwu (Interview Fishani Msafiri). Temwa has

led several projects in Livuwu over the past years, from microfinance to educational, and the inhabitants reached out to them for help. In 2016 a big cholera outbreak hit Livuwu and many people got sick or died. Temwa decided to help and asked the CCAP SMART Centre to join because of their experience and knowledge of safe water solutions. The project in Livuwu is a pilot project on water filter distribution and based on the results the project setup can be adjusted and hopefully expanded to other regions of Malawi. The project aims to follow the three components of safe water systems (SWS) marked by the centre for disease control: an available product which can clean the water, safe storage once it is clean, and education on proper water and sanitation practices (USAID, 2007). This was translated into the proposal plan below in Figure 2.

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1. Training of the Trainers (TOT) and Surveyors

2. Community Education Session on HWTS and Water Filter Use, including distribution of vouchers.

3. HH Water filters distribution (for each household attending the HWTS training. At minimum 1 adult per HH is required).

     i)   Water filters will be given for free to each household following a try and buy system. After one month families will then set up a payment plan to pay for 50% of the cost of the filters (5,000 MK).

    ii)   Replacements parts will be made available at local shops for the price of MK 3000- and each HH will buy as needed. If a family cannot afford the replacements then the community health committee will access the HH vulnerability and will report to Temwa and CCAP for a subsidized replacement parts.

4. Monitoring and Evaluation

5. Ongoing community awareness campaigns.

Figure 2 Proposal pilot project

To stimulate the performance of the drinking water practice using a water filter, the organisations added a Community Education Session on HWTS and Water Filter Use to the project. During this training the community members get trained on the usage of the water filter and other hygiene and sanitation practices. They get taught on the skills needed to operate the filter - they acquire the competences to perform the practice of drinking water using the water filter. Besides acquiring skills to use the filter, people are also informed on the importance of drinking purified water. To stimulate the meaning linked to the practice, the teacher explains to the trainees what the consequences are of drinking contaminated water. Additionally, they also show the difference between contaminated and purified water. The

water in the upper bucket is unclear, whereas the water that has been filtered is clear. People can observe this difference and also taste the purified water. This way a reason or meaning is brought into existence for people to buy and start using the water filter. Fishani Msafiri, senior project officer at Temwa, explains that the Livuwu project is the first project with an extended training. Temwa has been part of other water filter projects, but the training at these projects only entailed an explanation on the usage of the filter.

> *"The training in Livuwu looked at the whole concept of WASH. We also talked about hygiene, treating water and WASH facilities and safe storage. Because water borne diseases are not only spread through water. One can also contract diseases through no purification, not washing your hands"* (Fishani Msafiri).

Different practices are linked because they are all part of WASH. Drinking water using a water filter should be combined with other hygiene and sanitation practices in order to stay healthy. It could be explained as a new bundle of practices: WASH practices.

The third part of the proposal highlights the plan of distribution. During the training, each household would receive a voucher. A few days later, these vouchers could be used to collect a water filter. A period of two months followed in which people could try the filter. If they were not satisfied, they could return the filter and otherwise they could buy the filter. People had to pay 5,000 MK and this could be done in a maximum of 5 instalments. If households were able to pay the entire amount at once this was preferred. The CCAP SMART Centre and Temwa decided on the price of 5,000 MK with 5 months to pay, because 1,000 MK a month was considered possible for most households. Asking the full price of 11,000 MK would have eliminated almost all inhabitants and possibly scared them off, especially since most people from the area were used to receiving development aid for free. The choice to ask for money was made because, first of all, the organizations do not have the sufficient funds to distribute the filter for free. Secondly, if people pay for their artefacts, a feeling of ownership is created. Owning a product because you paid for it increases the chances of proper usage and maintenance.

Besides ownership, access is also a part of the theorization of technologies. This pilot project will increase the access to this technology. Before the introduction of this project, there were no water filters present in Livuwu: the inhabitants of this village do not have access to the filters. The CCAP SMART Centre and Temwa will introduce the filters to the system of provision within the community. These new resources will change their practice of drinking water. In the previous chapter I identified the government as a system of provision when providing the inhabitants with chlorine and knowledge. Besides government

officials and these NGOs operating as a system of provision, 'supplying' people of Livuwu, the system in Livuwu is rather closed. The people are dependent on fishing or agriculture for food, which are part of the Livuwu system of provision. From time to time some people visit Mzuzu and might buy clothes, furniture or cooking utensils here. These visits create interaction between systems of provision, and therefore new resources enter the town. But most material elements of life are created and consumed within the village. During these visits out of town, knowledge is also exchanged, for example between family members and because of this interaction outside the village, people inside the village come in touch with different systems. However, since these interactions are limited, it can be stated that there are few systems of provision and new artefacts are rarely introduced. With the pilot project, additional to the water filter entering the village, new sets of rules and information also enter the system of provision during the training. If people (capable agents) buy the filter and start using it, they reproduce the system.

After the creation of the project proposal the focus shifted to the choice for a certain HWTS system. The team chose to compare several HWTS systems that are often used in African countries (Interview Rianne Veldman). However, they did not include chlorine as a possible option in their research, even though this is also a widely used solution to clean water issues. Veldman explains that they decided to exclude chlorine from their comparison because of its observed disadvantages. Chlorine strongly influences the taste of the water, which people dislike. Besides that the chlorine has to be added in the correct amount each time to the bucket - two more disadvantages: the correct amount and repetition. Each time people can make the decision to buy the chlorine or not. In times of money scarcity, they might decide to invest their money somewhere else. The rainy season often negatively influences the income of people, but is also the season most waterborne diseases are contracted. Because of these reasons, the CCAP SMART Centre and Temwa decided to exclude chlorine from the comparison research.

With chlorine as a safe water solution excluded from further research, which HWTS system were included and most likely to suit this project and therefore this community? The CCAP SMART Centre and Temwa used Stubbé et al.'s (2015) comparison research to make a first selection with possible HWTS systems. There are different ways in which an artefact can be suitable for a community - there is a certain flexibility. Therefore, these different systems were compared and based on several other researches they made a final decision: closure was reached. The four possible HWTS systems taken into consideration were: SODIS (solar disinfection), biosand filters, ceramic pot filters and ceramic candle filters. SODIS refers to the method of exposure to solar light in transparent clean 1 to 2 litre bottles to inactivate bacteria, virus and some parasites. The water should be in the sun for at least 6 hours if the sky is bright. SODIS is recommended by the WHO, low-cost and simple.

However, SODIS cannot remove chemical pollution. Additionally, only small volumes can be treated and it is strongly weather dependent (Spuhler & Meierhofer, 2018).

Secondly, the method of biosand filter was explored. A biosand filter purifies the water through gravel and sand. Physical straining removes pathogens, iron, turbidity and manganese as the water flows through the filter. Whereby "two filter mechanisms govern the removal principle of biosand filters: physical removal of organic matter and turbidity and biological removal of colloidal particles and harmful pathogens in the so-called Schmutzdeke" (Stubbé et al, 2015). This Schmutzdeke is a biofilm that contributes to the removal of these pathogens because of the predation and 'competition for food of non-harmful microorganisms contained in the biofilm and the harmful organisms in the water' (Dangol & Spuhler, 2018). However, Biosand filters have a low rate of virus inactivation and the filter requires to be used on a regular basis. Additionally it is difficult to scale up after the end of a project, since the filter is too large and heavy to sell in local shops.

The third HWTS solution researched is the ceramic pot filter. This filter consists of a pot-like shaped filter element that is placed in a plastic bucket. The filter is easy to use and has proven to produce high water quality (Halem, van et al., 2009). The main drawback of this HWTS solution is the fact that this filer is not being produced in Malawi.

Finally, the ceramic candle filter is a filter with a candle shaped filtering element, made of clay or diatomaceous earth. This filter is produced in Malawi and has proven to remove at least 99.5% of all E.coli bacteria, a bacteria that can cause water borne illnesses. Other advantages are the low price, it is simple and easy to use and clean and it improves the taste, smell and colour of the water. This filter can be constructed with locally available material and keeps the water cold and safe. However, the disadvantage is that it does not remove chemical contaminants and highly turbid water can clog the filter.

The comparison focused on the effectiveness, the costs, the capacity and availability in Malawi. This resulted in the choice to work with the candle type filter produced by Safi because of 'its availability, its local production, its high efficiency compared to other options and the low costs' (CCAP SMART Centre and Temwa, 2016, p.10). The relevant social groups that were directly involved in the decision making process were the two NGOs: the CCAP SMART Centre and Temwa. Using other researches, Temwa's knowledge on the Livuwu area and the CCAP SMART Centre's knowledge on safe water solutions, the team came to this decision. The users were not actively involved in these negotiations. However, the purpose of this project is the adoption and usage of the water filters by the inhabitants of Livuwu. Therefore, the two NGOs had to constantly think of the end-user when choosing the water filter, and additionally when creating the whole project proposal. In other words, because there was no involvement of different relevant social groups, it can be stated that interpretative flexibility (different groups with different meanings) did not exist in this process.

However, the different meanings were still taken into consideration when thinking of the different important elements, when making the decision and reaching closure on the most appropriate HWTS system. In the next section, the role of the inhabitants of Livuwu will become clearer. Here I will focus on the project implementation process in Livuwu. In other words: after the creation of the proposal, what happened?

Before focusing on the drinking water practices that are performed after the introduction of the water filter, step 3b of the proposal should be discussed. As stated in Figure 2, the NGOs propose to sell replacement parts at local shops and households who cannot afford this can report this to the community health committee, who will then contact the CCAP SMART Centre and Temwa for subsidized spare parts. This is a very important part of the project, because the project will not be able to continue if people cannot replace broken parts or the candle after one to two years. This is a major part of the sustainability of the project. The NGOs were made aware of the fact that these types of stores often do not survive in small communities. Despite this information, the local store was still part of the plan. At the start of the project, the moment the water filters are distributed, there is no concrete plan concerning the replacement parts yet. This will be developed during the first year of the project.

Conclusion

In this section the project proposal process is explained and analysed. The relevant social groups are the CCAP SMART Centre and Temwa, two NGOs located in Mzuzu. Together they can be identified as the producers of this pilot project. Three main decision moments can be determined in the process. The first main part of the proposal is the choice to include an educational training on WASH. This is considered important because all different WASH practices should be performed in order to prevent contamination. Drinking purified water is not the only solution for the prevention of waterborne diseases. Second, the plan of distribution was set up. Inhabitants will have to pay 5.000 MK for the filter, which can create a feeling of ownership increasing the chances of proper usage and maintenance. Finally, the NGOs had to make a decision on the type of clean water solution. Based upon its availability, local production, high efficiency compared to other options and low costs, they decided to use the Safi T9 table top filter as the material element to encourage the practice of drinking purified water.

5.3 The project implementation process

In the previous two sections I discussed the design process of the water filter and the project proposal. As mentioned above, the relevant social groups that have been involved actively were the advocates (the government), the producer (Safi filter designer) and the two other producers (the NGOs who are the marketers and financial investors). But when implementing the project, the active involvement of the next relevant social group is required: the user. Involvement of this group in the stages before the actual distribution of the filters is necessary to increase adoption rates. Inhabitants of the village can help inform the other groups on important issues necessary to take into account when implementing the project. Additionally, the CCAP SMART Centre and Temwa strive for community led development. *"They have to own and manage the project on their own"* (Interview Fishani Msafiri). The NGOs hope that if the project can be community-led the project will be more sustainable.

The CCAP SMART Centre and Temwa had a first meeting with representatives of Livuwu on the 21st of December 2016. This was the first moment of user involvement. As stated in the previous section, closure on the appropriate artefact was reached. Closure is never permanent and might change when new social groups become involved, which can lead to interpretative flexibility and a new conflict about the technology. The social group 'entering' the project now actively is the (potential) user. During the meeting they introduced new information to the CCAP SMART Centre and Temwa, and therefore creating interpretative flexibility. Whereas the NGOs had reached closure on the artefact with the idea that people drink water from the lake, they were now informed by the Livuwu inhabitants that people also collect water from the few taps in town and the dirty rivers which flank the village. The water from the tap and river is too dirty during the rainy season to filter quickly through the ceramic candle filter and the filters will need to be cleaned after each bucket of water because of the risk of clogging. The choice for the ceramic candle filter had to be reassessed. Closure on this subject was reached through the mechanism of closure by redefinition; the design was not altered to solve the clogging problem. The risks of using river or tap water during the rainy season would be discussed during the WASH training and using this water for purification was strongly discouraged. The problem did not exist anymore and was therefore 'solved'.

Another important aspect of this meeting for the two NGOs was the 'evaluation' of Livuwu as a suiting pilot community based upon the conversation with the representatives. Fishani Msafiri explained to me that one of the most important factors is good leadership:

"Because with poor leadership, most projects fail. Projects need the participation of good leaders. This is leadership that allows people to contribute. Democratic leadership. Where people are free to make decisions and can discuss these with leaders like the chiefs."

Msafiri already had positive experience with the leaders from Livuwu during previous projects, and the two chiefs were also present during this particular meeting, showing their interest. After this meeting the CCAP SMART Centre and Temwa agreed that Livuwu is a strong village for the pilot project, but also acknowledged that there is the need for a second meeting before the project can actually kick off.

During the second meeting on the 4th of January, 2017, a project committee of ten people had been established to help with the water filter distribution following the WASH training, money collection following the trial period, and community monitoring and evaluation to assure households are using the filter correctly and consistently. This is the first step to have the community lead and own the project. The committee was very enthusiastic and felt ready to work hard (Committee meeting, 10-04-2018). However, they did voice their concern about the amount of money the filter would cost. They felt that there would probably be some inhabitants who would not be able to pay. Temwa and CCAP SMART Centre responded that the committee would assess the poorest households and decide about the provision of filters to the most impoverished. After agreement of both the NGOs and the committee on the content of the project, they went into the field to conduct a baseline survey. This survey can help to track change over time. The involvement of the whole community into the project had started.

In the days following this survey, the WASH training was scheduled. The inhabitants of Livuwu were informed about this meeting by invitation letters distributed in the community. People who were interested and looking for more information about the project and the filter visited the WASH training. During the training the filter (material) was introduced and the trainer explained on the usage and maintenance (competences) of the filter and why it is important to drink clean water (meaning). But, as explained before, the focus was not solely on the drinking water practice, but also on other WASH practices. People asked questions about these practices and many participated actively. In addition to the adult training, children were also invited to join a youth training. The CCAP SMART Centre and Temwa explained that they could notice the interest and knowledge of the children increasing during the training. Whereas they would first answer questions incorrectly, they picked up the knowledge and interest around WASH practices as the training continued. Involving children is important because they are part of the user group as well. After the project has started it will become evident whether the children are allowed to use the water filter themselves, but

even if this is not the case, they should know that only the water treated by the water filter is drinkable.

At the end of the training people received coupons and were able to pick up their filter two days later. *"There were two days between to filter out the non-motivated people"* (Interview Rianne Veldman). This was the beginning of, possibly, a new practice in Livuwu. The project proposal includes a plan on the sustainability of the project, including regular evaluations and the possibility for people to buy spare parts. In the next chapter I will discuss whether the new practice has been incorporated in the people's lives and whether the project has proven to be sustainable.

Conclusion

This section deals with the first moment the possible end-users become involved in the project and therefore become the second relevant social group in this section (besides the NGOs). During the first meeting between these two groups the proposal was explained to representatives of Livuwu. Questions were asked and different meanings on the artefact arose, causing interpretative flexibility. The problem concerning the risk of clogging the filter using river or tap water during the rainy season was solved through the mechanism of closure by redefinition. The second problem that arose was regarding the inability to pay for the filter by the poorest of the community. The NGOs responded that the committee would assess the poorest households and decide on the provision of water filters.

Before the second meeting closure was reached on the Safi T9 filter and the water filter committee was established. This was the first step towards community-led development. The committee supported the project and helped during the WASH training. This training was the moment all interested possible users became involved in the project. During this training the material, competence and meaning element of drinking purified water were explained and the users could ask questions. No different meanings were introduced by the users and the project had started. Coupons were distributed and two days later people could collect their water filter - the possible beginning of a new practice.

5.4 Conclusion

This chapter analysed the design process of the filter and the proposal process and implementation of the water filter into Livuwu. Analysing these processes is of importance because it will help understand how the filter was designed, which groups were involved, and therefore the expected consequences that are embedded in the filter. When reflecting

on the results of the project, it will be possible to connect this to these design processes and possibly give recommendations for new projects.

The design process of the water filter included two social relevant groups, the advocates - the Ministry of Health, and the producer - the engineer of the water filter Degabriele. The request to design a safe water solution came from the advocates, however the whole design process can be labelled as a case of expert decision making. The Safi t9 table top filter became part of the pilot project from the CCAP SMART Centre and Temwa, after researching different HWTS options. This filter was chosen because of its availability, local production, high efficiency compared to other options and low costs. These two NGOs are a new social relevant group - a group that can also be identified as producer (of the project). The proposal is created by these two NGOs, however before closure is reached, the social relevant group of the user should be involved. During a meeting with some representatives of Livuwu, interpretative flexibility comes to exist. The problems that arose seemed to have been solved. Finally, closure is reached on the choice of the water filter, the set-up of the distribution, the creation of a committee and an idea about the sustainability of the project. The Safi T9 table top filter will be distributed a few days after an educational WASH training. People can try the filter for two months and if they decide to keep the filter they can purchase it for 5,000 MK with the possibility to pay in monthly instalments. A committee of 10 members will help with the distribution, money collection and follow-ups. If spare parts break, the NGOs will make sure that a local shop sells replacement parts. Despite raised concerns about the viability of a shop, this remained part of the plan.

6. One year after the introduction of the water filter: zooming in on drinking water practices

This chapter provides an overview of the drinking water practices after the implementation of the water filter project. These practices involve everything from collecting the water from the source to people drinking the water - all practices that concern drinking water. Following Nicolini (2012) I zoom in on this bundle of practices and take a closer look at the doings and sayings the practice consists of. I will analyse the practice by identifying and examining the three elements material, competence and meaning.

After the implementation of the water filter project, drinking water practices changed for the majority of the village. However, some people did not buy the water filter and therefore did not change this practice. In this chapter the latter group will first be discussed with a focus on the reasons not to buy the filter, the meaning element. The second section will analyse the drinking water practices of the inhabitants who use a filter. I will solely discuss the practices prior to the purification practice that entail changes, and not repeat practices that are not affected. The division of this section is based on the 'three elements' model provided by Shove et al. (2012). The materials, competences and meanings the drinking water practices consist of are analysed and allow us to examine the change of the drinking water practice in Livuwu after the introduction of the water filter. This chapter will finish with an evaluation of the sustainability of the changed drinking water practices.

6.1 Refraining from purchasing the water filter: main reasons

Not all inhabitants from Livuwu attended the WASH training in January 2016 and from the attendees not everyone collected a water filter. In this chapter I focus on this group and discuss their reasons to refrain from buying the filter. From the 79 respondents, 24 do not own a water filter. Their drinking water practices have not changed compared to before the introduction of this project in Livuwu. The materials, competences and meanings discussed in chapter 4 on the history of the practice, is not their history but the present.

The main reason why people have not bought the water filter is poverty. Most respondents explained that the amount of 5,000 kwacha was too high. It was not possible for them to

save 1,000 kwacha a month. Respondent 72: *"Food is my priority, I cannot spend money on anything else"*. The material element of the drinking water practice with a water filter cannot be paid for and therefore the practice does not exist. When discussing the importance of the water filter and the possible health effects with these people, 50% expresses that this is something they do not think about because the possibility for change is non-existent. This shows that they might have knowledge on health practices and an understanding of the importance of health, but poverty overshadows this, and they feel that this makes it impossible to change the drinking water practice and therefore do not think about it. Others (45.8%) share more knowledge about the impact of clean drinking water on health and sometimes buy water guard when they have enough money or use chlorine when this is distributed.

The second reason that was mentioned was the absence during the distribution of the water filters. This is the reason that 10 respondents who do not own a filter were not able to buy one. However, this does not imply that this group would have purchased a filter if this would be possible. During the interviews, 3 respondents explained that they would not be able to afford the filter - again the reason of poverty. The other respondents would be willing and interested in purchasing a filter. Why would it be important to them to perform the drinking water practice with a water filter? This connects to the third element of the practice: meaning. First, people have noticed that other inhabitants from Livuwu own a water filter. Therefore, they feel that it is important to also be in the possession of a filter. They do not link this to anything else but stress the fact that it is important to have the same as their neighbour, family member or friend. Secondly, this explanation is sometimes linked to the importance of health. Respondents explained to us that they have observed a difference in health from the people who drink water from the filter. What this difference in health entails was not explained clearly. They acknowledge the importance to purify water and are therefore interested in the purchase of the water filter.

To be able to understand why this group does not buy the filter, we study the last element of the practice: competence. The latter group of people we discussed was not available during the distribution, however they are willing and able to purchase the filter. Competence is about the knowledge and skills needed to perform a practice. But it can also be useful to look at these elements when analysing the absence of a certain practice. In this case, the practice does not exist yet (drinking water from the filter) because most people do not know where to buy the filter. Stating that this is the only reason why the filter has not been purchased yet is not possible, because there was also a group of respondents who could tell where the filters are sold but this did not lead to the actual behaviour of purchase. In other words, even when the sayings of people show that a certain practice might come to

exist, the doings show that this is not the case. This is possibly because the nearest place where the filter is sold is Mzuzu - 2,5 hours by car. Most people rarely go here, which makes it difficult to purchase the filter. This group shows that it would be of great importance to create a possibility for people near the lake shore to purchase the filter closer to home.

The last reason for respondents not to buy the water filter is because people are not interested. Two respondents expressed that they simply were not willing. It was difficult to identify reasons behind this answer, because these respondents were also not very cooperating during the interview. When asking why there was no interest, both shrugged their shoulders and did not answer or repeated that there was simply no interest. One of the respondents finally explained that in her whole family no one had ever used a water filter or purified water in any other way, and they had all been fine. She could not understand the importance of the water filter if these family members could have lived a whole life without one (Respondent 54).

Conclusion

In this section I focused on the reasons why people did not purchase a water filter. It is important to understand the barriers for inhabitants of Livuwu to start this new drinking water practice using a water filter. Most people explained that their lack of income hinders them from buying the filter, or even considering this for health reasons. Secondly, a smaller group of respondents was not available during the WASH training and distribution. However, a large part of this group expressed interest in the purchase of the filter, but this did not lead to action and purchase. This group is willing to buy the filter and has the economical means - a group with the potential to change their drinking water practices. A possible explanation could be the accessibility to the filter, it is not sold in the nearby area which probably constraints many people. The last reason is because people are simply not interested and do not understand the importance of clean drinking water.

6.2 The drinking water practice: materials, competence and meaning

This section analyses the drinking water practices of people who own a water filter, by using the three elements approach provided by Shove et al. (2012). This approach helps us to entangle the practice and see how these three elements are linked within the practice. The structure of this section follows this approach - the first section identifies and analyses the *material* objects involved in the drinking water practice after the implementation of the project. What artefacts are used in the practice and how are they used? Various items were used in drinking water practices before, like a bucket to transport water from the source to

the house or a cup to drink the water with. But other objects entered the practice when this changed, for example the water filter and a toothbrush - other objects were sometimes no longer part of the practice, like a clay pot or cooking pans and utensils (when water was being boiled before drinking). In the second part of this section the focus is on the *competences* involved when practicing drinking water with the water filter. What knowledge is present on the practice and how is this knowledge transferred? Striking is the type of knowledge that people are able to reproduce, but also the information that convinced them to start using the water filter, which links to the third element *meaning.* Why did people decide to buy the water filter? What are the reasons behind this decision? What is important to them? To research the third element we will answer these questions.

As explained previously, this chapter will mainly focus on the changes that have occurred after the implementation of the project. Some parts of the drinking water practices have not changed and will therefore not be discussed again. Women and children go to the lake or the river with large buckets and fill these with water. They scoop the water into the buckets; put these on their heads and walk back home. At this point the procedure becomes, in most cases, different compared to before. Because at home the water filter is being used. The use of the water filter also connects to a new part of the drinking water practice: the cleaning of the filter. This is necessary to keep using the water filter.

The first change that should be mentioned before focusing on the different elements of the practice, is the difference in the amount of people that have now included the practice of 'purifying the water' into their bundle of drinking water practices. In chapter 4 I stated that 57% of the respondents used a method of purification before drinking their water. However, I also questioned whether this was happening daily and based on the interviews and observations I suspect that the actual amount of people using purification methods daily is considerably lower. The data also shows that after the introduction of the water filter, 87% respondents purify their water before drinking (taken into account that the randomized sample could have also influenced this). This is an increase that could have been expected after the introduction of the water filter. In the next sections the material, competences and meaning of the changes in practices are discussed, to get a more detailed understanding of this change.

6.2.1 Material

When thinking about drinking water most people might solely think of the cup they use to drink as a material needed to perform this practice. However, as I explained in chapter 4, there are many practices that are bundled together called drinking water practices - the practice from collecting the water to the actual performance of drinking the water. The object

that played a large role in these practices was the water bucket. After the introduction of the water filter it becomes evident that this has not changed. Additionally, a new artefact has entered the practice, the water filter, which has been discussed thoroughly in the previous chapter and will therefore only be mentioned in relation to the practice.

Before the introduction of the water filter two respondents used the method of boiling to purify their water. The materials they needed to perform this practice are no longer needed for their drinking water practices. Similarly, many respondents stored their drinking water (purified or unpurified) in a clay pot. This is something that still happens frequently, but 8 respondents changed this. They do not use the clay pot anymore but store their water in the water filter. This shows that because of the change in practice, artefacts have left the practice. However, these artefacts are still useful in each household since they are also part of other practices.

Artefacts that have entered the drinking water practice are the water filter, bottles and a toothbrush. The material elements bucket, cup, clay pot and water have remained as part of the practice. However, the material 'water' now involves different concerns and gives in a different way sense to the practice for many, which links to the meaning element of the practice and will therefore be discussed in section 6.2.3.

Because of the introduction of the water filter there is now a dichotomy of contaminated and purified water, which also shows in the usage of the buckets. Before, water was stored in buckets and used for cooking, cleaning or drinking. There was no division made between the several purposes of the water; the buckets just contained 'water'. Now it is clear that the buckets near the kitchen store water used for cooking and cleaning and the water filter and/or clay pot contain drinking water. This means that it may seem as if the practice of 'storing the water' did not change because of the arrival of the water filter, but this example shows that when zooming in on the material element the change becomes visible.

The artefact responsible for these changes is the water filter. In chapter 5 the focus was on the design of the water filter and its possible influence. In this chapter we analyse what happens when the filter is being used. Most of the water filter owners use the filter daily. The 7 respondents who do not use the filter daily can be divided into three groups. The first group does not use the filter because it is the rainy season. This links to the element of competence and will be discussed in section 6.2.2. Additionally, there is one respondent who does not want to use the filter. Her response of reasoning is further analysed in section 6.2.3. The last group does not use the filter anymore because it broke, and it cannot be fixed within the community. One of the goals of the project was the availability of spare parts for the community. However, after 1.5 years this is not the case. If people want to buy new spare parts they should go to a shop called Arcade in Mzuzu which is 2.5-3 hours from

Livuwu and can only be reached by four-wheel drive. The inability for people to buy new spare parts stops them from using the water filter and therefore drinking purified water. The four respondents who cannot use their water filter anymore reported that they have gone back to drinking unpurified water. This shows that when the material element of the practice is not available to the practitioners anymore, the practice stops. Because they do not have the possibility to buy spare parts, they cannot perform the practice anymore, which shows that the project is not sustainable. In the section 'meaning' we will further investigate this group.

When analysing the changes in the drinking water practices, we see a third artefact entering the practice: a bottle. When people leave their house in the morning to work on their land, they might want to take purified water with them. Respondent 52 explains that she pours the purified water from the filter into bottles and takes it with her to the land. This way she makes sure she can always drink purified water. These are plastic bottles, often empty soda bottles. Others explained that they do no not drink water from the filter when they work; during work they put water guard into their water. In other cases, people drink straight from the river or the lake when working. This shows that when people leave the place where the artefact is situated, the practice of drinking purified water no longer exists for them.

As explained in the introduction of this section - there is a practice that has been added to the bundle of drinking water practices: cleaning the water filter. This is necessary for the filter to keep functioning. To clean the filter, one needs water (purified or unpurified) to clean the upper bucket and purified water to clean the lower bucket. People use a cloth to clean the upper bucket but for the lower bucket they often only use water because of the risk of contamination when using a cloth. The cloth is an artefact that is new to this practice. Most people already own a cloth, used for other cleaning practices, but now it enters the practice of cleaning the water filter. To clean the candle, one needs a toothbrush. Similar to the cloth, is this also a new material element to this practice. When brushing the candle, it becomes smaller and smaller, and approximately between 1-2 years the candle should be replaced. People in Livuwu have the water filters for nearly 1 year and 4 months, and no one has a replaced candle. We observed great differences between the sizes of candles - the size of the candle can tell us how often it has been cleaned. It is also possible to clean the candle too often. The senior project officer from Temwa explains that he has encountered many households where people brush the candle repeatedly and the candle shrinks very fast. This is because people enjoy brushing the candle and feel more secure of its cleanness when they repeat this practice regularly. The toothbrush should also be replaced occasionally, but this rarely happens. Replacing the toothbrush depends on the income and whether people believe this is a necessity.

This section showed that the change towards the practice of purifying water with the water filter becomes visible when zooming in on the material element of the practice. However, using the material elements when performing the practice, requires certain skills and knowledge. This will be discussed in the next section about the competence element of the practice.

6.2.2 Competence

Besides the material element of the practice, we should also look at the competences that are required to perform the practice of drinking water using the water filter. The competence element considers the capacity of a practitioner to carry out a practice - from practical knowledge about the importance and functioning of the water filter, to necessary skills and know-how about the usage and how these skills and knowledge are shared.

Changes before the purification practice

It should be emphasized again that this chapter focuses on the change in drinking practice. Therefore, the skills and knowledge needed to collect the water and transport it home is not explained again. However, the location where the water is collected has changed for some households. Before, households often collected their water from a tap (if available), the river or the lake depending on the proximity of the location to their houses. This is not the only condition anymore, because the collection of water now also depends on the season. During the WASH training the inhabitants of Livuwu were taught that in the rainy season the water should only be collected at the lake. This is because the water of the river contains many particles such as mud in the rainy season which makes the water difficult to filter and the lower bucket will fill up very slowly. Most respondents shared this knowledge with us and get water from the lake. Two respondents explained that they do not use the water filter at all during the rainy season. They told us that all water contains dust, which might break the filter and they want to be as careful as possible with the filter (Respondent 30, Respondent 37). This lack of knowledge results in a pause of the practice for almost half a year.

After the transportation of the water, it is being transferred into the water filter. Some do this using a cup, others pour it directly from the bucket into the filter. This depends on the strength of the person pouring the water and the placement of the filter (if the bucket is heavy and the filter is placed relatively high, it is sometimes too difficult to pour the water directly into the filter without using a cup).

Doings and sayings

Nicolini (2012) provides the question 'What are people doing and saying?' when analysing the competence element. 'Saying' refers to the information provided by the respondents, 'doing' refers to the actual behaviour. In this research, we identified both the sayings and doings.

The research on the 'doings' had two components. Firstly, we identified the use of the filters by their owners and whether the usage was correct. In some cases, the actual use of the filters was not observable during our visit of the village. I still could say something about the 'doings' by, secondly, observing the filter - whether it was assembled and positioned in the right way. If people use the filter in the right way, I can conclude that they are competent. The mere fact that people assembled and positioned the filter in the right way, does not imply that they are competent in using the filter. If, however, the filter was incorrectly assembled and positioned, I could conclude that the villagers lack the competencies to use the filter properly.

We observed correct usage of the water filter. However, if people do not have the skills to use the water filter they will probably not do this and therefore incorrect usage of the filter was not observed. We observed men, women and young children pouring water into a cup and drinking this or giving it to babies. This behaviour shows that the water filter indeed is being used. We do have to take into account that our presence and questions about the water filter might encourage people to show us that they use it. The 'sayings' demonstrated that 90.9% of the filter owners could explain how to use the filter. The 'doings' are not consistent with this percentage. The artefact of the water filter can tell us more about the doings. If 90.9 % know how to use the filter (saying), 90.9% of the filter should show this (doing): it should be assembled correctly, standing in a firm position and out of reach of animals. We observed 76.4% of the filters assembled correctly, 62.7% were standing in a firm position and 74.5% were out of reach of animals. This disconnect between saying and doing could be explained with the 'responsibility-argument' - the respondent might not be the responsible person for the water filter. This will be further examined in the 'responsibility' section. Placing the filter out of reach of animals is necessary because animals could break the filter, as Respondent 31 explains: *"A chick came in the house, got on top of the filter and the filter fell. The candle broke and both buckets."* Not all 55 filters could be observed in use - 4 filters were broken, and the 3 other filters were placed in the parents' bedroom. In these 3 cases the interview was not with one of the parents and it is culturally forbidden to enter the master bedroom, therefore we could not see the water filter (Respondent, 4, Respondent 77, Respondent 78).

During the observations we did not observe anyone cleaning the filter. People could show us the toothbrush they used for cleaning and sometimes demonstrated the movement of brushing the candle. When taking a closer look at the filters, 18.2% were very dusty. People might claim that the filter is cleaned regularly but the amount of dust we sometimes encountered tells a different story.

Sharing and reproducing knowledge

In addition to Nicolini's (2012) distinction between sayings and doings, he also provides the question 'how is knowledge shared between practitioners?'. Knowledge about the water filter has entered the village of Livuwu during the WASH training in January 2017. During the training, only one person per household was present. This means that for family members of the trained person to have knowledge on the water filter, it should be transferred. It is possible to get an idea of the way information has been shared by interviewing the person that was not present at the training. If this person has knowledge on the filter and therefore the new drinking water practice, information was transferred correctly. From the 55 water filter owners, we interviewed 24 people who did not attend the training. This means that 43.6% of the water filter owners can only possess knowledge and skills on the water filter drinking practice if this has been transferred by the family member who attended the training. During the interviews, knowledge subjects were divided into 3 main sections: knowledge on water filter usage, knowledge about the functioning of the filter and knowledge about the cleaning (including the skills needed to perform the practice). While talking about these three subjects we could get a clear idea whether the respondents have obtained this knowledge and therefore if and to which extend information was indeed transferred. It shows in Figure 3 that within the group of filter owners who did not attend the WASH training, the ratio of people with knowledge compared to those who do not, is similar to the whole group. It could have been a possible assumption that those who did not attend the training would be the respondents who could not reproduce knowledge on the water filter, but this is not the case. The fact that not everyone can share information on the water filter does not necessarily relate to absence at the WASH training.

	Knowledge on water filter use	Knowledge on functioning water filter	Knowledge on cleaning water filter
All water filter owners	90.9%	74.5%	76.4%
Owners who did not attend the WASH training	87.5%	75%	70.8%

In the previous chapter is explained what the WASH training entailed. One of the main aspects of the training was an explanation about the functioning of the filter - what happens when the water drips from the upper bucket into the lower bucket and how the candle contains chemicals which purify the water. Most of the water filter owners (74.5%) could explain this correctly. Part of the 23.6% who could not explain the functioning of the filter, were the 4 respondents mentioned earlier who also did not know how to use the water filter correctly. Most of the others who could not explain this did not take part in the training. This shows that this knowledge shared at the training was remembered by the majority of the attendees, and they were able to reproduce this.

Responsibility for the water filter

During the interviews the correct usage of the filter was discussed. Respondents were asked to explain step by step how they use their filter. 90.9% could answer correctly and 7.3% were not able to do this. Possibly, there is a connection with the responsibility of the filter. In many households there is one person who is responsible for the water filter. The four respondents who could not explain correctly how to use the filter were not responsible for the filter. Additionally, 3 of these 4 respondents did not attend the WASH training. Accordingly, there is possibly a correlation between the knowledge on water filter use and responsibility for the filter and/or attendance of the WASH training.

In other words, often the person responsible for the water filter is also the one who has the knowledge and skills to deal with the filter. In some households it occurs that the filter will not be used if this person has left the house. In other words, when the person responsible for the filter is not at home, the practice of drinking water from the water filter stops (Respondent 5, Respondent 15, Respondent 20, Respondent 59). From these 4 respondents who explain that they stop using the filter when the responsible is gone, 3 possess the knowledge on the usage and cleaning of the filter. These people know how to

use the filter, but do not practice this when their wives have left (in these cases those responsible were all women). Respondent 5 explains that she visits Mzuzu sometimes and then places the water filter in the house of her mother in law. Her husband is not always home, and she cannot lock the house. She is afraid the filter might get stolen and therefore does not leave it at home. During these periods her husband and children do not drink purified water.

The committee: ability to repair and general functioning

Besides the knowledge and skills concerning using and cleaning the water filter, we researched the ability to repair broken buckets. As mentioned in the previous part about the material element of the practice, 4 respondents do not use their buckets anymore because they broke. If the water filter is severely damaged, there is no possibility for repair within in the village. However, with smaller issues there is one committee member who has the skills to fix this. Four respondents reported that their taps had broken, and they asked for help from the committee. Committee member Goodson would come by their houses and fix the tap for them. Goodson was mentioned in many interviews and has been a very active and helpful member of the committee. Because of his skills, many households can still perform the practice of drinking purified water. Many respondents mentioned Goodson's name and told us that he was the most active member of the committee. He had been very helpful as a committee member - some households were only able to mention Goodson as a committee member and could not recall the names of the other committee members. This also reflects on the role of the other members and their lack of active participation. The attitudes of the inhabitants of Livuwu towards the committee were inconsistent. Some respondents explained that they were unsatisfied about the committee because they did not perform their tasks. On the other hand, other people share that the committee did a great job and they expressed their gratitude and satisfaction.

The committee members voiced their complaints in the group meeting. They explained that during money collection inhabitants were often rude and disrespectful. Eventually, two employees of the CCAP SMART Centre and Temwa had to come back to Livuwu to finish the money collection. Suddenly people had money and could pay off their debts, whereas they told committee members they did not have the sufficient amount. This is an example that shows that assigning the task of money collection to the committee might not have been a good idea. Veldman (Project assistant CCAP SMART Centre) explained that in her experience committees often fail in development projects. However, the NGOs decided to include this in the project because this was the strong preference of the

community members. Next to the fact that the NGOs decided to honour these preferences, this also fits their philosophy of community-led development.

The practice of cleaning

To be able for the water filter to keep working, it should be cleaned regularly. During the training the cleaning procedure was explained and performed. The cleaning of the filter is a new practice and therefore contains new skills and knowledge. The lower bucket of the filter should be cleaned using purified water, the upper bucket can be cleaned with unpurified water and the candle should be cleansed/brushed with a toothbrush. It was stressed at the training that soap should not be used. This was repeated several times because the inhabitants of Livuwu were taught before by government health officials that cleaning is done with soap. Therefore, it might have been confusing for some that the cleaning of the water filter should definitely not entail soap. When sharing knowledge on the cleaning practice 76.4% knew how to clean the filter properly and all mentioned that soap should not be used. In the interviews these 42 respondents showed that they had remembered this and emphasized this to us. However, when asking the reason why they did not use soap, 50% could not answer this. Difficulties answering 'why' questions was something that stood out during most of the interviews. People, for example, remember that the filter should be placed at least at knee height, but have no idea why this is the case (Respondent 2, Respondent 52). Nevertheless, competence focuses on the capacity of a practitioner to carry out a practice. If a practitioner puts the water filter at knee height, does not use soap when cleaning and knows how to drink from the filter, it might not matter that the reasoning behind this is not understood. Additionally, many respondents admitted that they often forget information concerning the filter and were asking for more follow-ups and trainings from the CCAP SMART Centre and Temwa to remember them (Respondent, 3, Respondent 5, Respondent 15, Respondent 23, Respondent 25, Respondent 57, and Respondent 60).

The practice of storing the purified water

After the filtration of the water, people either drink the water straight from the filter (using a cup), or they transfer the water from the filter into the clay pot (this is what most people do - 87.3%), because the water stays cooler here. At this point, the water could get contaminated again because people might use dirty cups or buckets to transfer the water. Unfortunately, we did not observe this and can only base this on the answer of all respondents claiming to use a clean cup or bucket. When drinking the water straight from the water filter, it is of

course also of great importance to use a clean cup. We did observe this several times and the cups seemed clean, however this cannot be certain.

Gender

In chapter 4 on the history of drinking water practices it was explained that the collection and transportation of the water from the source to the house is done by women. Gender plays a strong role in this practice. If the women carry the responsibility for the first part of the practice, it might be possible that they also have the responsibility for the water filter. During the interviews it became clear that women are often responsible for the water filter, but not in every case. Women are responsible for the water filter in 45 (81.8%) households - in 10 households the man carries this responsibility.

This section focused on the competence element of the practice. It explained which skills and what knowledge people possess about the performance of the practice. The last step is to discover why people would perform the drinking water practices. What are the incentives for people to start performing this practice?

6.2.3 Meaning

The third element of Shove et al.'s model (2012) is meaning. The meaning element creates an understanding of the reasons behind the practice. Five main reasons were mentioned by the inhabitants of Livuwu to start using the water filter and in this section these will be discussed.

Changes before the purification practice

Before researching the meaning element concerning the purifying practice, I share the changes in the practices prior to purification. At first glance nothing seemed to have changed when asking about the 'practice walking to a water source'. However, in chapter 4 it was explained that the reason why people started walking towards the water source was not linked to a specific time, but whenever buckets were empty and they would have time available, the buckets would be filled. This has changed because the water filter requires to be filled at set times. Households need to make sure that the water filter is completely filled before the family goes to bed. The water does not get purified quickly - the water gets filtered drip by drip. When the filter is filled before night, the lower bucket of the filter will be filled

with purified water when they wake up. Therefore, the practice of collecting water is now directed by the need to fill the filter before bedtime.

Additionally, the perceived meaning of the element water has changed for many. Because some drank water straight from the lake before, this was just 'water' to them. But with the introduction of the water filter, the water from the lake has become contaminated drinking water, before it enters the filter to become purified. The idea of contaminated water did not exist, but because purified water now exists for them, the concept of contaminated water also came into existence.

The purification practice

The reason for buying the water filter that was mentioned the most was 'health' (96.4%). People would explain that they wanted to be healthy or reduce sickness in their families. Often this was linked to the Cholera outbreak of 2015. Sick people would be carried to the hospital (Respondent 23) to get treatment, others did not make it. This outbreak was in 2015, but when we interviewed the respondents, many told us that they did not treat their water before the introduction of the filter. Before the pilot project of the CCAP SMART Centre and Temwa, government health workers had already explained the importance of clean drinking water and sometimes provide chlorine (chapter 4). This shows that health is probably not the only reason and might not have been the driving factor to buy the water filter for some. Because if this were the case we could assume that people would have started treating their water already before with water guard, chlorine, boiling or other water treatment methods.

It could also be argued that the information provided by these health workers did not influence the inhabitants to change their behaviour. Telling and informing about health risks, without giving the villagers sufficient tools simultaneously, did not result in purification practices. I believe this is a possible explanation because of the enthusiasm of the inhabitants about the WASH training provided by the CCAP SMART Centre and Temwa. The respondents explained that this training was very convincing, and this was the reason they decided to buy the water filter. Different elements of the training were mentioned that were convincing. First of all, the change in colour of the water when dripping from the upper bucket into the lower bucket. The fact that people could observe - see with their own eyes - that the colour changed was convincing for many and meant that the water filter really did something. Additionally, because the water from the lake and river was now in a transparent bucket, people could see that the water coming from these sources was not clear. In the colourful buckets used by the villagers, it is not possible to see this, and the water can seem

clear (Picture 3). Respondent 31: *'The training showed that the water we were drinking was dirty, that was the reason to buy and be healthy'*.

Picture 3 Water filters showing the colour of lake water

The second argument that was convincing during the training was the taste of the water. People were able to taste the water from the lower bucket - the purified water - and could experience a different taste compared to what they are used to. This again showed to them that the water filter really changed the water. In short: the fact that people were able to observe how the filter works convinced them to try the filter.

Next to the arguments of health and the training being convincing, several villagers mention that they bought the water filter because it is a new development. New developments entering the village make people curious and think *'let's give it a try'* (Respondent 5, Respondent 7, Respondent 36, Respondent 41, Respondent 62, and Respondent 67). Respondent 5 shares that many people in Livuwu are ignorant when it comes to health practices, because there are no direct problems. She also says this about herself. When asking her why she was not ignorant towards the water filter, she explained*: 'it is a new development, so I wanted to try it'*. Being the owner of 'a new development' can make people proud. This is because it is something new and made from plastic, with a modern look. Respondent 62 is proud that she has a bucket with a tap and that she knows how to use the filter if she would find one in another village. This feeling of pride links to the idea of ownership discussed in chapter 5.

The combination of these three arguments - the importance of health, the observed usefulness of the filter during the training, and the fact that this is a new development which

makes people curious and proud to own - was the main drive for the inhabitants of Livuwu to purchase the water filter.

A factor that also influenced the purchase of the water filter are family members, neighbours or other acquaintances - 69.1% of the respondents explained that it is important to have a water filter if one of your acquaintances also owns one. Understanding the reasoning behind this was rather difficult - people had difficulties explaining why this was important. However, there was one group in the village who received the training two months after the first distribution because they were not available the first time. For them it was important that their friends and family already owned a filter in order to observe change. Also, solely the fact that others owned the filter (whether this resulted in change or not) affected Respondent 36: *'Others were using it (the water filter), so then I also wanted one'*. From the 30.9% that stated not to be affected by others, most share the opinion from Respondent 16*: 'It was my own decision to buy the filter, to be healthy, it had nothing to do with friends'* or from Respondent 23*: 'It is not because of others, but the training convinced me'*. The possible influence of friends and family links to the idea of a community feeling.

The last argument that was mentioned by several respondents is safety. Using the water filter for water purification is a very safe option. The water drips into the lower bucket, and the purified water can be drunk straight from there. Because the purified water is stored in the water filter, it stays safe from any possibility of contamination (Respondent 32, Respondent 47, Respondent 49, and Respondent 59). Respondent 59 compares this to the situation at her house before the water filter, when she stored the water in buckets with no lid - this was not safe: *'Now the water is always covered in the filter and you know that it is definitely protected'*.

Besides the often mentioned arguments of health, the training, a new development, influence of acquaintances and safety, two respondents mentioned reasons related to responsibility. The first argument, introduced by Respondent 53, concerns responsibility towards her family. She feels a responsibility as a woman to provide clean water for her family. This feeling motivated her to buy the water filter. Respondent 6 did not feel responsible towards her family but towards health officials. She explained that she might have gotten sick because of contaminated water which would lead to hospital visits and therefore costs. It is possible that health officials would have to pay for these costs if she is not able to. Therefore, she felt the responsibility to start using the water filter and prevent this from happening.

All the reasons mentioned above were drivers to purchase the water filter, but combined with the observed change in health, they also encourage people to continue using the water filter for drinking water. The majority of users (94.5%) have experienced a

decrease in sickness which is an important incentive to sustain this drinking water practice. Even though Respondent 1 did not experience water related diseases in the past, and therefore does not experience a decrease in sickness, he feels a difference when drinking purified water: '*My body feels much stronger*'.

One respondent was reluctant to answer the questions and told us that she does not use the water filter. She says that she bought the filter for health reasons but does not go into detail about this. When trying to understand why she is not using the filter anymore she responds that she 'just doesn't want it'. This woman shows that when the meaning element of the practice is non-existent, the practice is not being performed. There is no drive for her to use the filter, even though she owns the material and has the knowledge and skills to use the filter.

Finally, we investigate the group of four respondents (Respondent 31, Respondent 33, Respondent 55 and Respondent 57) mentioned in section 6.2.1 - the group of four respondents who cannot use their filters anymore because it broke and returned to their previous drinking water practice. For all four respondents the past drinking water practice signifies drinking straight from the lake - not purifying their drinking water. When the material element, the water filter, is not part of the practice anymore, drinking purified water using the water filter does not exist anymore. However, when interviewing these respondents, they all explained that they decided to purchase the water filter because they want to become healthier. This example shows that the argument of health is not the only drive for these people to drink purified water. The water filter plays a significant role in the practice of drinking purified water. These people could use other methods to purify their water. Nevertheless, they only purify if they can use the filter. This strengthens the third argument mentioned above: people purchase and use the water filter because it is a new development. This might imply that, in this case, using the water filter is more important than drinking purified water. Possibly this group mainly uses the water filter because it is a new development, not because it provides clean drinking water.

6.3 Conclusion

This chapter analysed the changes in drinking water practices after the implementation of the water filter in Livuwu. Many of the first practices that are part of drinking water practices, from collecting the water to bringing it home, do not include major changes. The moment of water collection has shifted - the filter is always filled in the evening, in order for the lower bucket to be filled with clean water in the morning. Besides this, the source where the water is collected is now depended on the season - in the rainy season people collect water from

the lake because the river water is too dusty to be poured into the filter. Because of a lack of knowledge some people some people do not purify in the rainy season and the drinking water practice using the water filter pauses for half a year.

The purification practice has changed substantially. Most inhabitants did not purify their water frequently in the past, however people who now own a water filter use it regularly. This is mainly because people desire to become healthier and they were convinced during the educational training that the water filter is a well-functioning system, which improves the taste, colour and therefore quality of the water. However, this study also shows that many inhabitants decided to purchase the water filter because this is a new development and becoming the owner of this modern artefact can enhance a feeling of pride. I believe this is the guiding argument for most inhabitants to use the filter. First because people who cannot use their water filter anymore due to damages return to the practice of drinking unpurified water. Whereas, if health was the dominant reason, people could continue purifying their water using other methods. Additionally, before the introduction of the filter people were already informed by health officials about the dangers of drinking water without purification. This did not lead to frequent purification for many. The introduction of this new development, which is easy to use and guarantees safe and clean water, encouraged people to start performing the practice of purification.

For others it was not possible to purchase the filter. This was mainly because people did not have the economical means. This group explains that purification is not priority because it is not feasible for them. The other inhabitants who do not own a water filter, would be interested to purchase one, but were not available during the distribution. Being able to purchase a water filter and start the practice of purification would be possible if the filters are sold in the Livuwu surroundings.

Besides the reasoning for changing practices, the usage of the water filter can also be identified when focusing on the material elements of the water filter. The water filter itself can tell us whether the filter is being used and whether this is done properly. This also links to the competence element of the purification practice which showed that the majority of the filter users possess the necessary skills and knowledge to use and clean the water filter. However, possessing these skills does not necessarily mean that the practice is being performed. This study shows that responsibility for the filter is key in the performance. In most households there is one person who is responsible for the filter, and the data demonstrates that the practice sometimes stops if this person is not present in the house. Furthermore, when people leave the place where the artefact is located, the house, the practice if often not performed anymore. Some respondents explained that they pour purified water into a bottle to take with, but this is not always the case.

Finally, a practice that entered the bundle of drinking water practices is the cleaning of the water filter. This practice entails new skills and knowledge necessary to perform the practice. Many respondents have obtained these skills and can explain how to perform this practice. A toothbrush and a cloth have therefore entered the practice and show us how the practice should be performed. This section gives a clear overview of the changes that have occurred in the drinking water practices after the introduction of the water filter. In the conclusion I will link these results to the previous chapter and investigate the influence of the filter design process and the project proposal process on these changes.

7. Discussion

This chapter will give a critical reflection on the research performed. First, I will reflect on the value of practice theory and the social construction of technology. Second, the contribution to the body of knowledge on WASH project is discussed. Last, I explain the societal relevance of this research and will reflect on the chosen methods.

Reflection on the theories

In this section I will reflect on the usage of the social practice approach and the social construction of technology approach. How did these theories contribute to my research and what were the limitations?

The usage of social practice theory as a framework to analyse my data resulted in detailed insights of the drinking water practices and therefore into the success of the project. This perspective moved the focus of analysis from the individual to the practice. Combining this with SCOT, led to the water filter being considered as a material element or artefact embedded in a social system and not solely as the physical solution to the safe water problem. Social practice perspective showed that we should look beyond the water filter and ask the practitioner how and why he or she performs (or does not perform) the practice.

The element approach of Shove et al (2012) gave me the opportunity to analyse the practices in a concise and clear way. Using this three elements approach had both its risks and advantages. The main risk of this approach is that it oversimplifies practices. First, practices are dynamic and can be very complex – researches that limit practices to these three elements, run the risk of reductionism. This should be kept in mind during interviews and the analysis of the data. The researcher should not only focus on these three elements during interviews and simply 'tick the boxes', but also go into different issues related to the practices that come up during the interview. Second, when analysing the data, I had to be aware that not all data can be categorised with the help of the three elements, which does not make this data any less valuable. This is in line with the observation of Røpke (2009) that the nature of practice theory is rather abstract and that developing an empirical study could lead to complications. He argues that decisions on, for example, the inclusion or exclusion of practice elements should be made with the purpose of research in mind. Therefore, I believe using this three elements approach was a useful tool, because the risk of reduction was kept in mind.

The main advantage of the practice approach was its possibility to unravel motivations for people to use the filter. When asking respondents the reasoning behind the

usage of the water filter, almost everyone explained that this was for health reasons. People claimed to understand the consequences of contaminated drinking water very well. Focusing on the group of people who used to own a filter, but because of damage could not do this anymore, resulted in a surprising observation: although people say that health is key, they go back to the old practice of drinking unpurified water. This practice shows us that the importance of health might not be the most important reason for the inhabitants of Livuwu, since there are other options of purification. When it comes to purification, people do purify their water with the filter, but not with, for example boiling or other inexpensive methods. This makes it more plausible to believe that people mainly use their water filter because it is a new development. Focusing on the practice, the actual doings and sayings, and the discrepancy between these, showed me that.

Looking at the water filter as the material element of the practice shows that it has linkages to the other elements - coming together in the drinking water practice. It explains that different meanings are attached to the filter. The filter is not only being used because it purifies the water and the water taste improves, but also because it is a new development. People are proud to own an artefact with a tap and are proud that they have the skills to use the filter. Practice theory helped me analyse this.

Using SCOT led to important and interesting additional information, for example when analyzing the implementation process of the project, it seemed as if both producers and users were involved in this process. Therefore, closure was reached rather fast and the artefact could be introduced in the village. Usage rates show that most people who own a water filter, also use the filter. However, when the filter breaks, the practice stops. SCOT can show us that the process surrounding the water filter should have also included the structure around the artefact: the maintenance. The producers suggested a shop where these products could be sold, however the users shared their meaning that shops selling these specific products often go bankrupt. In other words: there were different groups with different meanings, and after discussion there was no end conclusion, no closure. Because of the lack of closure, it was not possible to establish a technological frame for the maintenance structure - there was no script for the provision of spare parts.

The example above shows the added value of combining two theories. Theories can complement each other and provide the researcher with additional information. However, social practice theory and social construction of technology theory are ontologically different. One would assume that problems arise when both theories are integrated. Combining these theories did not lead to any complications, mainly because the outline of this study is chronological. Chapter 4 and 6 concentrate on the practices whereas chapter 5 analyses the design process of the filter and project with SCOT. The incorporation of both theories can be

found in chapter 5 - explaining that it is essential to keep the practice in mind when designing a new technology. SCOT can be defined as an actor-oriented theory with different social groups discussing an artefact. Combining this with a social practice approach demonstrates that one should consider the practice while designing a new artefact. This way the design will not only be a new technology, but the material element of a practice. The material element is linked to the competence and meaning element which can now be incorporated in the design process.

In addition to these risks and advantages, I have my doubts about the added value of Spaargaren's (2003) contextual approach with the concepts of lifestyle and system of provision, for this particular case. I can imagine that using this approach when examining complex change processes or large projects can be very relevant, compared to this relatively simple change process. By calling the Livuwu water filter process 'relatively simple', I refer to a limited number of actors, one artefact, a remote and small area, and a rather closed system of provision. The more complex the society and different lifestyles of people, the more this will influence the practice, and the more relevant this contextual social practice approach as an analytical tool will be. Of course, I cannot be sure about this. Had I had more time, I could have researched the systems of provision and lifestyle more thoroughly and could have possibly found that this practice is much more complex, e.g. because of underlying institutions, which would have made Spaargaren's conceptual approach more relevant.

A limitation of my research is the focus on the drinking water practice. The social practice approach is a useful tool to explore connections between different practices. During my visit in Livuwu, I realised that the WASH training often only resulted in usage of the water filter, whereas the goal was to influence all WASH practices. Unfortunately, this goes beyond the scope of this research, but for further research it would be interesting to investigate how these different practices are linked together and how they do or do not influence one another.

Contribution to the body of knowledge on WASH projects

This research contributed to the body of knowledge about WASH projects, or other development projects introducing a technological artefact. The body of knowledge already existing around this topic is a mixture of different expertise, for example from the world of engineering, economics, behavioural sciences and health. The sociological perspective of this study contributes to the body of knowledge to improve the implementation of similar projects.

This is first of all because of the qualitative approach in this study. This research method has been underutilized in WASH research (Jordan & Kaminsky, 2017). Jordan and Kaminsky (2017) claim that the method most used in WASH research is the randomized controlled trial. Methodological issues related to this quantitative approach concern the use of closed-ended questionnaires which allow for statistical analysis but 'force individual response intro pre-determined schema that may or may not be appropriate' (Jordan & Kaminsky, 2017, p. 196). Besides this, a common quantitative approach issue is the difficulty to discover the reasoning behind answers. I believe that the reason behind the use of quantitative research in development projects is often linked to the necessity for funding. Funding agencies are used to base funding decisions on numbers and statistical indicators (Frechtling, 2002). Quantitative research may show how many filters were distributed and how many are being used one year later. Based on those findings it could be concluded that a large number of respondents still use the filter, but it fails to address the problems people experience with the filter and therefore possible solutions to make these projects more sustainable over time. This study illustrates the importance of qualitative research – it addresses the complexity of WASH projects and shows that funding tends to focus on short term successes.

Additionally, this study researched a WASH project which strives to be community-led. This is a goal that other WASH projects also strive for. This research adds to the literature that has been dedicated to investigating community-led projects - the choices made with this philosophy in mind, the difficulties encountered when implementing this type of project and the results it can lead to. This is important because research shows that community-led projects have not been as successful as one might hope. Mansuri & Rao (2004) reviewed projects that create effective community infrastructures and explain that 'not a single study establishes a causal relationship between any outcome and participatory elements of a community-based development project'. This shows that there is still a struggle to implement community-led projects and more research will lead to more insight into this struggle and possible solutions.

Another important contribution of this research is the practice approach when analysing WASH projects. Besides the fact that most WASH researches use quantitative research tools, the focus on practices is not a common approach in this field of research. Adding different approaches to the variety of analytical tools used for the evaluation of WASH projects broadens the perspective and retrieved knowledge because of the usage of different approaches.

Finally, in addition to the contribution to the general body of knowledge on WASH projects, this study strengthens particularly the literature on WASH projects in Malawi. The

literature on Malawian projects is scarce. Research shows that often WASH sector aid in Malawi is not targeted to the areas with the highest need for WASH interventions (Marty et al. 2017). With a scarcity of projects for the most needed, it can be assumed that the literature on these projects is also limited. This study can be an example of a project targeted at the most needed.

Societal relevance of this research

The issue about the maintenance described above, does not only contribute to the body of knowledge on WASH projects, but also shows how sociological theory can be employed to analyse these projects, which results in recommendations for organizations implementing WASH projects. The main goal of the NGOs was to study the potential for behaviour change in this pilot project, and hopefully expand to other areas. My research reveals the reasons behind the purchase of the water filter and explains why people decide not to purchase a filter. Project producers can learn from these answers and respond better to the needs of people with this information in mind, and therefore improve the sustainability of this project.

In the conclusion of this study I will go into these recommendations. This is of great importance because globally there are so many development projects being implemented and not leading to success. It is often thought that community-led projects have a greater chance at succeeding. However, projects that rely on community participation are often not particularly effective at targeting the poor (Mansuri, G. & Rao, V., 2004). This project confirms this - the poorest of the community are not a part of the project, and therefore stresses the importance of a change in strategy to involve the poorest.

Methodology reflection

In this part I would like to start with the strengths of this research. First, the remote setting of Livuwu, my dependency on local transport and the necessity to work with a translator were barriers to data collection and research. I will go into these barriers in this section, but the fact that I managed to interview 79 households despite these circumstances is a strength of this research. The choice for the social practice approach, and therefore the use of qualitative methods was a great benefit for this research. The local project team used a quantitative approach during their baseline and half year research, but to research a project like this I believe qualitative data is extremely useful. Understanding the reasons why people perform a practice or not and discussing in detail the knowledge and skills the respondents have gained, results in a broader understanding of the people's behaviour. Finally, my

approach was systematic and structured. After the first day conducting interviews in Livuwu, we reflected on the first day, adjusted some of the questions to improve the flow and create a better understanding for the respondents.

On the other hand, this research has several limitations. First, I was constraint by transportation. As mentioned before is the Livuwu area very difficult to reach. There are only two four-wheel drive cars that occasionally move between Livuwu and Mzuzu. This made me very dependent on the schedule of the driver.

Secondly, this thesis is limited to a certain amount of time in the field. Because of this I was not able to interview all inhabitants of Livuwu or spend more time in the field observing. Despite this, we were able to interview 79 of the 135 households in total.

The third limitation of this research was my lack of knowledge of the languages Tonga and Chitumbuka. Because of this language barrier, I had to work with an interpreter. Unfortunately, the interpreter did not always translate everything. Additionally, translation is an interpretative act - meaning may get lost in the translation process.

The last limitation I will mention in this discussion is my role as a researcher. In my methodology I explain that the researcher should try to be a fly on the wall. Literature explains that this is the best situation when researching a practice. When I arrived in Livuwu I immediately realised that I could never become a fly on the wall in the limited amount of time I was going to spend in the village. I believe that even after years living in Malawi it is still impossible for a white person to be a fly on the wall. My colleagues from Mzuzu with a white skin colour, who had lived in Mzuzu for years, explained to me that people still stare at them and call them 'the mzungu', a term used for white people. In my time in Livuwu I was 'the mzungu'. From the moment I crossed the river and met the first inhabitants, I felt like an elephant on the wall. Within moments the whole community knew that a white person had entered their community and each day there was a group of children following me around the village. I believe this had implications for my research. However, it should be mentioned that each researcher, no matter the skin colour, will have an influence on the research. Research is about examining a subject in the natural context; however, the fact that the researcher is present already changes the context. This will always be the case.

The fact that I was considered a mzungu was, on the one hand, positive, because people were all very excited to talk to us and nearly everyone we approached invited us into their homes. However, on the other hand, people knew I was a researcher, which might have led to socially acceptable answers. Having a mzungu in their house could also have influenced their behaviour. People might have felt privileged to welcome a mzungu into their homes, which again led to socially acceptable answers. My presence might have also been distracting at times, because some people were more focused on my mzungu role compared to my researcher role, which led to conversations drifting away from the subject.

This chapter has covered academic, societal and practical implications of this research. The relevance of social practice theory and the social construction of technology approach in this context were discussed. Additionally, further research into the linkages between WASH practices was mentioned. In the next chapter I will summarize the findings of this study. The results of this practice-based research will be presented regarding the influences of the development of the Safi T9 water filter on drinking water practices, including their sustainability, after the implementation of a WASH project and the possible explanations will be discussed.

8. Conclusion

In this research the influence of the development of the Safi water filter on drinking water practices in Livuwu and the sustainability of these practices have been analyzed. In this chapter I will answer the main question of this study:

What are the influences of a ceramic candle water filter on drinking water practices after the implementation of a WASH project, and what explanations for these influences can be given?

The first part of this study answers the *theoretical questions* concerning the added benefit of social practice theory and the theory of social construction of technology (SCOT), that have been used as analytical tools. Social practice approaches behavioural change by focusing on the practice instead of using rational choice as a driving force of human behaviour. These practices can be analyzed by focusing on three elements: material, competence and meaning. Individuals are the carriers of these practices and by zooming in on the practice, it is possible to identify change.

SCOT-theory helps to understand where the introduced artefact, the water filter, comes from - because a new technology is created by human action and interaction. The artefact has been designed, became part of a NGO-proposal and was implemented. During these processes various social relevant groups can be identified, having their own ideas of the problems the new technology is supposed to solve. The SCOT analyses of these processes are connected to the drinking water practices after the introduction of the water filter.

I discussed the drinking water practices in Livuwu before the introduction of the water filter step by step – my first *empirical question*. The drinking water practice is a bundle of practices, starting with the practice of walking towards the water source and ending with the practice of drinking the water. A description of these practices is necessary, in order to identify the main changes after the introduction of the filter.

SCOT argues that technological innovation is a process of co-creation. Therefore the next *empirical questions* were answered - *'Which social relevant groups are involved and what role do they play?'* and *'Which factors influenced the decision making process regarding the design of the water filter and the project proposal?'*

In order to understand both the involvement of stakeholders and the factors shaping the practice, I distinguished two phases: the design of the filter, and the proposal-phase

comprising the decision making about the selection of the filter and the design and implementation of the project in Livuwu.

In the design phase, there were only two actors involved: an expert in WASH solutions designed the Safi water filter, in interaction with the Ministry of Health. The designer took the perspective of the end-user into account - safety of water (proven by certificates of the Ministry of Health), good taste, good smell, affordable, good appearance, ease of use and local production. This phase can be defined as a predominantly expert-driven stage.

In the proposal phase of the project, the only groups included in the decision on the Safi filter were the two NGOs. In this phase the Safi filter was selected based on its availability, local production, high efficiency compared to other options and low costs. Part of the proposal was an educational WASH training to teach people about the usage and importance of the water filter. Besides that, the proposal included the distribution plan, which was based on a try-and-buy approach.

The last phase involved the end-users. Many issues were raised by the inhabitants of Livuwu. The NGOs responded to these issues and without further discussion closure was reached.

To understand the change in practices after the introduction of the water filter the last _empirical question_ was answered *'How have drinking water practices changed after the implementation of the WASH project?'*
Chapter 6 provides a detailed overview of the changes in drinking water practices. For the sake of readability, I will present the most important empirical findings in the next sections that present the analysis of the introduction of the water filter.

'What factors explaining the changes of drinking water practices, can be retraced to the design process of the water filter and the proposal process of the project, respectively?'
This first _analytical question_ concerns the explanation of the changed water practices. To answer this question, I first analyse the reasons for people to purchase the filter, followed by an analysis of the main issues that emerged.

Zooming in on drinking water practices showed that the main reason for water filter owners to start using the filter was the desire to be healthy. For some people, the argument of health was sufficient to buy a filter. Others were convinced during the educational training, where people could observe a change in the colour of the water and in taste. Additionally, there was the remarkable argument of the water filter being a 'new development'. People are proud to own a modern, well-designed plastic artefact with a tap. The fact that people who cannot use their water filter anymore go back to the old practice of drinking contaminated

water and do not look into other methods of purification indicates that the argument of the 'new development' and the attractiveness of the design (in particular the tap) might even have a stronger relation to the usage of the filter than the health argument.

How can I relate these observations to the process of design and the subsequent process of proposal and implementation? As mentioned before, the design process was mainly an expert decision process with the user in mind. The producer of the artefact knows Malawi and the Malawian user very well and was therefore able to produce a highly accepted artefact. He stressed the importance of the appearance in the design process of the filter. It becomes evident that he succeeded: the elements he considered when designing the filter were mentioned by users as arguments for usage.

The results of this study show that high user involvement is not always necessary in the design process of an artefact. This result has one nuance: since the attractiveness of the design is a key explanation for the acceptance of the filter, involving users in the esthetic part of the design process, might have added value.

Main issues

Drinking water practices have changed for the majority of the inhabitants of Livuwu. However, this is not the case for all inhabitants - there were several issues.

First, there is a significant group of inhabitants who are willing to purchase the filter but cannot afford this. This issue was known and raised during the proposal phase. The NGOs explained that the committee could decide on providing filters to the most impoverished households, but this issue disappeared from the NGOs' agenda. In other words, involvement of the user group during the project proposal process raised a relevant issue, but this was not solved by the NGOs.

Second, people are not able to buy spare parts or new filters because the filters are sold a 2.5-3 hour drive from their homes. This key issue was also raised by the villagers in the final phase of the process. The NGOs did not solve this problem. This has major consequences: people who need spare parts cannot perform the purification practice anymore and go back to drinking contaminated water. A possible explanation for the NGOs non-response on these two issues is their project orientation. They worked on this project and after finishing it, their attention shifted to creating and implementing new projects. Maintenance of finished projects is not their priority.

Third, my results show that some households do not use the water filter during the rainy season because they are afraid the water will clog the filter. These inhabitants had misinterpreted this information and their drinking water practice using the water filter stopped

for a half year. This could have been noticed earlier if frequent monitoring would have taken place. This was the task of the committee, which links to the fourth issue.

Fourth, the NGOs acknowledged the importance of involvement of the users and because of their ambition for community-led development projects, they decided to create a committee. This is a paradox because the NGOs on the one hand know by experience that committees in their projects often do not work. On the other hand, they would offend the community if they would not set up a committee. The paradox is that one creates a committee involving the community, already knowing that this will not work. The main reason for the malfunctioning of the committee was low commitment, which was a result of a lack of incentives. Committee members explained that they were too busy to work for the committee voluntarily. Due to the project orientation of the NGOs, they also did not pay much attention to the malfunctioning of the committee.

It can be concluded that drinking water practices changed for the vast majority of the inhabitants. Most inhabitants who purchased a filter are using it for purification. However, there were also major problems. Two of these problems - affordability and spare parts - had been addressed in the project proposal process, but the NGOs did not pay enough attention to these problems, probably due to their project orientation. The third problem - use of the filter during the rainy season - should have been managed by the local committee. This committee does not function well, which is what the NGOs expected, but they simply could not decide not to install a committee. Again, the functioning of the committee was also out of scope for the NGOs.

The last _empirical question_ focuses on the sustainability of the practices. The observations above - the affordability issue, the non-availability of spare parts, the lack of knowledge and the under-performing local committee - make clear that the drinking water practices using the water filter in Livuwu are not sustainable. Over the years more water filters are likely to get damaged and candles need to be replaced – if this does not happen the practice cannot be performed anymore. In addition to this, in some cases the practice stops if the person responsible for the filter leaves the house. Remarkably, many of these issues have been raised during the proposal phase, but have not been followed up by the NGOs.

Recommendations
The issues mentioned above lead me to a series of recommendations concerning aspects of the project which could lead to more sustainable drinking water practices.

The first recommendation concerns the design phase - the expert should have local knowledge. If this is the case, user-involvement is not always necessary. However, since the esthetics of the design may have a huge impact on the acceptance, some involvement on this aspect might be valuable.

Second, health is an important argument for the inhabitants to start using the filter. In some cases, they have to be convinced by showing that the filter produces clean and well tasting water. Therefore, it was of great value to add a WASH training to the project, instead of solely explaining the usage of the filter. The design of the filter and the mere fact that this is a special artefact also contributes to the acceptance - and may be even more important than the health argument.

Third, the local community should be involved in the process of implementation. It is important to pay extra attention to the concerns, raised by the users, that might be out of the project-scope of the NGOs. There is the risk that these issues will not be resolved and influence the sustainability of the practices.

Fourth, the position and performance of the local committee should be strengthened by paying attention to the incentive-structure. The present incentives are too weak to perform sufficiently well. A better performing committee will result in better information for the users - and in a better utilization of the water filter.

Finally, the main concerns of the users regard affordability issues and maintenance issues. Both issues are key for the sustainability of the project. A project should not be considered 'finished' after the distribution and one-year evaluation which shows that many inhabitants are still using the filter. The drinking water practice should be sustainable and requires a maintenance structure for the people to continue performing this practice independently.

Besides the recommendations concerning the sustainability of the drinking water practices and therefore the project, I recommend further research. This study has touched upon one WASH practice: safe drinking water. However, as becomes clear in this thesis, the practice of drinking purified water is not enough to assure a healthy life. The other practices discussed during the educational WASH training should also be performed, for example washing hands, using a toilet etc. In Chapter 5 it is explained that drinking water practices are part of the bundle of WASH practices. Further research should focus on the connectivity between these practices and investigate possible solutions to influence these practices as a whole.

Finally, it should be taken into account that there is no blueprint for WASH projects. Each village is different, and people can therefore respond different to projects. This study used a social practice and SCOT approach to analyse the influences of the Livuwu WASH project.

These results should be taken into consideration by organisations developing WASH projects in order to increase sustainability. Improving and implementing WASH projects are necessary steps to contribute to reach Sustainable Development Goal 6: clean water and sanitation - and prevent people from dying because of preventable water and sanitation-related diseases.

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Appendices

Appendix 1 - Interview list

Respondent	Drafted On		Gender
Fishani Msafiri	25/04/2018	Senior project officer Temwa	Male
Rianne Veldman	20/03/2018	Project assistant CCAP SMART Centre	Female
1	04/04/2018	Inhabitant Livuwu	Male
2	04/04/2018	Inhabitant Livuwu	Female
3	04/04/2018	Inhabitant Livuwu	Male
4	04/04/2018	Inhabitant Livuwu	Female
5	04/04/2018	Inhabitant Livuwu	Female
6	04/04/2018	Inhabitant Livuwu	Female
7	05/04/2018	Inhabitant Livuwu	Female
8	05/04/2018	Inhabitant Livuwu	Male
9	05/04/2018	Inhabitant Livuwu	Female
10	05/04/2018	Inhabitant Livuwu	Male
11	05/04/2018	Inhabitant Livuwu	Female
12	05/04/2018	Inhabitant Livuwu	Male
13	05/04/2018	Inhabitant Livuwu	Female
14	05/04/2018	Inhabitant Livuwu	Male
15	05/04/2018	Inhabitant Livuwu	Female
16	05/04/2018	Inhabitant Livuwu	Male
17	05/04/2018	Inhabitant Livuwu	Female
18	05/04/2018	Inhabitant Livuwu	Female
19	06/04/2018	Inhabitant Livuwu	Female
20	06/04/2018	Inhabitant Livuwu	Male
21	06/04/2018	Inhabitant Livuwu	Female
22	06/04/2018	Inhabitant Livuwu	Female
23	06/04/2018	Inhabitant Livuwu	Female
24	06/04/2018	Inhabitant Livuwu	Female
25	06/04/2018	Inhabitant Livuwu	Female
26	06/04/2018	Inhabitant Livuwu	Female
27	06/04/2018	Inhabitant Livuwu	Female
28	06/04/2018	Inhabitant Livuwu	Male
29	06/04/2018	Inhabitant Livuwu	Female
30	09/04/2018	Inhabitant Livuwu	Female
31	09/04/2018	Inhabitant Livuwu	Female
32	09/04/2018	Inhabitant Livuwu	Female
33	09/04/2018	Inhabitant Livuwu	Male
34	09/04/2018	Inhabitant Livuwu	Male
35	09/04/2018	Inhabitant Livuwu	Female

36	09/04/2018	Inhabitant Livuwu	Female
37	09/04/2018	Inhabitant Livuwu	Male
38	09/04/2018	Inhabitant Livuwu	Female
39	09/04/2018	Inhabitant Livuwu	Female
40	09/04/2018	Inhabitant Livuwu	Female
41	10/04/2018	Inhabitant Livuwu	Female
42	10/04/2018	Inhabitant Livuwu	Female
43	10/04/2018	Inhabitant Livuwu	Female
44	10/04/2018	Inhabitant Livuwu	Male
45	10/04/2018	Inhabitant Livuwu	Male
46	11/04/2018	Inhabitant Livuwu	Female
47	11/04/2018	Inhabitant Livuwu	Female
48	11/04/2018	Inhabitant Livuwu	Female
49	11/04/2018	Inhabitant Livuwu	Female
50	11/04/2018	Inhabitant Livuwu	Female
51	11/04/2018	Inhabitant Livuwu	Female
52	11/04/2018	Inhabitant Livuwu	Female
53	11/04/2018	Inhabitant Livuwu	Female
54	11/04/2018	Inhabitant Livuwu	Female
55	12/04/2018	Inhabitant Livuwu	Female
56	12/04/2018	Inhabitant Livuwu	Female
57	12/04/2018	Inhabitant Livuwu	Female
58	12/04/2018	Inhabitant Livuwu	Male
59	12/04/2018	Inhabitant Livuwu	Female
60	12/04/2018	Inhabitant Livuwu	Male
61	12/04/2018	Inhabitant Livuwu	Female
62	12/04/2018	Inhabitant Livuwu	Female
63	12/04/2018	Inhabitant Livuwu	Female
64	12/04/2018	Inhabitant Livuwu	Male
65	12/04/2018	Inhabitant Livuwu	Female
66	12/04/2018	Inhabitant Livuwu	Female
67	12/04/2018	Inhabitant Livuwu	Female
68	12/04/2018	Inhabitant Livuwu	Female
69	13/04/2018	Inhabitant Livuwu	Female
70	13/04/2018	Inhabitant Livuwu	Female
71	13/04/2018	Inhabitant Livuwu	Female
72	13/04/2018	Inhabitant Livuwu	Female
73	13/04/2018	Inhabitant Livuwu	Female
74	16/04/2018	Inhabitant Livuwu	Female
75	16/04/2018	Inhabitant Livuwu	Female
76	16/04/2018	Inhabitant Livuwu	Female
77	16/04/2018	Inhabitant Livuwu	Male
78	16/04/2018	Inhabitant Livuwu	Male
79	16/04/2018	Inhabitant Livuwu	Male

Appendix 2 – Topic List

Survey number
Date of Interview
Name respondent

Demographics
Gender
Age
Number of people in the household
Education
Occupation
How long have you lived in the area?
Who is the head of the household?

People who do not own a water filter
Reasons
(If money is no reason) Willingness to buy?

Knowledge on where to buy
Knowledge on purification
Attend WASH training?

History of drinking water practice (MCM)

People who own a water filter
History of drinking water practice (MCM)

Attend WASH training?

Water filter
Reasons for purchase
Advantages/disadvantages

Usage
How often?
When don't you use the filter? Why
Challenges?

Responsibility water filter

Consequences usage for health?

Drinking water practices – describe practice
Where is water collected
How is collected
Who collects
Which materials involved (show)
Storage – where? (show)

Knowledge
Explain usage
Explain function
Explain cleaning
Explain other hygienic practices (WASH)

Payment
Difficult?
Payment procedure
Committee
Opinion about functionality committee

Repair
Possibility for repair?
Financial means?
Where spare parts?
What would you do?
Knowledge on replacement candle?

General impression project

Values
Likert scale 1-4. Strongly disagree to Strongly agree.
Health is the main reason why I use the water filter
I have a water filter because I can afford one
It is important to me to have the water filter if my acquaintances also have a water filter

Behaviour Change (these statements were part of the half year survey)

	Strongly agree	Disagree	Neutral agree	agree	Strongly agree
40. I like using my water filter to treat my water					
41. I can see change in the health of my family after getting the water filter					
42. I think treating water using the water filter is a lot of work					
43. I encourage my friends and family to drink clean water					
44. I see people in my community drinking straight from the lake					

Observation water filter

	Yes	No
Filter assembled correctly		
Filter stands in a firm position		
Filter out of reach of animals		
Filter with water /currently in use		
Is the water filter clean		