Norges miljø- og
biovitenskapelige
universitet

Master´s Thesis 2017 30 credits
Faculty of Landscape and Society

Community engagement in identifying potential unintended harms and mitigation strategies related to the implementation of the Biosand filter in the Ngorongoro Conservation Area, Tanzania

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Acknowledgements

Two years of hard work and dedication have come to an end. In the beginning of my master degree I would have never dreamed of it leading to friendship around the world and a genuine commitment towards the Maasai people in the Ngorongoro, Tanzania. I am forever grateful to my so talented, caring and intelligent supervisor Sheri Lee Bastien for welcoming me to the SHINE team and allowing me to join the field school. An experience I will cherish forever. Global public health is a field that has interested me for several years, so therefore to be able to dedicate my final thesis to this subject as well as knowing that so many disciplines working together towards an improved health for the Maasai community, has been a driving motivation.

My gratitude to the Global Health Field School program, to Drs. Frank van der Meer and Karin Orsel for including me and making me feel so welcomed in the "veterinary team". It has been a huge privilege to see how a transdisciplinary team work and learn from each other in the field. I would further like to recognise some of the members of the Project SHINE research team, to undergrad student Lauren Hebert for incredible teamwork and notetaking skills, bright mind and her never ending funny comments. To PhD-student Elias Nyanza for in-field support and co-supervising. Last but not least, a special thanks to the community in Endulen for their warm welcome and to all Project SHINE participants who have brought the intervention to life.

There is an African proverb that says "If you want to go fast, go alone. If you want to go far, go together". This has become my favourite proverb. I could never have done this process alone. Without Sheri, friends and family supporting me, this thesis would never have been completed. Therefore, there are some important persons I will dedicate a special thanks to. First of all, once again a big thanks to Sheri for always being available and offering constructive feedback and support. To Tina Paasche, my fellow student and team SHINE member that has been my rock through field school and thesis writing. Your support, incredible knowledge and wonderful humour have many times been a lifesaver through this sometimes lonely process. To my childhood friends Ragnhild and Camilla for taking their time off from their hectic lives to read and correct spelling mistakes and provide me with valuable comments. Last but not least to my incredible sister Linda, mom and dad for always supporting me and to always be so engaged in what I do. So to all of you, a big thanks from the bottom of my heart.

Lise Hovden

Abstract (English)

Background: Providing access to safe drinking water is one of the most effective measures to promote health and reduce poverty in low and middle income counties (LMIC). There is a great need for public health interventions (PHIs) addressing the need for safe drinking water. In evidence-based PHIs the focus usually is centred around the positive outcome of an intervention. An intervention may be both well planned and initially have good intention, however the reality is that PHIs may lead to unintended harms (UHs). This has received limited or nearly no attention in evidence based public health.

Rationale: Formative research conducted as part of Project SHINE (Sanitation and Hygiene INnovation in Education), a youth and community based intervention to develop sustainable water, sanitation and hygiene strategies among Maasai pastoralists in rural and remote Tanzania indicated that water scarcity and water quality were substantial public health concerns among community members. Therefore, a pilot study was conducted to assess the potential of the Biosand filter (BSF) as a low-cost, low-tech water treatment option. In order to avoid potential UHs as a result of the implementation of the BSF, meaningful dialogue with the Maasai community both to identify potential harms but also to simultaneously develop mitigation strategies to tackle potentially UHs was conducted.

Objectives: This study seeks to develop an understanding of community perceptions related to water scarcity and water quality, and how this effects the Maasai pastoralists as a foundation for understanding the context in which the BSF study is being implemented in. In addition, the study aims to engage and identify community perspectives concerning potential UHs and mitigation strategies, related to the implementation of the BSF. An UH typology by Allen Scott et al. (2014) will be used as a guiding framework.

Methods: A descriptive qualitative case study design was used in order to investigate the research questions posed by this thesis. Carefully selected interviews included the following: one in-depth/semi structured interviews, one group discussion and three think tanks. Content analysis was applied as a strategy to analyse the data.

Results: Water scarcity is reported as a concern especially considering seasonal availability of water. Water quality is perceived as poor due to shared water sources with the livestock and

wild animals. The results demonstrated that UHs associated with the BSF may occur in all five of Allen-Scott´s et al. (2014) typology: physical, psychosocial, economic, cultural and environmental context. In addition, two external themes emerged; political harm and harm by omission. The potential harms were: inequality, poor leadership and education, poverty, lack of resources and the size of the BSF. Important mitigation strategies were: engaging with policy level, developing grassroot leadership within the Maasai community and adequate education regarding the BFS technology.

Conclusion: The BSF filter may be a viable solution to improve the water quality within the NCA context, however the BSF filter will not address concerns related to water scarcity, for instance the heavy workload associated with collecting water, such as long distance walks and heavy lifting. The need for extensive education and training, respected and qualified leadership within the community and engagement with policy leaders is fundamental in order to avoid unintended harm identified with the BSF implementation.

Sammendrag (Norsk)

Bakgrunn: Å fremskaffe rent drikkevann er et av de mest effektive virkemidler for å fremme helse og redusere fattigdom i lav- og middelsinntektsland. Det er et stort behov for at folkehelsetiltak fokuserer på behovet for rent drikkevann. I forskningsbasert folkehelse er fokuset normalt konsentrert om positivt resultat av intervensjoner. En intervensjon kan være både godt planlagt og ha hatt gode intensjoner. Likevel kan folkehelsetiltak føre til uønskede konsekvenser (UK). Dette har imidlertid fått svært lite til ingen oppmerksomhet i forskningsbasert folkehelse.

Rasjonale: Tidligere forskning i forbindelse med Project SHINE (Sanitation and Hygiene INovation in Education), en ungdoms- og lokalsammfunnsbasert intervensjon for å utvikle bærekraftig vann-, sanitær- og hygienestrategier blant pastorale Maasaier i landlige og fjerntliggende strøk av Tanzania, indikerte at vannmangel og -kvalitet var vesentlige folkehelsebekymringer blant lokalbefolkningen. En pilotstudie ble derfor gjennomført for å vurdere potensialet for Biosandfilter (BSF) som lavkostnads og lavteknologisk vannrensning. For å unngå mulige UK som resultat av implementering av BSF ble det gjennomført målrettet dialog med Maasai-folket både for å identifisere mulig skadevirkning og også samtidig utvikle skadebegrensningsstrategier.

Oppgavens formål: Denne studien søker å utvikle en forståelse av lokalsamfunnsperspektiv knyttet til vannmangel og -kvalitet, og hvordan dette virker inn på Maasai-folket som et grunnlag for forståelse av konteksten BSF-studien var satt i. I tillegg sikter studien mot å involvere og identifisere lokalsamfunnsperspektiv rundt potensielle UK og skadebegrensningsstrategier knyttet til implementering av BSF. En typologi utviklet av Allen-Scott et al (2014) vil bli brukt som et ledende rammeverk.

Metoder: En case-basert deskriptiv kvalitativ studie ble brukt for å undersøke forskningsspørsmål fremmet i denne avhandlingen. Nøye utvalgte intervju inkluderte følgende: Et dybde-/semistrukturert intervju, en gruppediskusjon, og tre tenketanker. Innholdsanalyse ble brukt som verktøy for å analysere data.

Resultater: Vannmangel er rapportert som en bekymring særlig i forhold til varierende tilgang gjennom årstidene. Vannkvalitet blir ansett som dårlig fordi vannressurser deles med

kyr og ville dyr. Resultatene viser at UK knyttet til BSF kan forekomme i alle fem kategorier av Allen-Scotts et al. (2014) typologier: fysisk, psykososialt, økonomisk, kulturelt og miljømessig. I tillegg oppstod to utenforliggende tema: politisk skade og skade ved unnlatelse. De potensielle konsekvensene var: ulikhet, dårlig ledelse og utdanning, fattigdom, manglende ressurser og størrelsen av BSF. Viktige skadebegrensningsstrategier var: å involvere på et politisk nivå, utvikle fungerende lederstruktur innen Maasai-befolkningen og adekvat utdanning i forhold til BSF-teknologien.

Konklusjon: BSF kan være en levedyktig løsning for å forbedre vannkvalitet innen NCA konteksten, imidlertid vil BSF ikke kunne adressere bekymringer relatert til vannmangel, som for eksempel arbeidsmengden forbundet med innhenting av vann, som lang gangavstand eller tunge løft. Behovet for omfattende undervisning og trening, respektert og kvalifisert lederskap i lokalsamfunnet, og involvering av politisk ledelse, er avgjørende for å unngå UK knyttet til implementeringen av BSF.

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List of Abbreviations

NCA	Ngorongoro Conservation Area
BSF	Biosand Filter
MDGs	Millennium Development Goals
SDGs	Sustainable Development Goals
UH	Unintended Harm
PHI	Public Health Intervention
SHINE	Sanitation and Hygiene INnovation in Education
NMBU	Norwegian University of Life Sciences
CUHAS	Catholic University of Health and Allied Sciences
WET	Water Expertise Training
CAWST	Centre for Affordable Water and Sanitation Technology
CUHAS	Catholic University of Health and Allied Science
NSD	Norsk Senter For Forskningsdata
NIMR	National Institute for Medical Research
CHRB	Conjoint Health Research Ethics Board
WASH	Water Sanitation and Hygiene
UNICEF	United Nations Children´s Fund
WHO	World Health Organisation
UN	United Nations
VEO	Village Executive Officer
PC	Pastoralist Council

1 Chapter 1. Introduction

1.1 Research problem

It is estimated that around 1.8 billion people globally are relying on a source of drinking water that is fecally contaminated (World Health Organisation [WHO], 2015). For the development and the well-being of humans, access to safe water is fundamental. One of the most effective measures to promote health and reduce poverty in low and middle income countries (LMIC) is to provide access to safe water (WHO, 2015). The issue of access to safe water has long been on the international agenda, most recently by the Millennium Development Goals (MDGs), which aimed to reduce extreme poverty by reducing the proportion of people without access to an improved water source and sufficient sanitation (United Nations [UN], 2000; Rheingans, Dreibelbis and Freeman, 2006). After 15 years of efforts, the MDGs have delivered the most successful anti-poverty movement in history, according to the final MDG Report (UN, 2015). However, there are still millions of people living in extreme poverty, without access to safe drinking water, basic sanitation and hygiene facilities. For instance, 663 million people lack access to improved drinking water, and 2.4 billion people lack access to sanitation such as toilets or latrines. Nearly 1000 children under five die each day due to diarrhoeal diseases related to poor water and sanitation (UN, 2016).

From 2016, the Sustainable Development Goals (SDGs) have been adopted and built on the core strength of the MDGs, and the goal is to eradicate poverty, inequality and exclusion, and protect vital ecosystems, within the year 2030 (UN, 2015). Among the SDGs, goal 6 is highly relevant for this thesis which aims to "ensure availability and sustainable management of water and sanitation for all" (UN, 2016). Access to safe water and sanitation is the key foundation for achieving the SDGs, and the focus on globally addressing issues related to drinking water, sanitation and hygiene, as well as quality and sustainability of water resources (UN, 2016). To reach this, it is necessary to invest in adequate infrastructure, provide sanitation facilities, and improve hygiene practices. One way to do so, is to encourage water efficiency and support treatment technologies such as the Biosand Filter[1] (BSF) in LMIC (United Nations Development Program [UNDP], 2016). Household water treatment options, have empowered people and communities around the world. The challenge has been to achieve sustainable and

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[1] The Biosand filter (BSF) is a household water treatment option which removes pathogens from contaminated water though slow sand filtration (CAWST, 2012).

safe use of different technologies. The BSF has been identified as one of the most effective household water treatment option and furthermore has shown to be both widely used and effective in decreasing waterborne disease and death, by improving the water quality (Sobsey, Stauber, Casanova, Brown and Elliott, 2008). However, even though the BSF is found to be a promising household water treatment option, the technology may lead to unintended harms which many public health interventions (PHI) seemingly do (Allen-Scott, Hatfield and McIntyre, 2014). Although PHIs seek to do no harm and protect health in communities or populations, unintended harm (UH) is often an additional result from well-intentioned PHI that is rarely addressed in the literature (Allen-Scott et al (2014); Lorenc and Oliver, 2013). For a PHI to be successful the need for addressing the target population, the unique social determinants, the needs and motivations and the implementation context is factors important to take into account (Davies and Macdowall 2006; Glanz and Bishop, 2010 cited in Allen-Scott et al, 2014).

The remainder of this chapter will present the intervention background information which this study is situated in, starting with introducing Project SHINE and the ongoing study activities of the BSF pilot evaluation. Thereafter outline the rationale for this thesis followed by research questions and thesis structure.

1.2 Project SHINE

In May/June 2016, I participated in the annual global health field school held in the Ngorongoro Conservation Area (NCA) in Tanzania. The data collection for this thesis took place in the small village of Endulen[2], which is inhabited primarily by Maasai pastoralists. This field school was hosted by the University of Calgary and the Catholic University of Health and Allied Sciences (CUHAS), Tanzania, with Norwegian University of Life Sciences (NMBU) as the newest academic partner to join the field school. Project SHINE (Sanitation and Hygiene INnovation in Education) is a partnership between the University of Calgary, CUHAS and NMBU. The transdisciplinary research collaboration includes faculty and students representing various disciplines such as medicine, public health and veterinary medicine, and is situated within a

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[2] According to the 2012 population and housing census (National Bureau of Statistic Tanzania, 2013) Endulen as a total population 13,537 people.

One Health[3] approach focuses on the interrelationship between humans, livestock and the environment (Hetherington et al. 2017). Project SHINE was developed in 2014 to address the issue of poor sanitation and hygiene among the Maasai pastoralists in the NCA, through youth empowerment using innovations in science education and social entrepreneurship (Bastien, Hetherington, Hatfield, Kutz, and Manyama 2015). Focusing on engaging youth as change agents to develop and sustain locally relevant health promotion strategies has been a cornerstone of Project SHINE. The study and intervention has not only involved school children, but also a wide range of different community members, including teachers, headmasters, women's group, parents, doctors, hospital staff, traditional leaders, stakeholders and other community members. The intervention also involves partnerships with a host of other organisations, including: Centre for Affordable Water and Sanitation Technology (CAWST)[4] and the Water Expertise Training (WET)[5] Centre in Zambia, and Aqua Clara (Kenya)[6], and all have been involved to some degree in the BSF evaluation which is presented next.

1.3   Ongoing project activities

Formative research conducted as part of Project SHINE indicated that water scarcity and water quality were substantial public health concerns among members of the community. In addition, records at the Endulen hospital showed that soil-transmitted helminth infections and protozoa are the top ten diagnoses for the Masaai pastoralists living in the NCA (Henderson et al. 2015). These concerns lead to the ongoing pilot evaluation of the BSF as a low-cost, low-tech water treatment option for pastoralists living in the NCA. The aim of the BSF pilot evaluation study is to develop an understanding of community and user perceptions of the filter with respect to implementation feasibility and cultural acceptability, as well as barriers and facilitators to uptake. The table below gives an overview of the BSF pilot evaluation study.

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[3] One Health is by the United Nations and the American Veterinary Medical Association defined as "the collaborative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals and our environment" (American Veterinary Medical Association, p. 13. 2008).

[4] http://www.cawst.org

[5] http://www.cawst.org/where#partner

[6] http://aquaclara.org/where-we-work/kenya/

Table 1. Overview of Project SHINE´S activities for the BSF Implementation.

Projects Activities	Description
Baseline survey – May 2016	Based on sanitation mapping data collected in 2014 by Project SHINE, two wards, Endulen and Nainokanoka were included in the BSF pilot. A random selection of fifteen households from each ward were drawn from a list by the Village Executive Officers (VEOs). Each household or a boma that has participated in this study, has completed a baseline survey. This survey includes questions related to socio-demographics, source of water supply in wet and dry season, and diarrhoea frequency for adults and children under 5 years.
Biosand filter and health promoter workshops – May 2016	In each community, two workshops were held simultaneously by experts from the WET Centre in Zambia, and Aqua Clara in Kenya. The first workshop trained BSF technicians, who were those selected to receive a filter as part of the pilot. The BSF technicians were trained in how to construct, install and maintain the filter. If the project scales up in the future, they will be the experts within the community responsible for teaching others how to manage the filter. The second workshop trained community health promoters to spread education and awareness about the link between water sanitation, hygiene and health in the wider community. A health promoter will do follow ups in the households that have implemented the filter, and furthermore, support any challenges they may have regarding the BSF. The community health promoters received filters as well.
Ongoing support for study participants	The BSF technicians and the health promoters in each research area have been trained to both support the community with assistance regarding the BSF technology, and to advocate the importance of clean water and sanitation to the community
Water quality assessment	Water quality testing took place prior to and after BSF implementation to compare general water quality from several sources within the community and was conducted by The WET Centre from Zambia.
Follow-up surveys and interviews – Fall 2017	Planned follow-up surveys at households participating in the BSF study and furthermore, qualitative interviews with household members who received the BSF. Groups discussions with community health promoters and BSF technicians in Endulen trained as part of Project SHINE. Think tanks with community stakeholders about the BSF and Project SHINE's sustainability.

1.5 Rationale for the study

PHIs tend to focus primarily on the evidence of effectiveness and the positive outcomes of an intervention. Although interventions may be well planned and are intended to improve the health of individuals and populations, the reality is that PHIs may have the opposite effect or other UHs or harms (McQueen, 2014). This constitutes a major gap in our understanding of how PHIs impact target groups (McQueen and Jones, 2007). Harms are often underreported in evaluations and reporting systems (Bernal-Delgado and Fisher, 2008), and so far, there have been few or non-existing frameworks to address this challenge associated with PHIs (Christakis, 2009). LMIC are often the subject for global health intervention. By not taking into account their unique context, such as the environment, culture, economy and health system, the exposure to UH could potentially increase (Garner, Kramer and Chalmers, 1992 cited in Allen-Scott et al. 2014). When implementing PHIs, there may be factors that are unique to the area in which the implementation is situated that are impossible or difficult to predict. Therefore, a framework addressing these structural level factors is highly needed and essential when planning, implementing and evaluating PHIs. As a sub-study of Project SHINE and in close collaboration with the Maasai community, this thesis seeks to both understand potential UHs and jointly develop mitigation strategies to minimize harm related to the BSF implementation. This may contribute towards a shift in mind-set whereby PHIs more explicitly and intentionally address potential UH in a constructive, proactive fashion. In order to understand UH and how it may occur, a typology developed by Allen-Scott and colleagues (2014) will be applied in this thesis to develop an understanding of potential UHs associated with the BSF implementation, and furthermore, how underlying factors associated with UH can be mitigated.

1.6 Research questions

The aim of the study is to develop an understanding of community perceptions related to water scarcity and quality, and how this effects the Maasai pastoralists. Specifically, the study aims to identify community perspectives concerning potential UHs and mitigation strategies, related to the implementation of the BSF, in the NCA. The following research questions guided the study:

- *What are the community perceptions of water scarcity and quality in the NCA?*

- *What are the main concerns and mitigation strategies identified by community members related to the implementation of the BSF in the NCA?*

1.7 Thesis structure

This thesis is organized into seven chapters. The current chapter (Chapter 1) has outlined the study background in which this sub-study is situated. Chapter 2 consists of essential background information relevant to the research questions. The conceptual framework of UH from which this thesis is built up on, will be introduced and discussed in Chapter 3. The methodology is then represented in Chapter 4, consisting of a detailed description of specific methods, data sampling and data analyse used, before describing the ethical considerations relevant to this study. Chapter 5 presents the results from both research questions, with the discussion following in Chapter 6. Finally, Chapter 7 brings forward the conclusion.

2   Chapter 2. Background

The background chapter begins with introducing the intervention setting (the NCA), followed by a discussion on the concepts of health, indigenous health and health literacy within the field of health promotion. Thereafter, a clarification of the terms water scarcity and water quality is provided. Furthermore, the BSF technology will be presented and the rationale for selecting this specific water treatment option for purifying water within the NCA context is described.

2.1   Ngorongoro Conservation Area, Tanzania

Tanzania is located in Eastern Africa and has a population of approximately 53 million people (World Bank, 2016). Located in the Arusha region north-west in Tanzania, the NCA (Figure 1) and its 8292 km^2 consists of highland plains, savanna, savanna woodlands and forests (Perkin, 1997). The Maasai population[7] living in the NCA are semi-nomadic pastoralists who live in close proximity to their livestock. They move according to the wet or dry season in terms of the availability for food and water for their cattle. Families live together in groups of semi-permanent houses called *bomas* (Bastien et al. 2015), and move to temporary *bomas* when out grazing their livestock. The NCA is a UNESCO World Heritage Site and a protected area due to its multiple land-use status, with wildlife coexisting with semi-nomadic Maasai pastoralists (United Nations Educational Scientific and Cultural Organization [UNESCO], 2010). Kijazi, (1997) cited in Galvin, Thornton, Boone and Knapp (2008) wrote that the NCA in 1959, was designated as a multiple use area for wildlife, people and their cattle, and therefore a new conservation policy was developed, as well as the start of Ngorongoro Conservation Area Authority, (NCAA). This led to restrictions regarding use of land. Two examples are the restricted use of Olduvai Gorge, which is a prehistoric world site for grazing and access to all permanent water sources in the Serengeti National Park (Galvin et al. 2008; Little, Smith, Cellarius, Coppock, and Barrett 2001). The restriction also applies to the NCA crater, gorge and plains, and collecting firewood. The various restrictions in the NCA have left the Maasai with few options other than limited agriculture. This is a challenge due to an unequal expansion in human and livestock population (Galvin et al. 2008). Tourism in the NCA is an important source of revenue, and in total, tourism in Tanzania has contributed with 5.1 percent of the GDP

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[7] The average Tanzanian household has 4.9 members (National Bureau of Statistics, 2016), and more specifically Endulen has an average of 4.7 members per household, while 4.5 members per household is the average in Nainokanoka (National Bureau of Statistics, 2013).

in 2014 (World Travel & Tourism Council, 2015). Restrictions apply even to tourism however, the Maasai were not permitted to benefit from tourism until the mid-1990s. Now they are allowed to for instance have cultural *bomas*, handicrafts, and ceremonial viewings, but in total the Maasai receive limited benefits from the tourism (Galvin, et al. 2008). For instance, the lodges in the NCA and the NCAA employees are competing with the Maasai residents, livestock and wildlife for surface water as the lodges have been diverting local spring water causing water security issues for the Maasai residents (Galvin, et al. 2008). The restricted areas have led to a decreased number of permanent water sources, and also lack of nutritious grassland for the Maasai people to grow crops to ensure nutrition for their livestock (Perkin, 1997).

Figure 1. Illustration map viewing Ngorongoro in the Arusha region, retrieved from National Bureau of Statistics, (2016).

2.2 Defining Health

This thesis subscribes to a holistic understanding of health, through addressing different dimensions influencing health and how the dimensions interact with each other (Naidoo and Wills, 2014). The WHO definition of health, formulated in 1948, reads as follows: "a complete state of physical, mental and social well-being, and not merely the absence of disease or infirmity" (WHO, 2006, p.1). The definition has been subject to critique due to being unattainable, with some of the criticism centred on the word "complete", which would be nearly impossible for most people to ever achieve (Huber et al. 2011). According to the WHO (1986), health is viewed as a resource for everyday life, not the objective of living, in order to have good health, fundamental conditions and resources need to be present, e.g. peace, shelter, education, food, income, stable eco-systems, sustainable resources and social justice and equity.

The WHO (1986) indicates that to gain social, economic and personal development, good health is an essential aspect of quality of life. Factors which can benefit, but also harm health are political, economic, social, cultural, environmental, behavioural and biological factors (WHO, 1986). To tackle aspects concerning these factors, WHO propose advocating health through health promotion[8]. Health promotion is about achieving equity in health, by ensuring equal opportunities and resources so that people can reach the fullest potential for their individual health (WHO 1986). To achieve this, people need a secure foundation in a supportive environment, access to information, life experience and opportunities for making healthy choices. For people to achieve their fullest health potential, people need to be able to be in control of those things which determine their health (WHO, 1986). In health promotion focus on the social determinants of health is essential. Multiple studies have identified social factors as the root for inequalities in health (Marmot, 2005). The determinants of health can both influence the individual through individual health behaviours, and through a higher structural level which the individual cannot control, e.g. socio-cultural, political, economic and environmental factors (CSDH, 2008). The national government is the primary responsible body for assuring and strengthen health equity, thus, the importance of implementing public health knowledge into political action is crucial for tackling the inequalities in health (Solar and Irwin 2010; Marmot, 2005). Inequality in health is described as a difference that are unnecessary, avoidable, unjust and unfair (WHO, n.d). Nevertheless, no matter how unnecessary or unfair

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[8] The WHO (1986) definition of health promotion; *Health promotion is the process of enabling people to increase control over, and to improve, their health* (WHO, 1986).

inequality in health is, millions of people experience inequality in health in various ways, and access to safe and sufficient water is one of them. Inequalities in access to safe water are tremendous, especially in rural areas. Women are greatly affected, due to their responsibility to fetch water, causing an enormous drain on energy, productive potential health. The lack of safe and reliable water sources puts the health of thousands of people at risk (WHO, 2001).

2.2.1 Health and indigenous ethnic groups

In a study conducted by Lawson et al. (2014) the authors point out that much scholarship focuses on socio-economic dimensions of health, however can ethnic disparities be of equal or greater importance. For instance, indigenous ethnic groups are a particular minority population, which systematically seem to fail to benefit from improvements in health. This is often seen in remote places, where the population relies on alternative approaches of production to agriculture, also often excluded from technological innovations and national and international investments (Lawson, et al. 2014). The Maasai people represent such an indigenous ethnic group which fails to benefit from improvements in health in comparison to other ethnic groups within Tanzania. They face many layers of marginalization, and the limited access to water, as well as the poor quality is just one of many examples of the health disparities they face. For instance, due to the many restrictions the Maasai face in the NCA and few resources, several factors are affecting the Maasai´s opportunity to gain optimal health, such as access to sufficient water supply and cultivation, which further limits the Maasai´s possibility for development. The One Health paradigm is an important aspect when working in such a unique context as the NCA. This approach emphasizes multi-sector, transdisciplinary activity across professions to ensure the well-being within the One Health triad. As the Maasai are nomadic pastoralists and live in close interaction with their livestock (Hetherington et al. 2017), they are exposed to zoonotic diseases which are diseases that can be transmitted from animals to people (Rock, Buntain, Hatfield and Hallgrimsson, 2009). Focusing on this holistic approach to address the burden of illness associated with zoonotic diseases, the One Health approach provides an opportunity to strengthen the health of humans, animals and the environment (Papadopoulos and Wilmer, 2011). In public health research, the One Health approach has become more common in the recent years (Papadopoulos and Wilmer, 2011).

2.2.2 Health literacy and indigenous knowledge

Individuals who are illiterate face greater challenges both regarding understanding the given information provided, and their ability to act upon the information received (Nutbeam, 2000).

According to the World Data Atlas (2015), 5,755,156 million adults are illiterate in Tanzania. Due to rapid population growth, there is an increasing number of illiterate adults globally (UNESCO, 2016). A systematic review by Sørensen et al. (2012) looking at definitions and models of health literacy and public health proposes a definition which encompasses the public health perspective, stating that the literacy is linked to people's ability to obtain and process health information in order to make decisions concerning healthcare. The Institute of Medicine (2004) cited in Sørensen et al. (2012) acknowledges that health literacy is affected by essential components such as: cultural and conceptual knowledge, listening, speaking, arithmetic, writing, and reading skills. Therefore, health literacy is a composition of the interactions between cultural, social and individual factors (Nielsen-Bohlman, Panzer and Kindig, 2004).

Indigenous knowledge is the local knowledge that is unique to a culture or society (UNESCO, 2010). This knowledge is passed from generations to generations, commonly passed through word of mouth and cultural rituals. Indigenous knowledge has been the foundation for agriculture, cooking, health care, education, and other activities which have formed the base of sustainable societies. Indigenous people have a broad knowledge of how to live sustainably (UNESCO, 2010). Nevertheless, indigenous knowledge often gets challenged by changes to the social environment aiming to improve lifestyles, introducing new technology and other modernisation processes. For instance, the issue on education as understood in a Western context undermines indigenous knowledge, and has been identified by many as the reason for decline of indigenous knowledge. In Western understandings, learning is accomplished through reading and instruction, however, indigenous knowledge develops through observing and doing, within the natural environment (UNESCO, 2009). This is especially true for the Maasai whose knowledge and awareness is a result of years of living and learning within their natural setting (Nielsen-Bohlman et al, 2004). Indigenous knowledge is therefore an important factor to consider when implementing new technology and knowledge with regards to health promotion and water quality.

The following sub-section will discuss water scarcity and water quality, as well as the BSF.

2.3 Water scarcity and water quality

In total, water scarcity[9] affects more than 40 percent of the global population and the number is projected to rise (UN, 2016a). There are 23 million people in Tanzania who lack access to safe drinking water (WaterAid, n.d., a). Access to sanitation is even lower, with 44 million people lacking adequate access and 4000 children under five die every year from diarrhoea due to unsafe water and poor sanitation (Water Aid, n.d.a). The population of Tanzania, especially the Arusha region is growing rapidly which stresses the demand for essential social services such as education, health and water (National Bureau of Statistics, 2013). From 2005 to 2009 water supply to rural settlements increased from 55 percent to 58.7 percent, however, supplying water to remote areas continues to be a major challenge due to the heavy investments needed in new water resources (International Monetary Fund, 2011).

In previous Joint Monitor Programme (JMP) reports have been focusing on inequalities in access to drinking water and sanitation between rural and urban areas (WHO/ United Nations Children´s Fund [UNICEF] JMP, 2015). For instance, JMP data on inequalities were used in the 2006 Human Development Report which reported that some people are systematically excluded from having access to clean water, due to their limited legal rights or public policies that place restrictions on infrastructure that provides access to water, eventually affecting life and livelihoods. In many countries water scarcity and water quality often affects people with few resources and the most impoverished therefore carry a disproportionate burden, with resulting impacts such as poor health due to contaminated water, or increased workload due to water scarcity (Human Development Report, 2006). Still today, the vast majority of people that do not have access to improved drinking water sources live in rural areas (WHO/UNICEF JMP, 2015).

Water quality is as important as an adequate amount of water for satisfying both human and environmental needs, and is highly important for the health and well-being of humans and ecosystems. By improving water, sanitation and hygiene, as much as 9.1 percent of the disease burden or 6.3 percent of all deaths can be prevented globally (Prüss-Üstün, Bos, Gore and Bartram, 2008). Diseases which are possible to prevent with improved water, sanitation and

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[9] Water scarcity is defined as lack of an adequate amount of water to meet the needs of both human, animal and environment within a region (UN-Water, 2006).

hygiene are: diarrhoea, malnutrition, intestinal nematode infections, lymphatic filariasis, trachoma and malaria (Prüss-Üstün et al. 2008).

Several simple interventions are available for improving the quality of water, for instance, household water treatment is a solution to address the lack of access to safe water. Studies have shown that household water treatment can reduce the risk of diarrheal disease by 35 percent or more, by using different varieties of technologies in different settings and populations (Fewtrell, Kaufmann, Kay, Enanoria, Haller and Colford, 2005). A systematic review and meta-analysis showed that access to available household water treatment and safe storage is associated with significant health gains, and improvements in drinking-water quality appear to be of significant benefit to health if the opportunity to treat the water is close to the household (Clasen, Schmidt, Rabie, Roberts and Cairncross, 2007). In the review, they found that improvements in water quality were often followed by other environmental interventions which target the prevention of faecal-oral transmission, including improved sanitation and water supplies, safe place to store water and education regarding hygiene, contaminated water and diarrhoeal disease. The study emphasized that if the aim is to reduce diarrhoeal disease, it is not enough to only look at the intervention effectiveness, but the need to also address affordability, acceptability, sustainability and scalability within a vulnerable population (Clasen et al. 2007).

2.4   The Biosand filter

The BFS uses a slow sand filtration process to remove waterborne pathogens such as helminths, parasites, bacteria and viruses, the technology has shown to be promising for areas where water has high turbidity (Manz and Eng, 2014). The BSF can last up to 10 years if used correctly, and comes with the housing constructed in two different materials, concrete and plastic (CAWST, 2012). The pilot study conducted as part of Project SHINE uses the plastic version of the BSF. The plastic version is a better solution due to the weight difference between the concrete and the plastic BSF, which is important due to the Maasai being semi-nomadic and is more appropriate to rural and remote settings. Water is poured through different types of layers consisting of: rocks, gravel, coarse sand and fine sand. When water is poured through the layers of sand, a complex process of biological, mechanical and chemical filtration and densification takes place. The top layer (the fine sand), is developed into a biological layer within 30 days after installation, and in order to keep the biological layer alive, it needs refill of water daily, the limit of pausing the flow through the filter should not exceed a maximum of 48 hours (CAWST, 2012). Water can be collected from several different sources, (e.g. shallow and deep

wells, springs, rivers, lakes, reservoirs, dams, ponds, irrigation canals and rainwater), although sticking to the same water source is advantageous. The importance of having safe storage opportunities is crucial for avoiding recontamination of the already filtered water, this requires clean and covered containers (CWAST, 2009).

A study conducted by Stauber, Kominek, Liang, Osman and Sobsey, (2014), refers to four peer-reviewed published trials examining the health impact of the concrete BSF, these papers suggest that the BSF can reduce diarrheal disease by 50 percent or more. Despite promising results from the concrete BSF, this type of material is heavy (approximately 150 kg) and therefore difficult to transport without assistance from for instance a car, truck or boat (CAWST, 2009). A study conducted in rural communities in Tamale, Ghana evaluating a plastic version of the BSF, also showed positive results after a randomized controlled trial of the plastic BSF, which reduced diarrheal disease and improved water quality. The study documented significant improvements in household water quality with 97 percent reduction of E. coli and significant improvements for turbidity. (Stauber et al. 2014). Multiple studies have shown promising results on the effectiveness of the BSF, but few have addressed acceptability and sustainability. Therefore, a study conducted in Bonao, Dominican Republic, by Aiken, Stauber, Ortiz and Sobsey, (2011), looked at continued use, performance and sustainability of the concrete BSF and found that out of 328 household, 90 percent of the BSFs were still in use after approximately one year after installation.

The picture below (Figure 2) illustrates the concrete BSF, despite that the concrete material is not the material used in the study pilot, the picture is used to show the different components of the BSF technology.

The Parts of a BSF
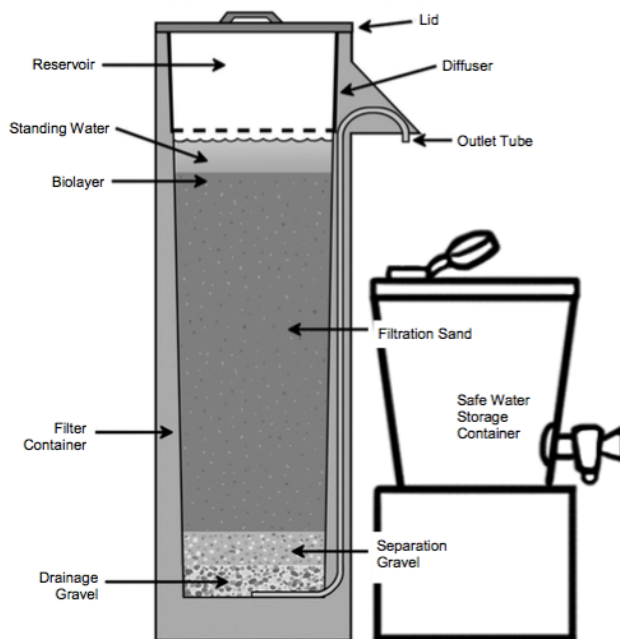
Figure 2. Picture retrieved from Biosand Filter Construction Manual (CAWST, 2012)

In the current chapter, background information relevant to the scope of this thesis has been presented. The conceptual framework guiding the thesis is described in the following chapter.

3   Chapter 3. Conceptual Framework

In this chapter, the framework which this study is situated within, is outlined. Starting with the socio-ecological model which inspired the framework of Allen-Scott´s et al. (2014), followed by a discussion of the principle of unintended consequences by Merton (1936), before presenting the UH Typology by Allen Scott et al. (2014).

3.1   Bronfenbrenner's Socio-ecological Model

A socio-ecological approach to health promotion popularized by Bronfenbrenner (1979) is helpful to understand how the Maasai are influenced by their surrounding social system (DiClemente, Salazar and Crosby, 2013). The UH typology by Allen Scott et al. (2014) (described in further detail later) assesses the issue of UH through a socio-ecological model lens, which contribute to describe the generation of UHs at various socio-ecological levels.
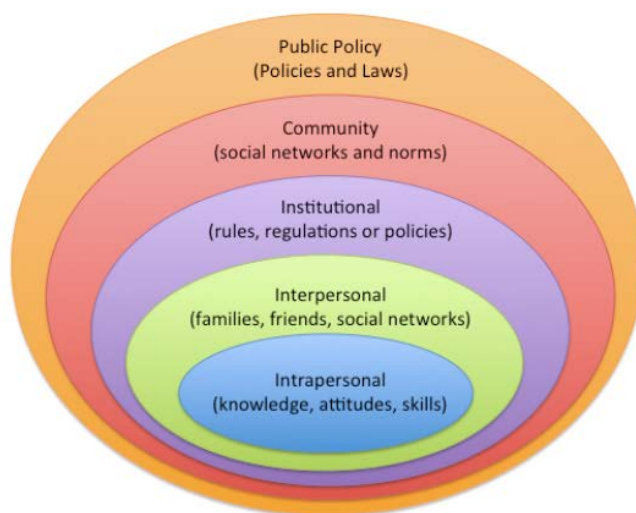
Figure 2. Socio-ecological conceptual framework (adapted from Bronfenbrenner, 1979). Retrieved from Allen-Scott, (2014)

The intrapersonal level in the centre relates to individual characteristics as well as biological and psychological factors. Next, the interpersonal level refers to the formal and informal social networks and social support system, for instance family and work. The institutional level consists of rules, regulation or politics that influence the individual, and the community level involves the wider community within defined boundaries, for instance belief systems. Finally, the general/macro level involves the broader spectrum which includes amongst others: social,

cultural, economic, political and environmental circumstances (McLeroy, Bibeau, Steckler, Glanz, 1988).

Due to the Maasai living in such a unique context and are influenced by previously mentioned factors such as NCAA restrictions and living in close proximity with livestock and wild animals, a holistic understanding of how the different level may interact with each other is necessary. When looking at potential UHs as a result of the BSF implementation, physical, psychosocial, economic and environmental categories can be assessed through the UH typology as developed by Allen-Scott et al. (2014). A detailed description of the UH typology will be outlined in paragraph 2.1.4. Firstly, a presentation of Merton´s unintended consequences which the typology is based on will be described.

3.2   Merton´s unintended consequences

The typology developed by Allen-Scott and colleagues (2014) is based on the work of Robert Merton, who in 1936 wrote; *The Unanticipated Consequences of Social Action.* Here he describes human actions when things do not go as planned related to underlying factors (Allen-Scott et al., 2014; Merton 1936). He describes unintended outcomes as *elements in the resulting situation which are exclusively the outcome of the action, i.e., those elements which would not have occurred had the action not taken place* (Merton, 1936. P. 895). These unintended consequences relate to underlying factors, such as *ignorance, error, immediate interest, basic values* and *self-defeating prophecy. Ignorance* can be explained as the inability to see the possible outcome of an action because the team cannot correctly anticipate the potential consequences, due to for instance inadequate knowledge. *Error* is usually related with the conviction that an earlier successful implementation should also work in the given context or situation, if a particular action has earlier given a desired outcome. Error can also occur if inadequate consideration of all different aspects of an intervention is overlooked. *Basic value* is referred to the impossibility of thinking in alternative objectives due to dominant values or believes. *Immediate interest* is when the research team fails to consider future consequences, due to being too concerned with immediate outcomes. Finally, *self-defeating prophecy* holds that activities focused on certain values can lead to change on the very scale of the study due to the researcher introducing his or her predictions or actions, and therefore affecting the initial aim of the intervention (Allen-Scott et al. 2014; Merton 1936). For this thesis it is relevant to acknowledge these factors. The choice of action is evidently affected by what motivates an action and the choice between different alternatives. Merton (1936) underlines the unforeseen

consequences of an action or intervention as a nonconformity, *from the consequences of an action due to the interaction of the context of action, and the action itself.*

3.3 Unintended harm typology

Allen-Scott and colleague's analytical framework was developed through a scoping review examining 26 full-text articles that discussed UH related with PHI. Furthermore, an iterative data analysis was conducted to determine both a typology and underlying factors associated with UH. After reviewing and comparing the data five categories of PHI-associated UH were identified: (1) *physical,* (2) *psychosocial,* (3) *economic,* (4) *cultural* and (5) *environmental*. In addition, there are five underlying factors associated with PHI UH: (1) *ignoring root causes,* (2) *prevention of one extreme leads to another extreme (boomerang effect),* (3) *limited and/or poor quality evidence,* (4) *lack of community engagement,* (5) *implementation in a low-middle income country (LMIC)* (Allen-Scott et al. 2014).

Allen-Scott et al. (2014) developed a conceptual map (see Figure 3 below) to illustrate the relationship between the UH typology and the emergent underlying factors. The conceptual map is designed to give direction for people working with PHI, during the process of developing, implementing and evaluating a PHI, regardless of which health issue it addresses. The map shows that the presence of UH is not a linear process, therefore, Allen-Scott et al. (2014) propose that PHI development and evaluation is a continual feedback loop. Furthermore, the complexities of evidence, context, potential boomerang effects and community engagement are important to take into consideration to be able to mitigate physical, psychosocial, economic, cultural and environmental UHs.
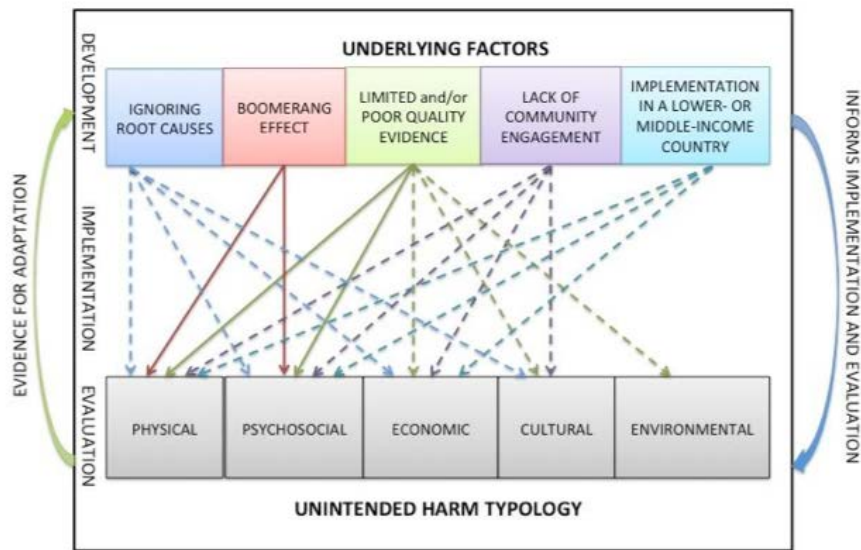
Figure 3. A concept map illustrating the relationships between the UH typology and emergent underlying factors. Solid lines indicate higher levels of evidence to support the underlying factors and typology relationship. Dashed lines indicate the presence, yet limited evidence on the underlying factor and typology relationship. (Allen-Scott et al., 2014, P. 11)

3.3.1   Underlying factors of Unintended Harm

Ignoring root causes was found in five studies by Allen-Scott et al. (2014), focusing on birth weight, infectious diseases, obesity and clean water. According to Marmot (2006) cited in Allen-Scott et al. (2014), root causes can be described as *the underlying social or environmental circumstances that influence behaviour and ultimately disease or injury risk*. Usually root causes are tackled through action on the social determinants of health (WHO, 2010). A study by Garner et al. (1992) cited in Allen-Scott et al. (2014), described an PHI which looked at increasing birth weight of new-borns in LMICs, which actually put both the mother and baby in danger due to increased frequency in obstructed labour in countries with weak health systems and limited opportunity for caesarean births. This was a PHI that was originally developed in high income countries with strong health systems and the opportunity for caesarean births.

Prevention of one extreme leads to another extreme or the *boomerang effect, which is one of the UHs, as* identified in eleven studies in Allen-Scott et al (2014) scoping review. Henriksen et al. 2006; Lucas et al. 2009; Werle 2012, cited in Allen-Scott et al. (2014) refers to the boomerang effect as an effect that occurs when the results are opposite of what was intended.

For instance, a study on rehydration solution intervention to treat people suffering from cholera had significant results, however the study found that oral rehydration solutions gets easily contaminated when prepared in the field, resulting in alternative growth of bacteria (Daniels et al. 1999).

Allen-Scott et al. (2014), identified 15 studies that were based on *limited or poor quality of evidence*, also the long-term perspective was lacking and this can potentially lead to UHs outcome of a PHI. Obesity programs were one of the PHI's that usually reported lack of good quality evidence, also long term evidence on physical and psychosocial effects, for instance on self-esteem. The lack of quality evidence may lead to UH which is not possible to predict during the planning and implementation phases (Allen-Scott, et al. 2014).

Lack of community engagement, was found as an underlying factor in six studies in Allen-Scott et al (2014) review. These studies were missing discussion or evidence of community participation and knowledge translation (moving best practice evidence into action), which led to underlying factor linked to PHI UHs (Allen-Scott et al. 2004). Barr et al. (2011) and Greer and Ryckeley, (2011) and Qadir et al. (2010) cited in the scoping review indicate that minimal engagement with the target population leads to PHIs that fail to consider more complex underlying biological, societal and environmental factors. Not taking into account community engagement, the risk of stigma, victimization and discrimination increases, as well as environmental contamination.

Implementation in a LMIC, relates to root causes, by not taking into account the local context before implementing a well-meaning PHI that was developed and tested in high-income countries, before implementing in a LMIC (Allen-Scott et al. 2014).

3.3.2   Categories of Unintended Harm

Physical harm is when a harm occurs to the physical structure of a person, as a result of a PHI (Allen-Scott et al. 2014). From the scoping review of UH, by Allen-Scott and colleagues, this harm is the most commonly experienced harm. Children and infants were those who were most vulnerable to experience physical harm regarding PHIs, particularly related to: birth weight, obesity, food supplementation, infectious disease, and suicide. The reason is, this population is often the target for PHI. Furthermore, Allen-Scott et al. (2014), found that physical harms can be seen in the context with limited and/or poor quality evidence, particularly the absence of

long-term evidence. Those working with PHI need to be aware of the so called boomerang effect. For instance, the study done by Carter and Bulik (2008) cited in Allen-Scott (2014) found that obesity preventing programs lead to the development of eating disorders among children, and another study by found increased threat and suicide attempts after a school suicide prevention program (Callahan, 1996, cited in Allen-Scott et al. 2014).

A study by Ojomo, Elliott, Goodyear, Forson and Bartram, (2015), looked at sustainability and scale-up of household water treatment and safe storage practices, found several examples of incorrect use of household water treatment technologies. For instance, the study refers to an example of solar water disinfection[10] not correctly exposed to the sun leading to reduced UV-A radiation. According to the authors, incorrect use of technology could reduce or eliminate health benefits (Ojomo et al. 2015).

In 2012 an outbreak of dengue epidemics was reported in parts of India, due to unreliable water supply in rural areas that encouraged people to store water within the household when water supply was scarce (Palaniyandi, 2014; WHO, 2001). This led to breeding places for mosquitoes and hundreds of thousands of people were affected. Gottesfeld (2007) is referring to UNICEF that in the 1970s drilled deep bore wells to provided clean drinking water for communities in Bangladesh. In the 1990s discovery was made that the water consisted of high levels of arsenic after increased frequency of skin lesions and other health impacts.

Psychosocial harm is when injury or damage involves both psychological and social aspects and may involve the connection between social condition and mental health (Merriam-Webster, 2013c). In the review by Allen-Scott and colleagues (2014), sixteen studies were identified that reported psychosocial harm associated with different PHI. Obesity was found to be most common to have psychosocial harms associated with their outcome, and children were the most exposed population to experience psychosocial harms. Among the studies cited in Allen-Scott et.al (2014) was Atkinson and Nitzke, (2001); Carter and Bulik, (2008); O'dea, (2005) and Striegel-Moore, (2001), which all found that obesity have shown to lead to stigmatization, victimization, and development of low self-esteem in children exposed to anti-obesity programs. Based on findings from Barr, Amon, and Clayon, (2011), cited in Allen-Scott (2014) found that stigma, fear, and social discrimination are common UHs when dealing with PHI, and

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[10] Solar disinfection is a way to treat water through UV-radiation.

the need for addressing these factors are highly relevant. Another underlying factor to consider regarding psychosocial harm is the prevention of one extreme leads to another, i.e. the boomerang effect.

A water innovation called the *playpump*, started out as a promising idea, which received both support from the World Bank and other aid projects. The idea seemed both well-researched, self-sustaining and adaptable to local context (Vandendriessche, 2012). The first playpump was installed in South Africa in 1994, and later on in multiple African countries, including Tanzania. The playpump is a water pump mechanically powered by the rotation of a children´s playground merry-go-round, which pumps water to an elevated water tank (Borland, 2011). There are several reasons for why the playpump failed to serve as a sustainable option for accessing water. Firstly, children's play could not produce enough water to meet the needs of the community, to meet the minimum requirement amount of 15 litres per person, children would need to play non-stop for over 24 hours every day. Usually leading to the women to operate the playpump. In addition, the playpump is usually situated in the sun, making the effort to pump the water even more exhausting. The playpump technology lacked local ownership, and involvement from local community. Several communities had trouble with the pump's maintenance. The playpumps were reportedly difficult to operate, and women did not such as using the playpumps. It was reported that the playpumps led to shame and embarrassment for women, and also causing social friction. (Vandendrieessche, 2012; Borland, 2011). The playpump did not only constitute to psychosocial harm such as shame and embarrassment, but also to physical harm due to being exhausted after pumping the water for hours.

The Community-led Total Sanitation approach which is mobilising communities to eliminate open-defecation is a widely used approach, developed in Bangladesh in the late 1990s (Kar, Chambers and Plan, 2008). The methods used for eliminating open-defecation is using shame and disgust as a means to change people's behaviours (Kar, Chambers and Plan, 2008). The method is both admired for being community driven and low cost, and criticised for being unethical for several reason, but especially for contribute to the stigmatization of already marginalised groups (Pickering, Djebbari, Lopez, Coulibaly and Alzua, 2015; Bartram, Charles, Evans, O´Hanlon and Pedley, 2012). Bartram et al. (2012), refers to the "Handbook of Community-Led Total Sanitation" who cited that children in Bangladesh were given whistles and went looking for people doing open defecation, and some places a flag was placed next to were a person had defecated, with the name of the person responsible. According to Bartram et

al (2012), both academic publications and professional reports have described this approach without any critical comment. If accepting such an infringements of basic human rights, it is equal to condemning some of the poorest and weakest members of the society to selective be excluded from universal rights, leading to psychosocial harm.

Economic harm refers to damage that relates to production, distribution and consumption of goods and services (Merriam-Webster, 2016a). In Allen-Scott et.al (2014) scoping review, economic harms were identified in four of the included studies. Geer and Ryckeley (2011) cited in Allen-Scott (2014) emphasise the importance of evidence of a planned intervention, which is further important for policy makers, in that way they don't waste time and resources on projects that are not based on a synthesis of evidence. The study conducted by Moreira et al (2009) also cited in Allen-Scott et al. (2014) pointed out that this is especially important when planning for PHI in LMIC where resources are already scarce. Factors such as limited evidence of effectiveness, lack of political and also community engagement are important mechanisms for potential unintended economic harm (Allen-Scott et al. 2014).

In Africa hundreds of millions of dollars have been wasted on projects which aims to address access to clean water (Skinner, 2009). According to The International Institute for Environment and Development as much as 360 million dollars has been used on building boreholes and wells that are useless due to lack of maintenance or reparation if broken. A total of 50,000 water supply stations are not in use across rural Africa. Water projects are often implemented by donors, governments and NGO´s without collaboration with the local community, leading to not take into account what kind of needs the community desires, and what it will cost to keep the boreholes clean and functioning over a sustainable time (Skinner, 2009). According to Skinner (2009), water projects needs long-term maintenance and engaged local communities, without it, "it is like throwing money down the drain".

Cultural harm is when damage occurs to a population's lifestyle. This includes language, arts and sciences, spirituality, social activity and interaction (RCHI, 2013). Allen-Scott et.al (2014) found four studies that looked into cultural harms regarding PHIs in areas of indigenous health and infectious disease. Clifford et al. (2009) cited in Allen-Scott et al. (2014) indicate that PHIs which are known to be effective, usually do not get implemented among indigenous populations. And if they are, it is with little consideration of the fundamental determinants of health that are unique for the people living there. Allen-Scott (2014) found that the most

common underlying factors based on the studies discussing cultural harm, were limited availability and implementation of quality contextualized evidence and lack of community engagement.

A large-scale ongoing water project in Lesotho and South Africa where the purpose of the project to provide Lesotho with a source of income in exchange for the provision of water to parts of South Africa (Hitchcock, 2012). Water has been channelled to South Africa through a major water transfer scheme in Lesotho, involving several rivers from the area, which has resulted in multiple UHs (Hitchcock, 2012). Among other has the Lesotho Highlands Water Project affected the population living in the area. Furthermore, it affected different ethnics and class diversity in new areas where people have been forced to move to, due to construction related to the project. Several households have split up, where the younger once moving to more urban areas, leaving elderly and infirm behind (Hitchcock, 2012), which has led to cultural harm.

Environmental harm refers to damage or injury to the circumstances, objects or conditions that humans are surrounded by (Merriam Webster, 2013b). Allen-Scott et al. (2014) found two studies that investigated environmental UH. Both studies suggested that poor quality or lack of evidence when developing and implementing PHIs, was the most common underlying factor. Adequate quality evidence needs to be available when planning and implementing PHI, and it is an important underlying factor associated with environmental UH (Allen-Scott et al. 2014). Qadir et al. (2010) cited in Allen-Scott et al. (2014) emphasizes the important factor to be aware of when working in LMIC settings, that resources are already scarce and therefore even more difficult to repair if an environmental damage or injury occurs. In many cases, sources are used to such an extent that they no longer can provide for a community´s basic needs, posing serious health risks to the population (WHO, 2001). In vulnerable communities, the impact on the environment and social determinants can lead to even poorer health status within the population (WHO, 2001). For instance, in a study conducted in Northern Ethiopia, the researchers found dams which led to a seven-fold increase of malaria transmission in the nearby communities (Ghebreyesus et al. 1999). According to Gottesfeld (2007) few public or private aid programmes performs carefully mapping of potential environmental harm initially in the planning phase. However, if environmental consideration was performed, potentially harm could be identified and mitigated.

Using the typology as a conceptual framework for this thesis can potentially help to uncover and contribute to a broader understanding of how to identify UHs regarding the BSF. Implementing the BSF in a unique context as the NCA, needs careful mapping of both context-specific UHs and underlying contextual factors. By specifically facilitating think tanks in addition to interviews and group discussions with key members of the Maasai community, a fruitful discussion about the role of underlying factors and their interactions with implementation of a new technology can potentially lead to strategies to mitigate the UHs of the BSF. In the following Chapter, the methods used to collect data for the thesis is presented.

4   Chapter 4. Methodology

As mentioned previously, the research objectives of this thesis were two-fold: (1) to develop an understanding of community perceptions related to water quality and scarcity; and (2) to identify community perspectives regarding potential UHs and mitigation strategies, related to the implementation of the BSF. In this chapter, the methodological approach used in this thesis is described in detail. The chapter firstly presents the philosophical orientation and study design, before describing the sampling of the data. Thereafter, the various interview methods are presented (in-depth interview, group discussion and think tanks). Next, the methods used to analyse the data is outlined, before the chapter ends with a description of ethical considerations and self-reflections relevant to this thesis.

4.1   Philosophical orientation

This study utilizes a qualitative descriptive approach, which according to Denzin and Lincoln, (2005) cited in Stanley, (2014) fits within an interpretive paradigm. Considering that the thesis research questions are about exploring community members' perceptions and concerns, a constructivist view to the study is appropriate and relevant. Constructivism is a set of beliefs about how people access knowledge (Lincoln, Lynham and Guba, 2011), and furthermore a philosophical paradigm based on a relativist ontology and a subjectivist epistemology (Lincoln et al. 2011)[11]. A relativist view indicates that "realities exits in the form of multiple mental construction, socially and experientially based, local and specific, dependent for their form and content on the person who holds them" (Guba, 1990, p. 27 cited in Lincoln, Lynham, & Guba, 2011, p. 102). A subjectivist view, holds that the finding is literally the results of the process of interaction between the researcher itself and the people being studied (Guba, 1990, cited in Denzin and Lincoln, 2011). Guba and Lincoln (1994) emphasizes that social science needs to be engaged at the worldview level, furthermore, Lincoln and Guba (2005) cited in Stanley (2014), indicate that epistemology contributes to the way which the researcher is given an opportunity to study participants in their context, which provides an understanding of how they

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[11] The difference between ontology and epistemology is that ontology is concerned around fundamental assumptions about how to look at the social world, and epistemology is about how to access knowledge about that world (Hollis, 1994). With an ontological foundation, a phenomenon can be seen through many different realities, serving multiple perspectives (Creswell, 2013). Epistemology is concerned with how knowledge is known, and due to its subjective nature, the relationship between the researcher and those being studied will inevitably affect what is known in qualitative research. (Creswell, 2013, p. 20).

make sense of the world. Each individual is the centre of their own world, with everyday individual experiences, but the individual is also a part of something bigger, a world which exists beyond the self. Typical for humans is that we alternate between our individual experiences, and based on these, form an opinion around the bigger world (Johannessen, Tufte and Christoffersen, 2016).

4.2   Study design

A case study design was used in order to investigate the research questions posed by this thesis. A case study gives the researcher an opportunity to analyse complex phenomena within the contexts of interest. When conducted properly, this approach becomes a valued method for health science research to promote theory, evaluate programs, and develop interventions (Baxter and Jack, 2008). In a case study, knowledge is built upon one, or more individual stories, also including groups and organisations. A case study gives the researcher a detailed knowledge on one or multiple cases, by collecting as much data as possible regarding the topic of interest (Kvale and Brinkman, 2015). Thus, this study represents a case study, considering the study is addressing community members' point of view with various interview approaches to explore the issues; water quality and scarcity, and the BSF evaluation. Yin (2014), expresses that a case study is well suited where it is impossible to separate the phenomenon being addresses from their context. Baxter and Jack (2008) references to Yin (2003) who base his approach to case study on a constructivist paradigm, addressing the subjective understanding of meaning and reality.

4.3   Data collection

All data for this sub-study were generated through in-depth semi-structured interviews, group discussions and think tanks in May/June 2016. The discussion guides varied with respect to content, according to participant and type of interview (See Appendix A-B). For instance, in-depth interviews were used in order to develop an understanding of the water-related issues in the NCA, especially considering water quality and scarcity. Group discussions were used to gain insight of opinions and experiences regarding water-related issues in the NCA, strategies to address water quality and scarcity, and community perceptions of the BSF as a feasible and acceptable water treatment option in the NCA, so that future programs can be better designed to suit community needs. Think tanks were used to present the study to community members and to engage them in systematic identification of concerns around introducing this technology in the community as well as dialogue around how potential UHs could be minimized.

Although additional in-depth interviews and group discussions were conducted as a part of the BSF pilot study, only five sessions were included in this sub-study and included the following interviews; one in-depth semi-structured interview, one group discussion and three think tanks. The rationale for including one in-depth interview and one group discussion is based on the participants all being Maasai residents which represent a grass-root perspective on water related issues in the NCA. All three think tanks are included which is representing community and stakeholder's perspective concerns and mitigation strategies toward the BSF implementation. Additional data were excluded based on lack of relevance to the scope and focus of the research questions posed in this thesis. Each method is described in detail below.

4.3.1 In-depth, semi-structured interview

The aim of qualitative research interview is to get a deeper understanding of the interviewees perspective, and seeks to understand the participant's knowledge, experiences and meaning of a topic (Bryman, 2016). In-depth interviews with key informants can contribute to examining the why and the how, and getting access to the participant's knowledge, experience and meaning of water quality and scarcity through their own life world (Kvale and Brinkmann, 2015). Asking questions which related to various themes of interest regarding water quality and scarcity in an appropriate order, gave the opportunity to probe and explore the answer given by the participants (Kvale and Brinkmann, 2015). According to Skovdal & Cornish, (2015), in-depth interviews are beneficial when exploring individual thoughts and feelings, and contributes to strengthen individual voices. The included in-depth interview was conducted in English and facilitated at field school base camp.

A semi-structured interview guide was used in both the in-depth interview and the group discussion in order to understand community perceptions on water scarcity and water quality, allowing flexibility in the interview process (Bryman, 2016). Therefore, the discussion guide was used to some extent, but was sufficiently flexible to allow for follow up questions depending on participant responses (See Appendix A). The interview guide covered a series of relevant topics and questions related to water-related issues in the NCA. The question guide probed the following issues, perceptions of water-related issues in the NCA, stakeholder engagement in water-related issues in the NCA, current strategies to address water scarcity, and current strategies to address water quality.

4.3.2 Group discussion

Group discussion as a method is a particularly suitable approach when the aim is to investigate experiences, beliefs and perspectives in a context where many people interact. This form of interview is often used when there is a need for evaluation of experiences or understanding of initiatives and organisations (Malterud, 2013). In this setting the interviewer has the role of a moderator, to create an active interaction between the participants, and the possibility to explore diverse viewpoints on a theme (Kvale and Brinkmann, 2015). According to Skovdal and Cornish (2015) is a group discussion usually among four to eight participants. The group discussion selected for this thesis was the group discussion involving three local men. Although Skovdal and Cornish (2015) defines four to eight participants as a group discussion, was the interview conducted following a group discussion strategy. The group discussion was conducted in English and facilitated at field school base camp.

4.3.3 Think tank method

The think tank approach as adopted by Allen-Scott and colleagues was developed based on the report, *Systems thinking for health systems strengthening* by WHO (2009), which divides *system thinking in the health system* into (ten) steps, starting with *Intervention design*, which consists of amongst others:

- Convening stakeholders;
- Collective brainstorming;
- Conceptualizing intervention effects; and,
- Adapting and redesigning the intervention

Project SHINE adapted these first four steps described above. But have added and modified the WHO version to fit the purpose of this study, which unfolded as follows during the think tanks:

1. The BSF pilot study was described;
2. Potential worries were identified;
3. The role of the underlying factors was discussed, and ranked;
4. Potential mitigation strategies were brainstormed to tackle potential UHs of the BSF in the NCA, and;
5. Aspirational conclusion

Therefore, bringing a larger group of experts together to share ideas, perspectives and reflections on the BSF evaluation process could contribute to a broad understanding of potential UH and mitigation strategies (WHO, 2009). The mentioned steps will be described next.

4.3.4 Think thanks conducted in this study

The think tanks in the study were divided into different phases (See Appendix B). Initially (Step #1), the project leader introduced the BSF pilot study to ensure a common understanding of the purpose and main components of the project. Participants then had the opportunity to ask questions regarding the practicalities around the BSF, and in addition to this, a picture of the BSF was passed around for everyone to see. After showing the picture, and describing how the BSF worked, questions related to the technology were addressed. After the introduction, we moved on to step #2, consisting of a brainstorming session to identify potential worries and concerns about introducing the filter in the community. Step #3, the role of the underlying factors and their interactions within the evaluation context were discussed, then top worries about implementing the BSF in the community were ranked according to importance by community members. Step #4, given the solutions oriented focus in the think tank method, the group then discussed possible mitigation strategies for each stated worry or concern. Step #5, finishing off with an aspirational conclusion, where participants were asked to express what their hopes are for their community and what they hope for in the future for their families (WHO, 2009). Table 2 below, provides an overview of the think tanks conducted in the study.

Table 2. Overview of Project SHINE´S Thinks Tanks.

Think Tank	Various perspectives	Numbers of Participants (n=)
#1	Perspective from various community members (grassroot) on the BSF evaluation process	10
#2	Perspectives from the local women´s group on the BSF evaluation process	15
#3	Perspectives from Stakeholders on the BSF evaluation process	11

Think tank with various community members

Think tank number one, was led by a PhD candidate and member of the Project SHINE research team from the Catholic University of Health and Allied Sciences in Tanzania. The member speaks fluent *Kiswahili* and English and conducted the discussion in *Kiswahili* before translating to English for the rest of the research team. Also, one of the male participants translated *Kiswahili* into the local language, *Kimaa*, for the women to fully understand the

content. This think tank was held outside, a short distance from the campsite. There were six men and four female participants, five note takers, one interviewer and the project leader all present during the meeting (the latter was present in all three think tanks). The composition of the think tank included various members of the Maasai community and was among others represented by two traditional leaders, village executive, a man from the pastoralist council, and members of the local women´s group.

Think tank with local women´s group
The author of this thesis had the opportunity to lead the second think tank and it was conducted in English with translation to *Kimaa* by Project SHINE´s research assistant. The session was conducted in the same location as the first think tank. The second think tank consisted of fifteen women from the women´s group. In total there were four note takers present during the interview: three members of Project SHINE, and one veterinary student from the University of Calgary.

Additionally, this think tank will be included to answer the first research question. Which relates to community perception of water scarcity and quality in the NCA.

Think tank with stakeholders
Lastly, the third think tank was also led by researcher of this study, with support from the project leader. The session was spoken in English and translated to *Kiswahili* by the Project SHINE coordinator. Think tank three consisted of six male key stakeholders, including: three respected members of the community, a technician at the hospital, staff from system of water project and an employee form the local water committee. In total, there were two note takers from Project SHINE.

4.3.5   Sampling and recruitment
Our timetable for our stay in the NCA was four weeks, and unfolded in May/June.

The local project coordinator for Project SHINE was responsible of the recruitment for all three think tanks, group discussion and in-depth interviews, which included both adult male and female participants. The involved participants all live in the Endulen area. The recruitment was based on a mix of purposive and convenient sampling. This means that the Project SHINE coordinator included both members from the Maasai community that were available to participate in the research, and *key informants* chosen by the coordinator which was suited to

participate in the study because of their role and knowledge regarding the research question (Bryman 2012; Skovdal and Cornish, 2015). In this study, the participants selected for the think tanks differed to some extent in terms of occupation, gender and role in the community. Participants recruited for the in-depth interviews were all represented at a grassroot level, however, these too differed to some extent in gender, age and occupation.

4.4 Data analyses

Shortly after each interview the research team came together, compared field notes, had a debrief regarding what went well and what could be improved upon next time. Identification of emerging themes and suggestion on further probing were also an important part of the data analysis process. According to Malterud (2013), data should be transformed into organized, interpreted and condensed material during the analysis process. To start this process, all of the data collected needs to be transcribed. Transcribing is the stage in the research when the data goes from spoken to written form making the material more suitable for qualitative analysis. Already at this stage in the process, the initial analysis starts (Kvale and Brinkmann, 2015). Each in-depth interview, group discussion and think tanks were transcribed verbatim by myself and a fellow student who is also a member of Project SHINE. All transcribed data were analysed and compared against field notes as a form of triangulation to strengthen trustworthiness. Triangulation is a multimethod approach, which means using more than one method or source of data in the study, for instance; group discussion, in-depth interview and think tanks, as applied in this thesis (Bryman, 2016). In addition to all the text written down in the filed notes, important observations as for instance facial expression, laughing, pitch and gesticulations were captured. When working with the analyses process these observations were combined together with the transcribed materials to ensure the atmosphere of the interview setting was captured.

Content analysis was chosen to analyse the data, with the two different approaches; *Conventional analysis* and *directed analyses* (Hsieh and Shannon, 2005) due to the two different research questions. The two approaches are outlined below. Content analysis is well suited to analyse sensitive phenomena, and is often used when little or no previous research is done regarding the topic of interest (Elo and Kyngäs, 2008). Based on these considerations, this particular analysis method was used as the thesis topic deals with sensitive issues including poor access to resources which may be stigmatizing, and the limiting research done regarding the subjects of interest.

4.4.1 Conventional content analysis

Data from in-depth interviews were analysed by using conventional content analysis, facilitated by the qualitative analysis software program NVivo 11.4.0. Conventional content analysis means organizing data by open coding, creating categories and abstraction while reading the transcribed materials (Hsieh and Shannon, 2005). Categories are derived from the data, not based on pre-determined codes, such as when analysing the data from the think tank. Also referred to as an inductive approach (Elo and Kyngäs, 2008). In this way, the author becomes immersed in the data which allows new insights to emerge (Hsieh and Shannon, 2005). Conventional content analysis involves the following steps; first, the analysis starts with reading all data repeatedly to achieve immersion and obtain a sense of the whole. Then the transcribed text that appear to capture key thoughts or concepts is highlighted. Notes of first impressions, thoughts and initial analysis of the text was written down, then codes emerged and was later on sorted into categories based on how different codes were related and linked. Lastly, the categories were sorted into meaningful clusters (Hsieh and Shannon, 2005).

4.4.2 Directed content analysis

Data from the think tanks were analysed using directed content analysis, facilitated by the qualitative analysis software program NVivo 11.4.0. According to Hsieh and Shannon (2005), directed content analysis means to *validate or extend conceptually a theoretical framework or theory*. This implies that the typology described previously by Allen-Scott et al. (2014) related to UHs, was applied during the analysis phase. However, the initial typology was extended to include additional themes that emerged during data collection in addition to the already existing categories with emerged themes, also referred to as deductive content analysis (Elo and Kyngäs, 2008). Thus, additional categories were created within the bounds of the model. This approach is well suited to studies based on earlier theory or models to refine or extend a conceptual framework or theory (Hsieh and Shannon, 2005). The directed content analysis process involved pre-determined codes and categories from the Allen-Scott et al. (2014) framework which served as the base for the first step in the analysis. Thus, beginning with identifying key concepts as initial coding categories sufficient to the UH typology model (Hsieh and Shannon, 2005). Each transcript was read multiple times to allow for immersion in the data. Starting with identifying all text relating to the BSF intervention, potential UH and mitigation strategies were highlighted, coded and applied to relevant pre-determined codes (Hsieh and Shannon, 2005). Text that could not be categorized with the initial categories from the model was given a new code and eventually a new category.

4.5 Ethical considerations

Ethical clearance has been obtained by three ethics committees, the University of Calgary´s Conjoint Health Research Ethics Board (CHREB) and Tanzania´s National Institute for Medical Research (NIMR), and the Norwegian Center for Research Data, (Norsk senter for forskningsdata [NSD]). See Appendix C for the NSD approval. This study involves minimal risk to the participants, nonetheless, the Declaration of Helsinki´s ethical principles for medical research involving human subjects (WMA), were followed throughout the study (WMA, 2013).

All participants were informed in advance about the purpose of the study and permission was obtained before any questions were asked. Permission was also granted to audio-record the sessions with the exception of one session where notes were taken instead with permission. We did not have written informed consent from the participants, due to large parts of the community being illiterate, therefore all information regarding the study was described by our interpreter in the participants preferred language; *Kiswahili*, *Kimaa* or English, and informed oral consent was obtained. All data collected are safely stored in password protected files and folders, in accordance with ethical requirements. To maintain confidentiality and preserve the anonymity of the participants, participants are referred to as female or male participant and by the participant's occupation or position in the community. Furthermore, the same system was applied when quoting participants in the results chapter below (chapter 5).

4.5.1 The author´s role and preconception of the research topics

No description is free of interpretation, but according to Sandelowski (2000) qualitative description is, as opposed to phenomenological or grounded theory for to for instance, a kind of interpretation that is low-inference. Meaning that researchers will agree more radically on the "facts" of the case, but not necessarily feature the same facts in their descriptions. Therefore, researcher must also recognize that their own background affects their interpretation and how they "position themselves" in the research (Creswell, 2013).

Being an outsider, which according to Hellawell (2006) can be defined as: "where the researcher is not *a priori* familiar with the setting and people she or he is researching" (Hellawell, 2006, p. 485), requires careful reflection and preparation. To be a white young woman from an affluent country in the NCA can have a major impact on the information given by the participants. In general, the importance of being aware of your own role as a researcher

is highly relevant when collecting data. Both preconception of the theme and your role as a researcher can potentially interfere with the data (Kvale and Brinkmann, 2015). In qualitative interviews the researcher wishes to engage in a mutual understanding, but nevertheless the interview unfolds in a professional setting, and therefore there will be an asymmetrical power imbalance (Kvale and Brinkmann, 2015). This asymmetry is particularly relevant to be aware of when interviewing people from other cultures. Factors such as how you frame your research questions, refer to sensitive phenomenon and gender differences are important factors that need to be taken into account. It is important to learn about the verbal and the nonverbal components in the culture you are studying, to increase understanding of their meanings. Furthermore, respect for the community and culture is essential, and as a researcher, the importance of understanding the rank and the hierarchy in a community being studied is vital (Kvale and Brinkmann, 2015). This is especially true within the Maasai culture. For instance, out of respect you greet men and women differently, this also applies when greeting the elderly. It is important to respect the rank in the community, for instance the importance of collaborating with traditional leaders and others with higher authority when planning or implementing a project. Several members of the Project SHINE research team have years of extensive experience with working closely with the Maasai community, and therefore have developed a meaningful and respectable collaboration. Nevertheless, it becomes even more important to be aware of the power dynamics between the community and the researchers, considering the possibility of getting too "close" and lose the research perspective (Kvale and Brinkmann, 2015). To mitigate some of the power dynamics, it was important to greet each other before each interview, briefly introduce ourselves and the project while demonstrating our gratitude towards the community who were willing to participate. Without them, the project would not have been possible.

Regarding preconception of water-related issues in the NCA, my understanding was limited. While reading up on formative research done by Project SHINE my knowledge rapidly increased. Also knowing that a larger part of the Maasai population share water sources with cattle and wild animals influenced my perception of how contaminated their water can be. The concept of UH in PHI was relatively unfamiliar to me. However, as an educated and practising nurse, I have witnessed several incidences with a planned desirable outcome, end with unintended harm. I learned during my preparation for field research that reporting unintended harm is much more common in medical science, compared to public health science. Considering how limiting my understanding was in both themes, there has been minimal impact or interference in the production of the data, however as mentioned I have personal background

characteristics that inevitably frame my broad understanding of the context. As a researcher the importance of having an open mind and a naïve viewpoint is essential (Kvale and Brinkman, 2015).

In this chapter, the methodology has been described in detail, however methodological strengths and limitations will be presented later on, in the discussion (chapter 6). In the following chapter, results from the data collection will be presented.

5   Chapter 5. Results

This chapter begins with a presentation of the results of the first research question related to community perceptions of water scarcity and water quality. This is followed by the results of the subsequent research question which focuses on identifying the community concerns and proposed mitigation strategies towards the BSF implementation.

5.1   Community perceptions related to water scarcity and water quality

The findings from the first research question will be presented including illustrative quotations by the participants. These are placed under themes with underlying sub-themes, representing community perceptions of water scarcity and water quality in the NCA. Higher structural level and relevant actors involved in addressing water scarcity and water quality are presented initially. Thereafter, an in-depth investigation into more specific community practises and knowledge regarding water scarcity and water quality is presented to enlighten our understanding of how the Maasai are adapting within the context they are living in.

Through conventional content analysis of the in-depth interviews and the think tank, six different themes with associated sub-themes emerged, related to perceptions of water scarcity and water quality. This can be seen in Table 3 below.

Table 3. Themes generated through the coding process, with related sub-themes.

Themes	Sub-themes
Higher level structural/contextual aspects	*Water scarcity* Contextual factors influencing water access
Actors working on water-related issues in the NCA	*Water scarcity and water quality* Groups addressing water scarcity Groups addressing water quality
One Health	*Water scarcity and water quality* Collective water source and animal interaction Basic human needs Seasonality as a determinant of water
Insufficient water supply	*Water scarcity* Water source management Stresses and danger associated with water collection
Community norms	*Water scarcity* Gender roles and responsibility Cultural norms and practices related to water Collecting water as a social activity
Water-related awareness	*Water quality* Knowledge on water quality

5.1.1   Higher level structural aspects

Contextual factors influencing water access

As mentioned in the background section (Chapter 2), the NCA has several restrictions influencing the Maasai´s limited access to water. When the Maasai lost their rights to access all permanent water sources in the Serengeti National Park, the Maasai received a promise from the Tanzanian government that new water sources would replace their loss towards the Serengeti National Park (Galvin et al. 2008). However, out of 29 water systems which was made to compensate the loss, as little as two of the systems were usable and accessible for the Maasai residents (Galvin et al, 2008). The restrictions that the NCAA place on the Maasai was mentioned in the group discussion, which expressed issues regarding limited access to water sources.

Participants in the group discussion stated that all natural sources are free to use, however with the exception of the Ngorongoro Crater and the fact that the Maasai residents are not allowed to dig private well for individual use.

> *There are no natural sources that are off limits except for in the crater (…) NCAA makes sure that people don't dig* (Local men: Group discussion).

In addition to natural sources being unavailable for the Maasai, tourism is another factor influencing the water that is available to the NCA residents. As mentioned previously the Maasai receive limited benefits from the tourism industry, and the Maasai are competing over the same drinking-water sources as the safari lodges, and due to the safari lodges are able to pay, they manage to access enough water for the tourists (Galvin, et al, 2008). According to the participants in the group discussion lodges also buy water from the water truck, which belongs to a manager of the pastoralist council (PC) filled with water from the NCAA headquarters or from the river. The water from the truck is available for all, however there are few Maasai residents that can afford this service.

5.1.2 Actors working on water-related issues in the NCA

According to the participants there have been efforts to address water scarcity through drilling of bore holes and wells in the NCA. However, there have not been any attempts to address water quality in this setting.

Groups addressing water scarcity

The local men expressed that organisations such as the World Bank, the NCAA, and the church provides water for the community by for instance building pipelines and drilling wells. The World Bank is one of the actors which have provided the Maasai with water by building pipelines close to a town called *Madukani*, the pipeline however, reach a radius of 16 kilometres, therefore few people are benefitting from this water source (Paasche, unpublished master thesis). On the question regarding if these actors work together, the answer was that this was not the case and that they work in silos. One participant pointed out that:

> *The district council should be involved in water related issues. They are the local government. The government and the NCAA don't work together* (Participant: Local men, Group discussion).

Although there are different organisations addressing water scarcity, several Maasai are reportedly using the river, given that few people benefit from the well or the pipeline. Likely this is due to the Maasai´s socio-economic status and where they reside. For instance, Maasai living in areas around *Madukani* and the pipeline, have access to the pipeline water, and Maasai living in more rural areas, are using the river.

The women in the think tank expressed that there have not been any actors working within the community that they are aware of that are trying to address water quality. Nevertheless, they sometimes attempt to treat the water using cloth filtration or boiling. According to the local woman interview, few people boil water because they do not like the taste. This finding is consistent with former research conducted by Project SHINE.

5.1.3   One Health

As mentioned previously, the need for addressing both human and animal health is essential when working with health promotion, especially in a pastoralist, rural setting such as the NCA. With livestock being the Maasai´s main livelihood, which generates both income and food supply, this stresses the need for healthy animals and sufficient water sources. According to UN water, water quality is a key ingredient in the health and well-being of humans, as well as for the sake of the ecosystems (UN-Water, 2012). However, according to the local men, water quality was less important compared to water scarcity.

> *Water scarcity is more of an issue than water quality. It is more important for the people to have enough water than to have clean water. More concerned with whether or not there is enough water for the animals* (Local men: Group discussion).

The importance of healthy livestock is essential for the Maasai pastoralists, and is elaborated even more, later in the same interview:

> *Water is an important challenge. Water is the main reason for disease. Affects both humans and animals. If you have no animals, you have no life* (Local men: Group discussion).

Therefore, human, animal and environment health are all interrelated and equally important, especially within the context of the NCA.

Collective water source and animal interaction
A consistent theme through both in-depth interviews and the women´s think tank was the shared water sources with livestock and other wild animals. This was associated with poor quality of water due to contamination through animal faeces and other sources. For instance, an additional factor affecting the quality of the water was according to the participants due to washing clothes in the same source as collecting drinking water.

Because people are washing there, the same place, cattle they drink the same place, so the quality is not [good] (…) yeah the contamination (Local woman: In-depth).

Furthermore, in the women´s group discussion they communicated what they described as bacteria that their livestock got on their tongue, which they associated with unclean water. Participants explained that they could see blood on the tongue, and that the men typically removed these bacteria from the cattle's tongue. Furthermore, they said that this was a common problem and if people drank that water, they could vomit blood, and they could see the bacteria.

Yes, it´s common. When people they can, person can drink that water. Have that… and then one person can vomiting that blood, the blood. Then they can see that it´s that bacteria (Participant: Local women´s group: Think tank).

To clarify the nature of the 'bacteria' as reported by the participants, one of the veterinarians on the research team asked the participant if these bacteria looked like a worm. The participants agreed that indeed they did. Upon return to the camp, faculty from the veterinary medicine from the field school team collected specimens from the tongues of cattle which proved to be leeches. See Figure 3 below.

Figure 3. A leech specimen found on the tongue of a cow. Picture credit: Sheri Bastien

Basic human needs

As mention in the background (Chapter 2), the average members of a household are 4.7 in Endulen and 4.5 in Nainokanoka. 50 litres of water a day is the estimated requirement of one person, to supply basic needs: drinking (5 litres), sanitation (20 litres), bathing (15 litres), food preparation (10 litres) (Landon, 2006). According to Human Development Report (2006), ensuring a minimum of 20 litres of water each day per person is a requirement for respecting the human right to water. When Maasai women collect water, they usually carry the water in plastic buckets, which contains approximately 20 litres. The picture below (Figure 4) shows a Maasai woman carrying a 20 litres bucket.

Figure 4. Woman carrying a typical water bucket containing approximately 20 litres of water. Picture credit: Tina Paasche.

When collecting water, drinking water to meet household needs was identified as the number one priority.

> *They get water for drinking, not for washing clothes, and for making themselves clean, just for drinking* (Local woman: In-depth interview).

Other needs, such as personal hygiene was not expressed as a priority by participants, this is particular a challenge when the water is scarce.

> *There's not enough water for cleaning themselves like bathing and hand wash* (Local woman: In-depth interview).

Lack of water is furthermore especially problematic for the women during their menstruation period. Menstruation hygiene management and access to basic facilities is important for women's health, safety and dignity. For instance, materials to absorb or collect menstrual blood, soap and water for washing and access to sanitation is essential elements needed in this period (House, Mahon and Cavill, 2012) Many Maasai women are struggling to meet these needs, and this was expressed in the in-depth interview with the local women:

> *In menstruation time, they got a big problem because the water is so shortage (…)*
> *not all of them are using pads, sometimes they are using the small clothes so the water to clean those ones is difficult* (Local woman: In-depth interview).

Few have the opportunity to buy pads, so most women use the *shuka* (traditional Maasai clothing) to make pads to use during menstruation. However, there are also women that neither use pads nor cloths. Globally, lack of sanitation and drinking water is well documented, however the availability on information regarding menstrual hygiene management is limited, compared to water, sanitation and hygiene (WHO/UNICEF JMP, 2015). In a study conducted in Mozambique, by Cairncross and Cliff (1987), it was found that hygiene practices and hygiene-related health outcomes were directly related to the distance of water source and household. It was explained by both the local women and the women in the think tank that previously, due to lack of water, the Maasai women used cattle urine to wash their clothes, however, using cattle urine is not a common practice anymore.

Seasonality as a determinant of water scarcity
Especially in the dry season the Maasai community is greatly affected when it comes to supply of water. The local women´s group think tank presented alternative perspectives from the two other interviews regarding water scarcity. Water scarcity was not seen as a challenge by the

women, because the river they use as their primary source of household water is reportedly never dry. We asked about when water is very scarce, if they still have enough water, they expressed that even during the dry season they have adequate amounts of water to meet household needs. However, when probed about whether access to water varies according to where one lives, one participant confirmed that this, as well as the socioeconomic status are key factors:

> *If they have money they take water with the car. Even with the donkey they take, from the river* (Participant: Local women's group, Think tank).

In the in-depth interview and group discussion, the amount of water supply was conflicting in comparison to the women´s think tank. Both the local woman, and the local men, expressed concern due to lack of water. In the interview with the local woman, she expressed that, firstly there was enough water to meet the needs of a household, but when asked about whether or not drought is ever experienced in the NCA, she answered:

> *Yeah, but in the rain season there is enough water, but in the dry season, there is not enough water* (Local woman: In-depth interview).

Water scarcity was especially highlighted as a concern by the local men:

> *Around September to October they are suffering. The rain only last about one to two months* (Local men: Group discussion).

Water scarcity has a greater impact on women and children, according to the local men. This is because women are the ones responsible for collecting water and the boys who looks after the livestock, are responsible for the finding water for the cattle to drink. Water quality however, affects men, women and children equally.

Rainwater harvesting is a common strategy to meet household needs during water scarce periods and a question was posed to determine whether this was a strategy among participants. Rainwater harvesting has been a way to collect water for thousands of years, and on par with the BSF, is a low-cost system. Rainwater harvesting systems are relatively easy to construct, install and operate. Maintenance and cleaning is important for successful use (CWAST, 2011). Rainwater harvesting was not reported to be common among participants, due to the access to the river. However, it is worth noting that this may also be influenced by socioeconomic status

since the tanks required to harvest water are expensive (approximately 1 million TZS. for a 100L tank or approximately 3800 NOK).

5.1.4 Insufficient water supply

Water source management
The primary source for collecting water was the river as also identified by all participants. Other options for obtaining water include the water truck, as mentioned above, selling water to people in Endulen area. Participants in the women´s group think tank mentioned the truck as a potential source of water, if you had money, which is consistent to what the local women said about the water truck being just for few people in Endulen area due to lack of money. The pipeline however, was according to the participants few Maasai that benefit from.
Due to the fact mentioned earlier that rivers serve multiple purposes, such as washing clothes, the Maasai have established a system to separate areas of the river to serve each purpose. The river is separated in smaller areas where there is a place for washing cloths and a place for collecting water. The women in the think tank expressed that this is an effective system to manage water sources, which is common knowledge among the Maasai community. However, those who do not know about and use the system, perhaps those living in other areas that come to graze their cattle, can be given a fine:

> (…) *they give him a punishment, and then they have to pay money* (Participant: Local women´s group, Think tank).

The word punishment was elaborated during the interview, and it turned out that the punishment was paying the fee, reportedly fifty thousand shilling (approximately 200 NOK). Furthermore, another method that the Maasai use to manage water sources is by putting up a fence to try to keep wild animals away.

> *They put fences around the water. So when they come, the wild animal, they cannot pass the fence* (Participant: Local women's group, Think tank).

An additional strategy used to manage the water is through the use of a guard (called *askari* in *Kimaa*) and scarecrow to scare livestock and wild animals away. Despite increased effort in protecting their water sources, wild animal, such as elephants and buffalo do not respect fences, and tramp over them.

Stresses and dangers associated with water collection
All participants, especially the female participants discussed several factors associated with the burden and workload required to meet household water needs. The distance women walk to find water was highlighted as a key challenge for women living in the NCA.

> *The distance is so far! They go from the morning, and maybe to the afternoon. Some places is, maybe some places are from morning to evening because there, there is many people, at the river,* (Local women: In-depth interview).

On the question regarding how many times per day was needed to go and collect water, the women in the think tank reported that it all depends on the amount you need.

> *(…) if you want much, you go more times, three, four. So it depends the amount of water, what you need for that day* (Participant: Women´s group, Think tank).

Some women use donkey as a means to help with carrying the water, although, few people have the economy to own one. Owning more than one donkey eases the burden on collecting water, due to less walks and the heavy carrying of the water buckets. The Maasai women call the donkey, *the car for women*. (See Figure 5 below).

Figure 5. A woman and her donkey. Picture credit: Tina Paasche

The long distances to walk for fetching water, was also identified as a challenge in the interview with the local men.

> *The water people gather is far away. The longest is 6 hours, the shortest is 1 hour and the medium length is 2 hours* (Local men: Group discussion).

UNICEF (2016), emphasizes how much time spent on collecting water, robs millions of women valuable time which can be devoted to other pursuits as for instance education, strengthen families and communities, and leisure. Water collecting also impact children, especially girls access to education (UNICF, 2016). During the interview with the local men, questions regarding if children were able to attend school while being responsible for collecting water, with one reporting that:

> *Some children don't go to school (about 60%) and some children do go to school (40%). Better than the past, because it used to be 90/10. Now we have more schools and the schools are closer. (…) The parent decides which children go to school. The father decides, the woman doesn't really have a decision. Government forces equality for both boys and girls to go to school* (Local men: Group discussion).

Having access to clean water close to the household, can lead to greater possibilities for both children and women (Wilbur, 2015). UNICEF (2007) refers to a study done by Redhouse (2004) in Tanzania, which showed increased school attendance with 12 percent, when access to water was available within fifteen minutes, compared to water sources which was more than half hour walking distance away. An observational study conducted in South Africa found that children spent an average of 19.5 hours on domestic activities, where collecting water was the activity which was the most time-consuming (Hemson, 2007).

Carrying heavy water and close interaction with wild animals was stated as a challenge women face when collecting water. The possibility to run into wild animals when collecting water was identified in all three interviews. The risk of meeting an elephant or a buffalo is according to the participants in the women´s group discussion, one of the challenges with collecting water. Participants reported that they had heard about recent attacks on the Maasai by wild animals, but not close to where they reside.

When you go in the morning you can find wild animals, like elephants (...) and buffalo (Participant: Local women´s group, Think tank).

When exposed to wild animals, women in the group discussion told that that they usually run back home. It is also common practice, when wild animals are close by, to warn other in the community and neighbouring areas.

An additional potential harm identified by the local women was rape when collecting water. Due to this, it is common for women to travel in groups when collecting water.

So it may be a challenge because children, people rape those girls. Yeah, sometimes living here and around (Local woman: In-depth interview).

When elaborating on this matter, *moranis* (young Maasai males become a *morani* around the age of 15, and goes through the transition from boyhood to manhood[12]) and older men, were the ones who were identified among those who rape. If there are people passing by, some are willing to help, but not always. People that sometimes help these girls are the boys/men that are taking care of the cattle. In the article *Safe access to safe water in low income countries: water fetching in current times*, the authors point out that *assaults and attack risks* on women collecting water are not well documented, and need to be considered in future research (Sorenson, Morssink and Campos. 2011). However, according to Kirchner (2007), almost every incidence of rape in the eastern Democratic Republic of Congo happens when women are out collecting water, firewood, or washing clothes.

5.1.5   Community norms related to water

Gender roles and responsibility
Globally, women are the primary providers of water and this was consistent with the responses given by all the participants, women were identified to both have the responsibility for collecting and treating the water in the household. In addition to this they are responsible for collecting firewood and food preparation. The women in the group discussion, expressed that girls often help with fetching water, but mostly in the weekends, due to children being at school during the weekdays. Men and boys are responsible for taking care of the cattle, which includes

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[12] http://www.newworldencyclopedia.org/entry/Maasai

both finding water and graze for them to feed on. Regarding shifting boma, the participant's answers was relatively complementary. The women in the group discussion said that women and children stay behind, and men and boys leave with the livestock to a temporary boma. This was consistent to what the local woman said, but when elaborating on the subject, she said that usually women and girls stay behind if there is enough water, if limited access, they also move to a temporary boma with the rest of the family. According to the local women, this happens twice or three times a year.

Cultural norms and practices related to water
During the interviews with both the local woman and the women's think tank, traditional Maasai rituals for bringing the rains in the dry season were discussed. It was explained that Maasai women perform a water ritual which consists of praying to the Gods for rain by going to the mountain (The mountain of God), where they slaughter a goat or a sheep as an offering to the Gods. Another ritual used when praying for rain is primarily practiced by pregnant women:

> *They believe that when a women got pregnant, lying there down, the believe that God can hear, then than hear they prays. They believe so, yeah* (Local woman: In-depth interview).

Rainmaking rituals are an ancient practice among pastoralists living in Africa where droughts are common (Semenya, 2013), especially in areas where people are depending on rainwater for agriculture and successful harvest. In South Africa among the Pedi tribes the rituals are practised when the water is scarce. When the Pedi are praying for rain they usually gather near a river that normally does not dry up even if a drought is severe, then sing spiritual songs and pray for rain (Semenya, 2013).

Collecting water as a social activity
Despite that there are several factors associated with the burden and workload with collecting water, this activity is also identified by the women in the thin tank as something the Maasai women enjoy doing. Usually women go together as mention above when collecting water. During the walk to the water source they have time to share stories with each other, they often talk about their families and everyday stories.

They ask them self about your family this morning, children that are fine. Yah. And make differences stories (...)They say they sing, and sometime they make gossip other people, like men, the second wife, and the first one (Participant: Women´s Think tank).

In the literature, social aspects of collecting water, for instance aspects such as social support and networking, are lacking systematic scientific evaluation (Sorenson, et al. 2011).

5.1.6   Water-related awareness
A multitude of perspectives related to water quality were expressed by the participants and related primarily to the water quality being poor, due to shared sources. Nevertheless, several time the quality was expressed as good, both by the local men and the women in the think tank.

Knowledge on water quality
While some of the participants expressed great concern regarding the quality of the water, there was some contradictions in the responses on this issue. For instance, in the interview with the local men, one participant reported initially that 60 percent of Maasai living in the NCA have poor water quality, but according to the participant, these people think that the water quality is acceptable.

> *Only a few people know what diseases can come from unclean water. They think that if our ancestors drank this water and survived, why can't we survive?* (Local men: In-depth interview).

However, if the water seems to be clearly contaminated (high turbidity), some women use cloth filtration, according to the participant. Later in the interview that same participant describes the water quality as satisfactory, although he mentions seasonality as a factor influencing water quality:

> *No, water quality is okay. Sometimes it is a problem. In the dry season, the water quality from the water is good. The water from the river is good* (Local men: Group discussion).

This was to some extent, also found to be the case in in the women´s think tank. The women expressed a great deal of gratitude toward the BSF project bringing them clean water. They demonstrated an understanding and hope that by having clean water, household illness could be decreased:

They hope that you may bring them the clean water through that filter. So they happy because they can go away [*unknown word] with the diarrhoea and the vomiting, so they happy (Participant: Women´s Think tank).

Nevertheless, some contradictions were present when the women in the think tank communicated that the water they provide for their family is clean. For instance, when asked (a sensitive) question about how providing unclean water to their family makes them feel, and the women collective replied: *it´s clean* – Participants; Women´s think tank. The perception of water quality, expressed by the local woman was stated as *not okay*, due to shared water sources with animals. In the women´s think tank health was described as important and essential for overall productivity and well-being:

It´s important because when you get sick you cannot do anything. Health is important to get to work, your home activity, to fetch water, to go collect firewood's, take care of your children, so it´s important (Participant: Women´s Think tank).

These conflicting results initially implies limited community knowledge regarding water quality, however there seems to be a common understanding that shared water sources with the animals may lead to illness.

5.2 Community concerns and identified mitigation strategies related to the implementation of the Biosand filter – UH Typology

In this section, the results from all three think tanks will be presented, starting with identifying potential underlying factors of the BSF evaluation, identified by the participants, and then link the worries to the associated harm typology. However, the harm typology will not be elaborated further in this section, but will be covered in depth in the discussion chapter. The top three ranked worries related to the BSF will be listed, and lastly the mitigation strategies identified by the community to tackle harm related to the BSF are discussed. Potential UHs concerning the BSF implementation were identified in all five of Allen-Scott et al. (2014) typology. In addition, two additional harm typologies emerged during the analysis: *harm by omission* and *political harm*. This interpretation is consistent with Allen-Scott et al. (forthcoming) paper on *Consideration of harmful unintended effects during planning and implementation of Project SHINE in Tanzania using a "think tank" approach.*

5.2.1 Associated underlying factors regarding the evaluation of the BSF technology

Underlying factors associated with potential UHs of the BSF evaluation were identified in two of the categories of underlying factors that makes up the unintended harm typology (Allen-Scott et al. 2014), namely *Ignoring Root Causes* and *Boomerang Effect*. The category that is originally *Lack of community engagement*, was in this thesis modified to *Lack of Sustainability*, due to given answers from the participants stressing the need for the BSF to be sustainable in order for the project to be successful. Factors identified with *Limited and/or poor quality evidence* was not relevant to the analysis of data in this thesis given that the evaluation on the BSF quality of evidence is too early to consider. *Limited and/or poor quality evidence* will however be relevant in the follow-up phase. *Implementation in a lower- or middle-income country* is also not relevant in this thesis. As previously mentioned, the BSF technology is specifically developed to fit LMICs, and especially rural areas where water turbidity is high. The table below gives a short summary of the definitions of the underlying factors.

Table 4. Summary of key definitions of the underlying factors.

Underlying factors	Description
Ignoring root causes	Not taking into consideration the local context in which the intervention unfolds (e.g. recourses, policy, and culture).
Boomerang effect	Opposite effect then first intended.
Lack of sustainability	Poor access to support from relevant groups involved.

Ignoring Root Causes

The main underlying factor which was found to be associated with ignoring root causes were concerns regarding poverty. This was especially a worry that was expressed in the women´s think tank.

> *They say that the challenges is money (…) they worry about if it´s possible to everyone to get that filter* (Participant: Local women´s group, Think tank).

The costs of the BSF was presented in all three think tanks, in the women's think tank the respond to what the tanks alone costs (approximately 40 thousand TZS, (ca. 260 NOK), was responded with affirmative nodding, without further remarks. The price of one filter varies according to country, context and materials, however, in total the filter cost approximately 120 000 TZS (ca. 500 NOK). Due to lack of money, the women in the think tank expressed concern regarding the possibility of occurring competition among community members.

It will be the competition because when she saw with her eyes, everyone wants to have (BSF) in here house, in her boma – (Female participant: Various community Think tank).

Despite the fact that the BSF may create competition among community members, the women in the think tank also expressed that it might not be a problem for those who do not receive the BSF since there are already existing practices for water treatment.

Before you bring that filter, we just used that boiling, and the filter with the cloth, we continuing to do so. So it would not be a problem for them, if they don´t have (Participant: Local women´s group, Think tank).

However, having the BSF was expressed as important by the same participants due to being beneficial for human health.

It will be the difference, because when they have the filter, they decrease the diseases like diarrhoea and the vomiting, so it can change the life of itself (Participant: Local women´s group, Think tank).

A consistent opinion expressed by the women, both in the think tank with various community members and the women's group, was that before they have an opinion regarding the BSF, they need to see how the filter works, in order to share concerns.

They first wait and see, and how to work and then they can bring out the view or the hopes, the wait to first see and how it works (Participant: Local women´s group, Think tank).

Despite the remark about needing to see the BSF before sharing comments, the main concern of the women who contributed in the think tank, was lack of money to be able to buy the BSF. The worry regarding poverty did not seem to be a great concern in the other two think tanks, whereas in the think tank with various community members and stakeholders, participants expressed the possibility for selling cattle as a means to buy the BSF.

Because the cattle which we have, goat and sheep, we can just sell them, and then do something which is interesting (…) and then find something good for, their health (Technician at the hospital; Stakeholders, Think tank).

One of the participants in the think tank with the stakeholders, gave an example which illustrated how the Maasai people are moving towards a more modern community. For instance,

by living in roof houses/modern houses, although this is expensive, is this a priority which is taken based on what is good for their health. Furthermore, the participant spoke about people having solar power gaining access to electricity and also having the opportunity to charge cell phones at home. The participant also expressed that when people learn about new technologies or ways to improve health, it is something that people are interested in, and therefore also something they want for themselves. For instance, several Maasai´s today have cell phones, compared to earlier, which was expressed as another example on how the Maasai are developing towards a more modern community. However, the cost of the BSF can be higher than the price of one goat or a cow. One participant poke of how the cost of the cattle varies according to gender and species. The price can differ from 25 000 TZS up to 100 000 TZS, (Approximately100 and 400 NOK). Despite the fact that lack of money was not brought up as a worry in the think tank with the various community members, the participants at multiple times expressed worry regarding that not everyone would be able to receive a BSF. It is likely that this can be related to the fact that not everyone has the money to buy one.

> *They worry that if one person is looking at this particular thing [BSF] is working very well. And someone is also eager to have that kind of facility in the bomas. And getting one might be a challenges* (Male participant: Various community members, Think tank).

The concern of the sample size being inadequate in relation to the scope of the area the pilot unfolded in, was another worry expressed in the think tank with various community members. Rural areas are at risk of not being reached by the project and hence unable receive knowledge about the BSF technology.

> *If we look one the sample size, and look how split the community of Endulen is. How spilt the community Nainokanoka is, the sample size is too small* (Female participant: Various community members, Think tank).

Underlying factors such as poverty and considerable large areas which can make it challenging for the Maasai residents to both receive and hear about the BSF, is associated with ignoring root causes and can lead to inequality affecting psychological harm. This was highlighted as a prominent worry in the think tank with various community members.

Resources are scarce in the NCA, and the need for permission to bring material into the conservation area was identified as a concern in the think tank with various community

members and stakeholders. The challenge of getting access to materials essential to the BSF both due to political regulation in the NCA, and local policy challenges between and among community members was also raised as a concern. This is similarly associated with ignoring root causes.

> *(…) are this material going to be used and be available in local city* (Male participant: Various community members, Think tank).

Project SHINE did not experience any challenges with bringing materials into the NCA the material needed for the construction of the BSF into the NCA however in the think tank with the women´s group, participants stated that for white people, it can be easier to bring material through the main gate.

Within the Maasai community there are different levels of leadership between the community members. It is essential to be aware of this hierarchy when working with the community, both from a grassroots and a stakeholder's perspective. The importance of acknowledging the hierarchy is essential when implementing the BSF in order for the project to be successful and sustainable. By not engaging different levels of leadership, can this lead to UHs associated with ignoring root causes. The households which was selected for receiving a BSF was conducted at an open community meeting where selection of households were discussed and facilitated at the VEO headquarters. Usually whenever there are pressing issues or any discussions which need to be addressed, these are made through community meetings, in dialog with the VEO. This is also how Project SHINE sampled participants which would receive the BSF. In the think tank with the various community members, one of the male participants stated that having the VEO laying the ground work for the selection of the bomas are an appropriate way of involving the community.

> *So most of the projects, be like the VEO officer. Approaching the shine, like not only talking to the existing structure, but going to the community, discussing the important kind off issues and the implementation itself as well, also involving the community on what they need and what went bad. That is how SHINE is something that have been successful and is also important to have succeed in the bigger picture. (…) So we see that, they approach itself, involving the community at the grass rote, so making subjects of ownership, a sense of ownership over the project* (Male participant: Various community members, Think tank).

The participants in the think tank were seemingly satisfied whit the decision of the selection of households took place through an open community meeting. However, multiple times during the think tank discussion, participants pointed out that they respect the political and cultural structure in the community, but at the same time they expressed a scepticism towards the executives. Although selection took place through proper community channels, one of Project SHINE´s employees were selected among the 15 households to receive a filter. An explanation of the fact that Project SHINE was not involved in the selection of the households was explained to the participants in order to avoid misunderstandings.

Furthermore, in the think tank with various community members, the participants communicated the importance of community involvement within the BSF project, and not to greatly be affected by executives. For instance, worries regarding the distribution of the filter was highlighted in the think tank with various community members. According to the participant's community members should be the one who decided who gets the BSF, as the people cannot question authorities if the project fails.

> (…) *so the project is managed by the executives, so if they fail, so who are we to question them?* (…) *And like now if the executive were the implementers, nobody would question them. That's why, like if they are the one who are deciding who are getting the BSF, at in the end of the day, the BFS is not supplied, nobody would question where did you take the BSF technic.* (Female Participant: Various community members, Think tank).

Furthermore, the same participant explained how a World Bank project failed to supply her village water due to poor management and therefore community members lost their opportunity to be involved in the project. This example illustrates a strained relationship between the community members and project managers or executives, which is an important root cause, needed to be addressed in order to avoid harm.

The Maasai pastoralists being semi-nomadic, was raised as a concern in the think tank with the stakeholders and is associated with the underlying factor, ignoring root causes. Despite the fact that the BSF consists of the plastic material, a fully installed BSF will approximately weigh around 65 kg[13], which can be difficult to carry around when moving.

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[13] CAWST. http://biosandfilters.info/faq/what-hydraid-r-plastic-biosand-filter

> *Our community and people are moving often according to the seasonal, following where they can get the grass and water for their cattle. This biosand filter, they are heavy (…) so, if they move, how, will they do whit it?* (Technician working at the hospital: Stakeholders, Think tank).

However, this was not raised as a concern in the think tank with various community members, due to the reason that women stay behind with the children and can maintain the filter while the men are out with the cattle. The women also expressed that educated people do not usually shift bomas.

> *Only cattle, goats and men are the one that move. But women and children remain behind. And that one, she said that educated people they are not moving* (Male participant: Various community members, Think tank).

Seasonality can potentially affect the use of the BSF in either way, due to when men leave with the cattle, they will not have the opportunity to drink clean water if the BSF is left behind with the women. Also seasonality may lead to water scarcity which can make it demanding to feed the filter the amount of water needed to keep the biological layer alive. This could potentially lead to women and children not being able to use the BSF themselves.

As shown there are several considerations to be aware of that relates to *ignoring root causes*, which again can lead to UH. By ignoring fundamental causes, such as unique context interactions and the way of Maasai living, this can potentially lead to multiple harms, and are therefore associated with several of Allen-Scott et al. (2014) UH typology, including the emerging themes; harm by omission and political harm. The mentioned harms will be discussed in Chapter 6. In the table below is a listed summary of factors associated with ignoring root causes which may lead to UHs.

Table 5. Factors associated with ignoring root causes which potentially generate the following UHs.

UH	Ignoring root causes
Physical	Shifting between primary and temporary boma Size of the BSF
Psychosocial	Power dynamic with in the community Resentment Socioeconomic status Gender
Economic	Poverty
Cultural	Local leaders Semi-nomadic
Environmental	Seasonality
Political	Leadership Bringing materials in to the NCA Recourse barriers
Harm by omission	Inequality among those not reached by the project

Boomerang Effect

Lack of proper education and maintenance of the BSF was identified in the think tank with the various community members and the stakeholders. The concern of people lacking proper training or knowledge on how to use the BSF can potentially lead to misuse of the filter, and an increased risk of recontamination of the water. In the study on household water treatment and safe storage practices, it was found that training was vital for ensuring correct use of household water treatment systems, regardless if the technology was easy to use (Ojomo et. al. 2015). Despite that the BSF is easy to use, essential knowledge is required to manage the filter.

> *So in case of any challenges, any difficulties, like if the technicians are not well trained, then that will be the end (…) there is a need for education, so the technicians should be properly trained* (Male participant: Various community members, Think tank).

As mentioned above (under ignoring root causes), receiving insufficient materials to build the BSF, was expressed as a worry in the think tank with the stakeholders. For instance, poor education could result in people both buying and selling incorrect materials.

> *If there is no people who really know the exactly, that this material needed and this quality needed. They might bring you the different quality, which if you come and use, then after a few days, that's it (Employee form the local water committee: Stakeholder, Think tank).*

Another worry related to this matter, was participants concern regarding people making profit and selling inaccurate materials needed for the BSF.

> *(…) they bring you different quality which is totally different. There are other people selling things to a cheap price, they say they look the same, but others are very expensive, but the quality is not the same* (Technician from the hospital: Stakeholders, Think tank).

In public health campaigns the boomerang effect often relates to warning messages (e.g. NO DIVING) and information based interventions which can induce opposite attitudes or behaviour, especially when it comes to warning messages (Ringold, 2002). According to Wogalter, DeJoy and Laughert, (1999), cited in Ringold (2002), potential and factors that lead to an opposite effect than intended have received limited attention in the literature. Despite the fact that the BSF evaluation does not include a focus on warning massages, the information and the technology related to the BSF, can lead to a boomerang effect if not understood correctly due to the risk of recontamination if the BSF is not maintained and used properly. Therefore, it is highly relevant to examine the factors which can lead to UH due to the boomerang effect. In this way, Project SHINE can address these factors, and tackle UHs. For instance, the study (as mentioned in 2.1.5) on the use of oral rehydration solutions which resulted in alternative growth of bacteria (Daniels et al. 1999), can potentially be the result of the BSF if not prepared or stored properly. If hands, dippers, cups or other external materials touches the water, it may become contaminated and be unsafe to drink (CAWST, 2012). Therefore, it is important to use safe water storage containers. Also worth to mention is the risk of particles smaller than the space between the sand grains passing through the BSF. According to Guchi (2015) who conducted a review on slow sand filtration in removing microbial contamination and particles from drinking water, cites to Huisman (1977) that found that high filtration rate may lead to potential breakthrough of bacteria. The reason for potential breakthrough is that microorganisms gets forced to live deeper in the sand bed. However, in some cases the filtration rate does not have an effect on bacteria removals. Nevertheless, potential breakthrough may lead to UH which is associated with the boomerang effect. In the table below a summary of factors associated with the boomerang effect is listed.

Table 6. Factors associated with boomerang effect which potentially generate the following UHs.

UH	Boomerang effect
Physical	• Recontamination due to lack of safe water storage containers, poor maintenance.
Psychosocial	• Inability to implement and receive knowledge concerning the BSF • Powerlessness
Economic	• Making profit selling inaccurate materials
Political	• Accessing proper material

Lack of Sustainability

Sustainability needs to be considered in every health promotion intervention, and involves an ethical concern, especially towards the participants and the community that is being worked with. What happens when the funding for the research ends, or when the timeline for the project expires? Who will be there to support the community (Scheirer and Dearing, 2011)? The definition of sustainability, according to the study by Scheirer and Dearing, (2011, p. 2061) is: "the continued use of program components and activities for the continued achievement of desirable program and population outcomes". Also, commonly used terms by other researchers include: continuation, confirmation, maintenance, durability, continuance, and institutionalization (Scheirer and Dearing, 2011). Despite some nuanced differences among these terms, the main point to emphasize is the importance of continuing the research beyond the initial funding period and in some cases till the desired indented outcome is fulfilled. This is also what the authors refer to with sustainability (Scheirer and Dearing, 2011).

The need for the BSF evaluation to be sustainable and the importance of feeling ownership towards the project was stated as highly important by the participants. This was especially highlighted in the think tank with the various community members. Concerns regarding poor leadership, both at a community level, but also poor leadership and lack of support from Project SHINE was a prominent concern.

> *So, if there is like a working support group if there are any major challenges form the communities addressing after the three months, six months. (…) And there will be no one to address this.* (Male participant: Various community, Think tank).

One of the reasons for the importance of adequate leadership and management was so people living in even more rural areas would have the opportunity to hear about the project. Without adequate leadership, participants expressed worry that some people would not be reached by the project and that the project would only benefit people living in more urban areas.

> *Because without adequate management, provision and adequate follow up from the project leader, and whoever is involved, the project will reach maybe only few, and might not reach the people in need* (Male participant: Various community, Think tank).

Community involvement may have significant impact on the physical and social determinants of health if the distribution of resources and collaboration with the relevant implementations programs are successfully provided. Therefore, intervention programs need to offer long-term support if aiming to be sustainable. More importantly, if an intervention program is pulled out too early, this may not unexpectedly, affect the results of the intervention (Swerissen and Crisp, 2004). One of the female participants in the think tank with various community members, gave a figuratively illustration on lack of sustainability, and was described as followed:

> *Because most of the projects is just passed away projects. They just come back like helicopter projects. They just land here today, do the next project for a short period of time, and then they disappear* (Female participant: Various community members, Think tank).

Statements such as this can indicate that the Maasai residents have been involved in different projects with various outcomes. And another statement may confirm this:

So in most of the projects, the first two times done properly and then we won´t see anybody from the community again (...) once we are in it, there is no support (Female participant: Various community members, Think tank).

Goodman et al. (1993), cited in Swerissen and Crisp (2004), emphasize that within the field of health promotion several projects fails to become sustainable due to insufficient resources provided to the project. According to Swerissen and Crips (2004), funding bodies should consider if the scope of the budget provided for the intervention is sufficient enough to facilitate sustainability.

Adequate leadership was important in both think tanks with various community members and stakeholders. However, leadership from a grassroots perspective was identified as important for the sustainability of the project in the think tank with various community members. In the think tank with the stakeholders, the importance of having appropriate leaders in place at a policy level was highlighted as necessary for sustainability and growth of the project. The importance of building capacity within the community, is essential to recognize and develop the skills and resources of the community (Naidoo and Wills, 2009). To identify and meet the community's actual needs, for instance providing opportunities for the Maasai community to learn through experience or opportunities that would not otherwise be available to them, is important (Naidoo and Wills, 2009). For instance, such as the BSF workshop. The vision is that Project SHINE is planting a seed, in order for the Maasai community to grow and nourish the intervention which in turn will hopefully affect the sustainability of the project. In the following table, a summary of factors associated with lack of sustainability is provided.

Table 7. Factors associated with Lack of Sustainability which potentially generate the following UHs.

UH	Lack of Sustainability
Psychosocial	• Stigma
Economic	• The scope or the budget of the project (also mentioned in ignoring root causes). • Follow-up from Project SHINE
Cultural	• Local leadership conflicts • Community conflict
Political	• Leadership • Rescores barriers
Harm by Omission	• Inequality between urban and rural areas

5.2.2 Mitigation strategies

Several mitigation strategies were proposed in all three think tanks, to reduce the top three worries which can lead to UH related to the BSF evaluation. In the table below, the top three worries are listed from each think tank.

Table 8. Showing top three worries in each think tank.

Think tanks	Worry number 1	Worry number 2	Worry number 3
Think tank with various community members	Inequality among the residents which will receive the BSF, and those who do not.	Local leadership and management regarding the BSF	Lack of education regards to the BSF
Think tank with the women's group	Lack of money	None stated	None stated
Think tank with the stakeholders	The size of the BSF	Availability of materials	Policy level

Mitigation strategies proposed by various community members

Starting with the think tank involving various community members, and potential mitigation strategy to address *worry number 1*: Inequality among the ones who receive and those who do not receive the BSF.

The importance of grassroot leadership and minimum involvement from the executives was stated as important in this think tank. Due to the scepticism towards the executives potentially having the responsibility of the distribution of the BSF may according to the participants lead to inequality due to inadequate distribution of the BSF. Participants are worried that executives may fail to reach the people in real need for the BSF. However, one solution for an approach to mitigate potential inequality, was by cross checking to see if there is a clear distribution in the community, of who receives the BSF.

> *That if you are selecting a boma, then it should be someone to cross check it and have a clearly presentation throughout the community. Some sort of cross and check to ensure that we have appropriate accountability* (Male participant: Various community members, Think tank).

Lack of/or poor local leadership towards the BSF project was listed as worry number two by the participants. And mitigation strategies are partly interrelated with worry number one, as it centres around the importance of establishing a proper leadership at a grassroot level. For the participants the importance of ownership and local leadership within the community towards the BSF project is essential for the BSF to become sustainable.

So, we see that, they approach itself, involving the community at the grassroot, so making subjects of ownership, a sense of ownership over the project (Male participant: Various community members, Think tank).

Lack of education towards the BSF was by the participants listed as worry number three. Approaches to mitigate concerns regarding poor levels of education within the community emphasized the importance of a proper implementation phase with adequate education and training of health promoters and BSF technicians. This was identified by one of the participants:

The education piece, more people will be educated and raise awareness so that people will understand the BSF and the importance of having safe and clean water. And it will be more successful in the second hand if there is adequate implementation. (Male participant: various community members, Think tank).

To involve school children and teachers was stated as a way to increase education and knowledge of the BSF technology within the community, which would also affect the sustainability of the project. Furthermore, to increase education and secure proper leadership even further, learning from previous projects, such as the World Bank project regarding the implementations phase, and administration and management of the project was identified as a way to mitigate the respective worry. In this way, the BSF project may have potential for scale-up and be more successful, if having adequate leadership and continuing follow up of the BSF evaluation.

Most of the world bank project have not been successful meeting the most people in need as it had got intended to, because of poor leadership, administration and inadequate management piece of it (Male Participant: Various community members, Think tank).

Participants in this think tank expressed a positive attitude towards the BSF evaluation, however it depends on adequate leadership, management and administration, especially at a local community level and furthermore, proper follow-up from Project SHINE.

Mitigation strategies proposed by the local women's group
In the think tank with the women´s group, participants expressed worries mainly towards poverty, which is a factor difficult to mitigate. However, a strategy proposed by the participants, was the possibility to share clean water with neighbouring bomas if someone had the money to buy one.

> *I have to pay maybe for her or to help her, and then, have in my house, I collect other people, I give them water through the filter.* (Participant: Local women´s group, Think tank).

Furthermore, participants identified education as a key word for long term sustainability, and if they would be given a BSF they could share knowledge and awareness on how to use and maintain the BSF within the community.

> *You have to give them, to teach them, and to give them and how to using them to spread word to other people. So they need to use, and to know, and they can spread for other people* (Participant: Women´s group, Think tank).

Mitigation strategies proposed by the stakeholders

Lastly, in the think tank with the stakeholders, participants expressed the size of the BSF as worry number one. In the implementation phase, the BSF used in the workshop was 100 litres, while ideally the size would be approximately 75 litres (CAWST, 2011). One mitigation strategy proposed by the participants, was the possibility of implementing 50 litres filters. In this way, the BSF would be easier to carry when shifting boma. However, it is important that the filter can accommodate as many litres required to meet the household´s daily needs.

Worry number 2; several strategies were proposed as a means to mitigate worries regarding available materials needed to construct the BSF. The importance of having multiple stakeholders in place advocating at different structural levels was communicated as important for the projects sustainability, which in turn will affect the availability of materials. The group suggested to have a spokesperson (health promoter/health officer) for the BSF who can speak on behalf of the community.

> *If health promoters, somebody that is like health officer in Endulen involve about this things, then it will be easier to use him for the process of the government, if there is any possibility of the government to support this project* (Technician working at the hospital: Stakeholders, Think tank).

Having locally key leaders from Endulen and Nainokanoka area who can promote and advocate the BSF to policy leaders in the NCAA and the government, can potentially mitigate the struggle of getting the materials needed for building the filters, into the NCA. One way to do

so is through a written letter from the village officer, given to the PC to present the project at a NCAA meeting. The NCAA can potentially also support with funding, if they approve of the project. With further funding, access to materials would potentially increase, giving more people in the NCA the opportunity to access a filter.

> *So if these two wards [Endulen and Nainokanoka] come together, then they can present this at a NCAA meeting, through the pastoralist council, then it will be easier, because if there is no reason for NCAA to refuse, then they can just put the budget to support the communities* (Employee form the local water committee: Stakeholders, Think tank).

During the think tank discussion, a concern experienced by the research team was shared with the participants, in order to give them an impression of some of the challenges regarding accessing materials for the filter. On particular challenge was getting hold of the sand needed for the BSF workshop during the field school season. The team experienced political challenges, due to collecting sand from an area which was not included in the project. Parts of the sand needed to construct the filter, was not available in Endulen. This resulted in a conflict as the sand collected was from an area that did not benefit from the project.

> (…) *behind the scenes there were a lot of political challenges. In getting the sand from communities from other than that, which we were implementing the BSF in* (Project SHINE coordinator: Stakeholders, Think tank).

Mitigation strategies to meet this concern was identified by the participants, consisting of offering information to nearby communities and informing the leaders about the BSF evaluation, ensuring them that the BSF is for all people living in the NCA. Despite that the BSF project started in Endulen, the vision is to spread the knowledge and the technology amongst everyone.

> (…) *we can invite some of the leaders from Esarie, we sit together and talk, then we will educate them, about what we are doing* – (Staff from system of water project: Stakeholders, Think tank).

Key leaders and politicians were according to the participants in the think tank with the stakeholders' important bodies to engage with for Project SHINE. Both to increase the BSF project's accountability and sustainability. It was also essential to engage with the PC, the NCAA, and the Development Office, to make sure that Project SHINE can ensure additional funding and support for other communities in the NCA.

Consideration of the Maasai residents' concerns and their unique context have been carefully addressed in collaborating with various community members, local woman´s group and stakeholders, in order to identify underlying factors potentially leading to unintended harms. Inequality, poverty, lack of education and training, availability of materials, and poor leadership and management has been dominant themes through all three think tanks. In the following chapter, the harms linked to the BSF evaluation, will be elaborated in depth.

6   Chapter 6. Discussion

In this chapter, the results will be discussed and situated within the broader literature presented in this thesis, together with the UH typology framework proposed by Allen Scott et al. (2014), followed by a discussion on strengths and limitations relevant to this study.

6.1   Community perceptions related to water scarcity and water quality

6.1.1   Main perceptions related to water scarcity

The community perception related to water scarcity that emerged through the analysis, was mainly centred around insufficient amounts of water for both humans and animals - especially considering seasonality, the struggles to meet basic human needs and the burden on women and their responsibility regards to water. In this section, concepts from the UH harm typology will be discussed in order to link already existing harms in the context in relation to the typology. An example here could be poor water quality being associated with physical harm. Later, the UH typology will guide the discussion related to UH and the BSF evaluation.

As seen from the results, there are some actors (e.g. the church, the World Bank and the NCAA) addressing access to water in Endulen area. However, it is mostly the Maasai living in close radius to the water pipe that are benefiting from this source, causing most people which reside in more rural areas to find other opportunities such as the river. This may create inequality among the Maasai living in and around that specific area, and can lead to harm by omission, and also physical and psychosocial harm. When actors, such as the World Bank is not providing water to more than a specific area, thousands of Maasai residents still need to use the river, and therefore being exposed to contaminated water, which may lead to stigma and inequality due to not being given the opportunity for development. As much as 85 percent of the poorest people in Tanzania live in rural areas, and inequalities have increased between those who live in urban areas compared to those living in rural areas (International Bank for Reconstruction and Development and World Bank, 2016). This also seem to be the case within the NCA, where people living close to more urban areas, are those who benefit from the pipeline. Since the Maasai residents are not allowed to dig for water themselves, few opportunities are left for them to explore, which may lead to even greater inequality in socioeconomic status. Several researchers are concerned about the possibility that PHI may increase inequality in the population (Lorenc, Petticrew, Welch and Tugwell, 2012), which can relate to as an UH.

Interventions aiming to increase access to water, need to carefully map of the context, especially considering UH. A focus on decreasing inequality in health among the people living in the intervention area should be top priority when implementing PHI.

According to the participants, most Maasai residents are using the river as their primary water source. However, this source has multiple functions such as washing clothes and serving as a primary water source for humans, livestock and wild animals. With regard to the holistic approach on health and the One Health triad, the need to develop sustainable access to water and methods to manage the water sources would strengthen the health of the Maasai, their livestock and their unique ecosystem. It is likely that the varied and high frequency use of the river, may lead to environmental harm, which can affect both humans and animals within the NCA greatly. In the dry season, there is a possibility for the river to dry out (not mentioned in the interviews), which would lead to multiple harms, such as water for neither humans nor animals. To rely on one single source for water, makes the river highly vulnerable. Adding to this vulnerability is the fact that the Maasai population is increasing, and that seasonality also affects the few sources available for use. When water become more scarce, it forces humans and animals to rely on even smaller areas, leading to closer contact between them which increases the disease transmission route (Mazet, Clifford, Coppolillo, Deolalikar, Erickson and Kazwala, 2009). The risk of zoonotic diseases can lead to physical harm (e.g. diarrhoea and influenza), affecting the health of the individual (Mazet et al. 2009). Healthy animals are equally important for the Maasai as their own health, (*If you have no animals you have no life).* Unhealthy animals can possibly lead to multiple harms for the Maasai community, especially economic and physical harm, as well as psychosocial harm. Many Maasai are depending on the herd for capital income and access to food. Therefore, without the livestock, the Maasai may be exposed to hunger and poverty. In the Maasai culture, socioeconomic status and the number of cows and goats or sheep are highly interrelated (Hetherington, 2017). The study by Lawson et al. (2014), experienced a particularly devastating drought, when collecting data in Northern Tanzania in 2009. This resulted in high levels of pasture depletion, and was by some Maasai described as the worst drought in living memory. The authors emphasize how this likely would reflect in high food insecurity and poor health outcomes (Lawson et al. 2014). This scenario may happen again, and are just as relevant for the Maasai living in the NCA, where seasonality is affecting all living beings. Water scarcity was told to be affecting women and children in greater deal than men.

Women´s incredibly heavy burden of collecting water affects both their health and leisure, potentially leading to physical harm and psychosocial harm, due to heavy lifting and time spent away from their children. According to the WHO (2001) poor women often experience ill-health due to hard physical labour, causing skeletal deformation and joint pain. Labour associated with collecting water can have negative effects on human health, despite this, within the public health field, few studies have been looking at the burden related to collecting water for household use and how this can impact the health of women. Only recently this subject has been given more attention after pressure from organisation working for women's rights (Sorenson et al. 2011). It is highly understandable when water is scarce that the water collected, is namely for drinking and cooking purposes and not for personal hygiene. If they were to prioritize personal hygiene, this would require even more walks, and sufficient amount of water. This is especially demanding during women's menstruation when the need to clean oneself increases. Without a proper access to water and sanitation, this can affect women's health, due to the link between unwashed pads or cloths may lead to reproductive tract infections, urinary tract infections, infertility, and anemia (House et al. 2012).

Collecting water is highly time consuming, and the desire to have a donkey to ease the burden was something that the women would be glad to have. However, few Maasai families have a donkey. More than one donkey would be helpful to reduce the time collecting water, and even if not mentioned in the interviews, it is likely that owning only one donkey could already helpful. Every year, a total of 40 billion working hours are lost to water collection worldwide, in Sub-Saharan Africa, women spend a combined total of at least 16 million hours each day collecting drinking water (WaterAid, 2016; WHO/UNICEF JMP, 2012), which consumes 26 percent of women´s time in rural Africa (WaterAid, n.d., b). On average, girls and children walk 3.7 miles a day for collecting water in Africa. (United Nations Human Rights, UN Habitat and WHO, 2010). WHO (2017) report on *Safely managed drinking water* shows that in several countries in sub-Saharan Africa the average time to go for collecting water is at least half an hour on a single walk. In Roberts (2008) article: *Privatizing Social Reproduction: The Primitive Accumulation of Water in an Era of Neoliberalism,* she is referring to *Water policy international* which has estimated that in South Africa alone, women collectively walk the equivalent distance of 16 times to the moon and back every day just to get water in order to meet their families need to survive. These numbers are staggeringly high, and needs immediately attention and action world-wide. The focus on goal 6 in the SDG´s gives hope for change. Getting would getting access to safe water sources closer to the household would likely mitigate several

burdens associated with women and water scarcity. Such as access to education, safer environment and increased personal hygiene, especially with regards to menstruation period and increased leisure. The BSF can provide the Maasai residents with clean water which can have a positive effect on their health, however the BSF will not reduce the time it takes to collect water, nor the danger associated along with it. Nevertheless, if the BSF can increase health within the population, this will potentially increase Maasai women´s overall productivity and well-being. Collecting water was not only associated with a burden, fetching water was also something that the women expressed as enjoyable.

Water scarcity affects the Maasai residents at various socio-ecological levels. From public policy level, it is for instance illegal for individuals to dig for water for personal use, and at an intrapersonal level, due to women´s need to be healthy and functional in order to collect water. The Maasai residents need to follow community norms and rules when collecting water, such as fetching water at the right spot, to avoid fees. With regards to the interpersonal level, water scarcity brings women together when needing to collect water. This is due to safety reasons (e.g. increased risk of getting raped and attacked by wild animals), and practical reasons (more women to carry the water) and a social activity where the women would share stories and spend time together creating friendships and a social network.

6.1.2   Main perceptions related to water quality

Considering that few Maasai residents actually treat their water (e.g. with cloth filtration or boiling) raises a question as to whether they actually believe that the water is contaminated or if they lack knowledge regarding to the link between water and health or if they simply have other priorities. Indigenous knowledge may affect the way they understand water quality. As told among the participants; if their ancestors drank the water, why can't they? Few details were expressed around knowledge of water quality. While there was a general agreement that shared water sources with the livestock would lead to contaminated water, there were some participants that still claimed that the quality of the water was good and that it was clean. This could be due to the way that the Maasai define when the water is clean or not. For instance, few Maasai was reported to use cloth filtration as a means to filter water, it is likely to think that purifying water was mainly done when water is turbid, and that is when they use the cloth, to filter visible particles away? So, if the water looks clear, maybe that equals clean water? Expressing that the water was clean and at the same time expressing gratitude towards the BSF project for finally giving them an opportunity to drink safe water, is in many ways a paradox.

For many Maasai residents, contaminated water is the only access to water available, leading them to no other choice than to use that as a drinking source. It is likely that this can bring shame and powerlessness, especially when western researchers are asking so delicate questions. Answering defensively may be a way to cope with the fact that they have the knowledge, but they do not have the ability to act upon it, which can lead to psychosocial harm. Therefore, the BSF technology can be an option for the Maasai community to treat their water, and in addition to bringing clean water it can also reduce the stigma and powerlessness which drinking contaminated water may lead to. And not to mention, it can also decrease the physical harm, such as diarrhoea. It is a possibility that implementing the BSF can be challenging if some Maasai residents do not believe that the water is contaminated. This circles back to health literacy, which can be challenging when a large proportion of the Maasai is illiterate. Such as understanding that complex phenomenon such as virus and bacteria in the water can affect human health. However, this can be challenging for all people, illiterate or not. Nevertheless, indigenous knowledge must be taken into account as equally valuable. The participants showed awareness towards the link between water and health in several ways. Such as the leeches which were described as bacteria which cattle got on their tongue. The leeches were described as making both human and animals sick. Another way to show awareness of the link between water and health was through managing water sources. Managing water sources is an action based on an understanding that a shared water source with the livestock and wild animals is bad for human health.

As the discussion shows, based on the Maasai´s perception on water scarcity and quality these two concepts have contributed to a greater understanding and a broader foundation on the subjects. Especially with regards to implementing the BSF and the need for careful consideration of potentially UHs, in order to avoid to contribute to additional harms or to amplify already exiting harms related to water issues.

6.2 Unintended Harms associated with the BSF intervention

In this section, the listed top three worries from each think tanks will be discussed in relation to the UH typology. Some of the worries are merged together, due to their resemblance, for instance *Leadership and management* and *Policy level* and *Lack of money* and *Availability of resources* (See Table 8). The most common overall worries, were inequality and lack of sustainability due to poor leadership and education. Other worries that were mentioned were usually a result of worries linked to inequality and sustainability, such as lack of money.

6.2.1 Inequality

A prominent worry was the concern regarding the inequality that may emerge if some Maasai residents will not be able to receive the BSF. The concern centred on the NCA being a very large area, and that people are scattered both in rural and more urban areas. The large area can make it difficult to reach everyone, especially the Maasai who would benefit from the BSF the most. By ignoring root causes, such as large areas and poverty may lead to harm by omission and psychosocial harm. The study conducted by Lorenc et al. (2012) refer to Tudor Hart which state that people in most need of benefiting from preventing intervention are least likely to receive them. Even if the intervention is showing results of improved health within the population, the intervention may still have generated inequality (Lorenc et al. 2012). Addressing inequality is highly relevant, and it is important that the BSF implementation does not increase inequality within the community. Therefore, the focus on identifying UH is a systematic way to try to ensure the intervention prevents further inequality in the community. Despite that it is likely impossible to eradicate inequality, Project SHINE in collaboration with various community members through the think tanks, have developed several mitigation strategies to minimize the worry of inequality. The importance of engaging with the Maasai community cannot be emphasized enough. To address inequality, Project SHINE must continue to be developed on the basis of an understanding of the processes that generate inequality among the Maasai residents, and can therefore not be understood without close dialogue with the Maasai community. The study by Ojomo et al. (2015) found that in the city of Morogoro, Tanzania, owning a BSF in some rural areas was seen as socially advantageous and due to this the demand for owning a BSF increased within the area. According to PATH, 2009; Lee and Kotler, (2011) cited in Ojomo et al (2015), ensuring that household water treatment technologies is viewed as inspirational has previously been identified as important in generating demand. This can relate to what participant said about "seeing the BSF in a neighbour boma

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and wanting to own one for themselves". If the BSF would be seen as socially advantageous in the NCA, this may amplify the inequality among those living in poverty.

Mitigation strategies to tackle inequality should be centred on the importance of community members being in control and having the responsibility of who would receive the BSF. In this way community members could make sure that the distribution of the BSF was done in an appropriate and equal manner. If they were to be responsible for the distribution, the BSF would be more likely to be given to households in real need for a technology which was providing clean water. As mention earlier, in the think tank with various community members, participants expressed scepticism towards executives. This is likely du to previous experiences with executives which also raised scepticism. For instance, the worry about the BSF not reaching people in real need, became clear when the research team became aware off the fact that the Project SHINE coordinator had received a BSF. There is reason to questions if the person concerned is one of the Maasai which are in real need for the BSF, compared to others in the community. Furthermore, it raises a question around the administration and selection of the households. However, to be an opinion leader advocating for a use of the BSF technology, may generate positive outcomes due to being a respected member of the community. This circles back to the importance of understanding the hierarchy within the NCA, when introducing new technology, both the desire to reach the people in need for one, but also engage the Maasai that have the ability to bring the project forward is valuable and necessary for mitigations of inequalities. In the future mapping households which are in real need for a BSF can be a way to mitigate inequality in collaboration with a grassroots leadership. By involving community members to promote and advocate for the BSF, may lead to the BSF project to develop into something more sustainable. Which in turn may lead to reaching out to the broader community, giving more Maasai residents the opportunity to access the BSF. In this way, it is possibly to both mitigate harm by omission, and psychosocial harm inflicted by the BSF evaluation.

6.2.2 Lack of sustainability

Lack of proper leadership at a grassroot levels was as mentioned above a prominent concern in the think tank with various community members. Promoting the BSF without any political support, both at a grassroot level and policy level may lead to political harm.

The importance of Project SHINE´s collaboration with policy leaders was stated as important for the project to be sustainable in the stakeholders think tank. If bodies such as the PC,

Development Office and the NCAA are involved and familiar with the project, this can potentially mitigate political harm associated with the BSF evaluation. For instance, the need for approval to bring materials in to the NCAA, or access local materials within the NCA, can be less complicated with policy leaders involved. For instance, the PC can promote the BSF project at a NCAA meeting, which can mitigate the challenge of bringing materials into the NCA. Project SHINE did not experience any problems with getting materials into the NCA, however for the Maasai residents, difficulties to bring materials inside the gate can still be a problem. In the women´s think tank, one participant mentioned that "white people" may not experience any difficulties bringing materials into the NCA, but the Maasai may. This example amplifies how the Maasai are affected by the restrictions from the NCAA, where unfavourable policy leads to marginalisation of the Maasai pastoralists. Policy level should support both the opportunity for development as well as preservation of unique Maasai culture. Therefore, engaging with politicians is important, both to increase voices of the Maasai community to be heard, and furthermore to address difficulties accessing necessary materials needed to construct the BSF. The fact that participants in the think tank with various community members and policy leaders spoke of the importance of the two different levels of leadership (grassroot perspective and policy perspective) has given Project SHINE a great foundation to work on. Engaging with policy leaders is important for receiving additional funding to expand the BSF, and to increase the accessibility towards materials both within the local context and outside of the NCA. Leadership at a grassroots level is important for the wider community to be involved and ensuring adequate and equal distribution of the BSF. Sustainable leadership is important at both levels, and can potentially contribute to mitigation of political harm and harm by omission. For instance, the challenge of accessing sand needed for the filter, could be avoided or minimized if local leaders of the different areas had been informed about the BSF project. The conflict was based on areas giving away resources without gaining anything in return. This is understandable when resources are scarce and there is a project addressing access to clean water. It is only natural wanting to be a part of such a project. Especially if parts of the materials needed for building the filter is situated in that specific area. A potential collaboration between local community members and policy leaders need to be carefully considered due to the power dynamics within the Maasai community and with regards to an overall scepticism towards policy leaders. This scepticism is consistent with former research Project SHINE have conducted earlier, that showed a great mistrust in politicians (Friebe, 2016). For instance, in Friebe´s study, a concern was elaborated on the issue of politicians seemingly have good intentions, however it is all empty words, and furthermore was advised not to be a part of the

project intervention if wanting the project to be successful. This example amplifies what is perceived in this study as an overall scepticism towards policy levels, as also expressed by the various community members.

Sustainability is one of the key factors stated as a prominent worry among the participants, and in order to address sustainability, proper education was another important strategy to increase sustainability within the project.

6.2.3   Lack of or poorly education regards to the Biosand Filter

Lack of, or poor education regarding to the BSF technology was a prominent concern expressed by the participants. Lack of, or poor education may lead to a potential boomerang effect which was associated with both physical and psychosocial harm. Fear of people not being properly trained, and therefore potentially misuse the BSF may result in an adverse outcome. Even though the BSF is a low-tech water system, the complexity of the components may be challenging to understand. It is understandable that participants are worried about the quality of the education. Due to the complexity concerning the mechanism of the layers, much is needed to be learned in order to build, operate and maintain the BSF. In a study on long-term effects of the BSF distribution in Ethiopia, the researcher found that low usage rates and poor performance was associated with quality of maintenance, lacking needed education, and lacking outside support (Earwaker and Webster, 2009). For instance, the study found that a considerable number of people were cleaning the BSF too often, too deep and with dirty water, which led to reduced effectiveness and lower water quality. Inadequate use of the BSF is what participants in the present study were worried about. If the education received is poor, it may contribute to the adverse outcome.

Many Maasai residents are relying on the training which was given to those who attended the three days' workshop. The importance of the local technicians being properly trained was stated as highly important in the think tank with various community members and proper education was further important for the sustainability of the BSF. The workshop was focusing on practical training, and all participants was included in all the different steps of the construction of the BSF. The vision was that together with participants involved in the second workshop which learned about health promotion, local technicians and health promoters would serve as change agents within the community, sharing knowledge and education on both the BSF and the link between water sanitation and hygiene to the wider community. Hopefully these locally trained

technicians will have the adequate skills to help others in the wider community in building the filter, as well as sharing knowledge about maintenance.

Psychosocial harm (not mentioned in the think tanks) may occur to those who also receive education regards to the BSF, due to several Maasai being illiterate which may lead to feeling embarrassed or disempowered. To be reminded that water quality is poor and in addition learning more about how poor water quality can have an ill effect on your health, can perhaps lead to a sense of powerlessness. Especially if also lacking money to buy one is a barrier. This can potentially lead to psychosocial harm, as accessing the BSF is in many ways out of the individual control. In Allen-Scott´s et al (forthcoming) paper on harmful unintended effects on projects SHINE´s implementation of locally and sustainable strategies to improve sanitation and hygiene, psychosocial harm was identified. Together with the secondary school students and teachers, psychosocial harm was identified as a result of frustration and disempowerment, based upon the inability to implement knowledge due to resource barriers, power dynamic within the community and criticism by the wider community. These underlying factors identified can relate to the present study, where participants were identifying similar worries. For instance, power dynamics can relate to the present study concern about not wanting to "destruct the structure", which is based on the worry about having the right leaders in place in order to promote the project further. In Allen-Scott et al. (forthcoming), students were worried about promoting youth empowerment without policy level support, which may result in a hierarchy conflict. So, according to statements such as these, the need for addressing the Maasai´s hierarchy is relevant considering spreading knowledge within the community. This is further important due to the consideration of potentially cultural harms. Therefore, it is important to engage within the local community and have key members of the community which can advocate and promote the BSF, and hopefully mitigate some of the cultural harm that the BSF may create. By providing quality training together with proper leadership and management, this can contribute to mitigation on the boomerang effect, which in turn can reduce among others, physical and psychosocial harm as a result of the BSF implementation. Another strategy is to include secondary school children and teachers during scale-up activities as a means to increase education and knowledge of the BSF within the community. This strategy may be a promising idea, and furthermore is in line with Project SHINE´s focus on youth's empowerment. However, the power dynamics need to be addressed carefully in order to avoid psychosocial harm, with regards to the hierarchy.

In the study by Ojomo et al. (2015) they found that in Tanzania, the BSF was a technology that the population desired, due to that the BSF had the ability to clarify turbid water. These preferences varied in some extent by culture and context. For instance, in several cultures the smell and taste of chlorine was unacceptable, which was consistent whit the present study. One participant expressed worried about the BSF before learning about the technology, due to the concern that the BSF would give the water a smell and taste of chlorine. The Maasai prefer the water to taste natural, without any addition of chemicals. The fact that the BSF consists of natural materials, may lead to increased willingness to learn about the BSF. Furthermore, if the BSF is a technology that the Maasai´s desire it may have lesser impact on the culture and indigenous knowledge.

6.2.4 Lack of money and availability of resources

Lack of money was a prominent concern stated in the women´s group, think tank. Lack of money or poverty is associated with economic harm, as well as psychosocial harm inflicted by the BSF evaluation. Even if the BSF is identified as a low-cost technology, the definitions lose some of its meaning when many Maasai residents will not be able to afford to buy one. Therefore, the opportunity for additional funding's and engagement with policy leaders is highly important so Project SHINE has the opportunity to further help household to access a BSF. Nevertheless, one way to be able to buy a BSF, expressed by the participants was the opportunity to sell cattle. As mentioned earlier herding livestock constitutes the Maasai´s most important livelihood, which generates both income and food. The price of a cattle depends on the size and species, so there is a possibility that there is a need for selling more than one cattle in order to buy one BSF. Although not mentioned in the think tanks, selling cattle may lead to less food, which in turn will lead to less money available for food, education and taking care of own health. Selling cattle to buy a BSF is a possibility to gain access to clean water, and mitigate the harms that is a result of contaminated water, however the price to get the BSF may potentially lead to other harms. Such as economic, psychosocial and physical harm. It seems that the Maasai community is slowly developing into a more modern society. In many ways, this can have a positive effect on their health and development, however, introducing new technology may harm the unique Maasai culture. Also, the fact that socioeconomic status seems to vary between rural and urban areas, may modernisation of the community create even greater inequality among those with low socioeconomic status, due to not being able to access technology such as mobile phone, solar power and also the BSF technology.

The scope of the project was stated as a concern by the participants. And it may have been misconception of the project budget and the fact that the project only being a pilot study. Participants expressed that the perspective of 30 households was too small, and therefore as mentioned not being able to reach everyone. Initially the focus of the pilot study was to identify if the BSF technology is a water treatment strategy that the Maasai residents are willing to accept and use. The approach of starting small and hopefully on a later stage expanding further within the community was explained to the participants. However, the misconception may be an issue, due to the Maasai seemingly have experienced projects in the past, that have been "like helicopter projects". Distrust within the community towards the project must be addressed carefully, or else it might influence the project trustworthiness, and lead to poor sustainability and economic harm. BSF´s may go to waste if people are not engaged, however, this was not stated as a worry in the think tanks.

Resource barriers were a prominent concern expressed by the participants, which is consistent to what Allen-Scott et al (forthcoming) study identified. Lack of availability of resources to construct the filter may lead to psychosocial harm, due to powerlessness. Lack of resources will affect the sustainability. Without access to resources, it becomes difficult for the BSF project to remain sustainable in the first place. One notable, somehow interesting factor was water scarcity, which seemed to not be a concern with regards to the BSF. However, in-depth interview, group discussion and formative research done by Project SHINE on water sanitation and hygiene, was water scarcity identified as a big concern by the participants. As mention earlier, the BSF need to be served water every day, in order to keep the biological layer alive. If the Maasai were to experience a severe drought, serving the BSF water may then be difficult. This is associated with environmental harm. Still, the BSF will not harm the environment, but the BSF may be affected by the environment, such as water scarcity. In the worst-case scenario if the BSF was not to be used, this could lead to environmental harm, however, the BSF containers would likely be used for another purpose.

To tackle underlying factors as lack of money and resources potentially leading to economic, psychosocial and physical harm is challenging. However, one mitigation strategy expressed by the women´s group was the ability to share and support neighbouring households. This suggestion may not be sustainable, but it may be a solution for mitigate inequalities among neighbours for a short period of time, until additional BSF´s is provided. According to Earwaker and Webster (2009) who conducted an evaluation of the long-term sustainability of BSF in rural

Ethiopia, they found that it was not only the households owning the BSF that benefited from the filter. Also, friends, neighbours and workers also used the water produced from the BSF. As mentioned, to increase the availability to resources the importance of collaboration with policy leaders was a prominent mitigation strategy.

6.2.5 The size of the Biosand Filter

The size of the BSF was stated as a worry in the think tank with the stakeholders. Due to the Maasai being semi-nomadic one participant was worried about the size of the BSF being too big and heavy to carry. Different sizes were discussed with the participants, and 50 litre containers was mentioned as desirable. However, this is likely not sufficient to meet the daily need of a household. The BSF would likely be highly difficult if not impossible to bring when shifting boma. If the Maasai were to bring the BSF this may lead to physical harm, due to heavy lifting which can be bad for the muscles and joints (although not mentioned by the participants). In the evaluation of the long-term study of the BSFs distribution in Ethiopia, the researchers discovered that the BSFs that were not in use, were broken due to people trying to move their filters unsuccessfully (Earwaker and Webster, 2009). This study was looking at concrete BSF, nevertheless the study may indicate that moving the BSF around is probably not a good idea, so leaving the BSF behind in the primary boma together with the women that stays behind, would be the safest solution. CAWST (2011) also recommends that preferably the BSF, both concrete and plastic should not be moved after installation, however the plastic is more resistant to breakage. There were some disagreements according to whether women stay behind in the primary boma, some men said that the women also move due to they also need to feed and find water. Likely this has to do with socioeconomic status, where educated Maasai people have the opportunity to perhaps buy both food and water, and are not reliable on livestock in order to survive, and therefore do not move. If the BSF were to stay behind in the primary boma, this raises some ethical questions. For instance, the men who leaves with the cattle will not benefit from the BSF, and then need to drink from unsafe sources which may lead to diseases, such as diarrhoea affecting both physical and psychosocial harm. If the size of the BSF are in fact too big and too heavy, the BSF as an option for household water treatment might generate inequalities due to being semi-nomadic and owning an BSF is not attainable, creating inequalities among the Maasai how move and don't move according to seasonality.

The research team had several anticipated worries regarding the implementation of the BSF, and it is worth mentioning that all worries were covered by the participants. The BSF project

have been welcomed with great enthusiasm by the participants in the three think tanks. Although there are many factors that needs to by exanimated in order for the project to be successful, it is important that the participants believe it can be a good solution for addressing water quality. As shown in this chapter, the typology by Allen-Scott et al. (2014) is interrelated and different mechanisms are influencing each other, resulting in several contextual considerations which can lead to harm. Allen-Scott and colleagues (2014) propose that the typology can be used as a guidance on the assessment of potential UHs during PHI planning phase. The present study has been guided by the typology which have addressed contextual, as well as individual's levels of underlying factors which may generate in multiple UHs. A summary of the most discussed worries is represented in the table below.

Table 9. Overview of potential UHs associated with BSF evaluation.

Physical	The possibility of diseases if the BSF is not used properly. Strain on muscles and joint if bringing the BSF when shifting boma.
Psychosocial	Inequality among those who will receive/own a BSF and those who do not, may lead to powerlessness. Poor education and the inability to operate the BSF properly.
Economical	Lack of money and recourses may lead to accessing inadequate materials.
Cultural	Lack of leadership at a grassroot level, might potential create conflict due to power dynamics, and may lead to conflict with neighbouring areas.
Environmental	The BSF need for daily water may be a challenge when water is scarce.
Political	Mobilizing the BSF project without political level support may create challenges with accessing materials needed for the BSF
Omission	Fail to include people living in rural areas due to NCA´s large area may lead to inequality

In this section of the chapter a discussion of the main themes, worries and mitigation strategies has been provided. Next section will outline the trustworthiness of the study, followed by strengths and limitations.

6.3 Methodological strengths and limitations

To establish the trustworthiness of a study, Guba and Lincoln (1985) cited in Bryman (2016), identified four strategies of how to reach the goal of trustworthiness in qualitative research as an equal term to the quantitative research criteria of internal validity, external validity, reliability and objectivity. The strategies proposed by Guba and Lincoln (1985) are the following:

- Credibility (in preference to internal validity)
- Transferability (in preference to external validity)
- Dependability (in preference to reliability)
- Confirmability (in preference to objectivity)

To ensure these strategies, Creswell (2013) are referring to Guba and Lincoln (1985) proposed techniques, where credibility can be provided with prolonged engagement and the triangulation of data sources, methods and investigators. Regarding transferability, thick description of the details of the culture is needed, and provides others with what Guba and Lincoln (1985) refers to as a *database* for making judgments about the possible transferability of findings to other contexts (Bryman, 2016). Rather than reliability in quantitative research, Lincoln and Guba (1985) proposed the term dependability. Which can be provided by ensuring a complete record of the research process, which include among others; problem formulation, selection of research participants, fieldwork notes and interview transcripts (Bryman, 2016). By doing so, peers can have a say as to whether or not procedures are being and have been followed, and then be able to evaluate if theoretical inference can be justified. However, this is highly demanding considering qualitative research usually generates a great deal of data (Bryman, 2016). Lastly, confirmability is a respond to quantitative researches which aim for complete objectivism when generating the value of the data (Bryman, 2016; Creswell, 2013). In qualitative research complete objectivism is impossible, therefore ensuring that the findings are the results of the participant's experiences and ideas, instead of the researcher own preferences is necessary (Shenton, 2004). The rest of this chapter provides an overview of factors relevant to the trustworthiness of this study.

6.3.1 Discussion on study rigor

Considering that this study is a sub-study of Project SHINE, thoroughly consideration of local context has been developed over years of research in the NCA area. Together with close

mapping of community interest in the past and present, the BSF evaluation is therefore carefully outlined. The different methods used in this thesis strengthens the credibility through triangulation (Guba and Lincoln, 1994, cited in Bryman, 2016), ensuring a wide range of data. Sampling of individuals to serve as informants was as mentioned in the methodology chapter done by the Project SHINE coordinator. However, the author was present during all interviews and responsible for transcribing all think tanks, in-depth interview and the group discussion included in this thesis. This strengthens the credibility due to consistency throughout the research process. However, there is a need for informing the reader about the complexity and several obscurities that unfolded during field work.

Credibility

The language barriers limit the trustworthiness of the data. Language barriers were likely both challenging for the researchers and the interpreters. For instance, there is reason to believe that the interpreters did not always understand what the research team were saying. However, with clarification regarding the question this was rarely a problem, but occasionally there were answers that did not suit the question. This can potentially have affected the trustworthiness of the data, in terms of creditability. Even though the interpreters were competent in English, interpreting can be difficult and requires a great deal of practising. For instance, the think tanks involved long discussion and therefore challenging for the interpreters to form precise direct quotations, and can influence the credibility. As a researcher you lose some control of what is being said, both from the participants and from the interpreter when not speaking the local language. For instance, as mention in 3.1.7 under the Methodology chapter, in the think tank with various community members one of the male participants occasionally interpreted *Kiswahili* into *Kimaa* for the women, this can be problematic in the sense of the researcher loses overview of what being spoken about. Another example is in think tank with the stakeholders, the interpreter had several discussions with the participants before and after translation. The fact the interpreter is also the coordinator for Project SHINE and knows the project well, this can potentially interfere with the translation because the translator knows the project in detail and also some of the challenges Project SHINE have faced. The in-depth interview and the group discussion that was conducted in English, without an interpreter, was not challenging regarding understanding the participants, but on the other hand, possibly the participants would feel more comfortable talking in *Kimaa* or *Kiswahili*. From the researcher's perspective, it was important to not use challenging academic language, but rather focusing on an informal language. This was further highly important regarding our need for the local interpreters. Even

though their English vocabulary is good, the accent can be difficult to understand. Therefore, being in a transdisciplinary research team with both members from Tanzania and Canada was really helpful, due to support which clarified some of the misunderstandings regarding the linguistic.

When using local interpreters, it is important to take into account their role and rank in the community, which can potentially influence the production of data. Power dynamics between the participants can potentially lead to holding back information, because it can be difficult for the participants to speak their mind when community member with higher rank is present during the interview. For instance, during the think tank with various community members, the interpreter had to encourage the women to engage in the discussion, which they did after a while, in the beginning it was mostly the men who participated in the discussion. Both in the think tank with the women´s group and the local woman interview, narrow answers were given even though power dynamic was likely not the issue here. For instance, in the local women´s group think tank, it was challenging in terms of engaging the participants to think of any potential harms regarding the BSF. A great deal of probing was required to get more data, nevertheless, rich information regarding water scarcity and quality unfolded during the think tank session, which was relevant for this thesis first research question. However, during the discussion there was a lots of side conversation, and often the translation was shortened down to few words, such as: *No, they don't, yes, don't know, maybe.* Several times during the think tank session, the women clapped and thanked Project SHINE for their efforts in the community. For instance, this happened after the project leader elaborated about the challenges of accessing materials for the filter. Therefore, a concern towards accuracy of the interpretation must be acknowledged. Nevertheless, all interviews gave rich and valuable data, unfortunately, an audio recorder was not used in the group discussion with the local men, which can lead to bias due to inaccuracy when writing down the participants answers and affect the credibility of the data.

Our presence as researchers can potentially interfere with the information given by the participants, for instance talking about challenges regarding implementing the BSF, may be difficult, firstly because it can be challenging to have an opinion about a technology that is unfamiliar to the community and secondly, they can potentially tell us what they think we want to hear, also referred to as social desirability bias (Bryman, 2016). For instance, telling us that they are not able to imagine any challenges with implementing the BSF, because the desire to

have a technology that cleans the water is highly needed and something that they wish for. This may circle back to why the women were clapping in one of the think tanks.

All the three think tanks were conducted close to the field school area, and the in-depth interview and group discussion was held at filed school base camp. This may have excluded actors from more distant regions within the NCA. Nor were there any interviews or think tanks carried out in Nainokanoka. Observation were made that some participants included in the think tanks were present in more than one think tank. This can potentially interfere with the data, in terms of increased knowledge regarding the BSF and because having the opportunity to reflect on the intervention, this can both leads to more rich data, but also raises the question of how much bias the data can tolerate without being affected too greatly.

The in-depth interviews and the think tanks included in this thesis have perhaps not reached saturation point. In qualitative research a common problem is to establish how many interviews are needed to achieve saturation point (Bryman, 2016). The sample size should be able to support convincing conclusions, however, this will likely vary according to different studies. In a study conducted by Guest, Brunce and Johnson (2006) who looked at how many interviews are enough to meet data saturation, which can be described as *the number of interviews needed to get a reliable sense of thematic exhaustion and variability within [the] data set* (Guest et al. 2000, p. 65, cited in Bryman, 2016, p. 417). Found that that six to twelve interviews will be an adequate number if the group being studied is relatively homogeneous, and the aim is to understand common perceptions and experiences among the participants. In this study, the number of interviews are in total five, however the local women´s group think tank serving data to both research question, which gives data to both research questions. Likely this is not sufficient to reach data saturation, however the data have provided the thesis with insightful and various results, supporting an adequate sample size.

Transferability
The findings in this study is specific to the NCA context and the Maasai participants involved, which is common in qualitative studies. In quantitative studies the importance of whether the study can be applied (generalization) to a wider population is of great concern (Bryman, 2016). There are contrasting views on the possibility of generalisability, or transferability in qualitative studies (Bryman, 2016), For instance, Denscombe (1998) suggest that although each case may be unique, there might be examples or results within a broader group that might be transferable.

To demonstrate if the findings and conclusions in this study may be applicable to other situations or population is rather difficult to answer, but It might be a transferability towards other communities in rural Tanzania and other similar contexts. However, some specific worries may be unique for the Maasai population, for instance their many restrictions within the NCA and culture. Such as being semi-nomadic. With that being said, qualitative studies are not meant to be representative of a population, but rather generalize to theory and concepts (Bryman, 2016).

In the writing up of this study, the author has outlined the data collection and analyses process with the aim of being as transparent as possible, and a thick description of the study has been provided through careful considerations of the respective situation and context in which the study is situated. Based on the discussion and the identification of methodological strengths and limitations that have been presented in this chapter, other researchers have been provided with a foundation to determine the quality of this study, and make decisions on the transferability of the study findings to other similar studies in similar rural and remote contexts. The next and final chapter provides a conclusion and presents recommendations for future research.

7   Chapter 7. Conclusion

By investigating community perceptions of water scarcity and quality, this thesis has generated new knowledge about public health challenges related to water faced by pastoralists in a rural and remote setting. Both water scarcity and water quality are important concerns affecting the lives of the Maasai on a daily basis. Water scarcity leads to several challenges for the Maasai, especially with respect to the burden on women. Having a BSF in the household will not ease the strains that scarcity causes, such as long walks to the river, which take women and girls away from other productive activities such as school and work, or the risk of sexual assault or attacks by wild animals. The study findings highlight the need for actors that are involved with addressing access to water, need to work together to build safe and adequate water sources for all Maasai living in the NCA. Nevertheless, positive community perceptions and attitudes towards the BSF indicate that the filter may be a viable low cost, low tech water treatment solution at the household level in the area. However, findings also indicate that it is essential that future efforts continue to engage the Maasai communities in dialogue and carefully address the context of the intervention setting (e.g. seasonality, hierarchy, policies), in order to avoid potential unintended harms. The results from the analysis have demonstrated that UHs associated with the BSF may occur in all five dimensions of Allen-Scott´s et al. (2014) typology: physical, psychosocial, economic, cultural and environmental context. In addition to these five harms, two external themes emerged; political harm and harm by omission. Concerns around inequality and sustainability towards the BSF were the main worries expressed by the participants, which have led to a ripple effects regarding other worries such as poor education, poor leadership, lack of resources and poverty among others. The focus on education, adequate leadership and engaging with policy makers were identified as important underlying factors and bodies to engage with regarding mitigation strategies. The typology has provided this thesis with a framework for facilitating careful and systematic consideration of the underlying factors which is unique to the NCA context. Furthermore, a holistic perspective not only of the social determinants of health, but also of the ecological aspects which also affects the health of the Maasai population has been provided. This study has contributed to explicit knowledge and awareness of potential harms, which can benefit Project SHINE in further research and follow ups.

This study indicates a need for further research on UH, both qualitative and quantitative studies following up on the BSF implementation. Qualitative studies should engage with the PC, the

NCAA and the Development Office, and furthermore with bodies such as the World Bank and the church. A collaboration between the grassroots leadership, policy level and Project SHINE is important to both mitigate potential inequalities, and increase access to materials. To address inequalities, new think tanks should be conducted within the local community, focusing on rural and remote areas specifically (both with the Maasai that have a BSF, and those how do not). Supportive networks, both from outside partners, and within the local community, and ongoing education through training and outreach is essential in order to provide sustainability of the BSF. Qualitative interviews (group discussion and think tank) should also include secondary school children and teachers, to further spread the knowledge in the community in terms of correct use and maintenance of the BSF. Lastly, quantitative studies should be included to provide information on the actual performance of the BSF in the NCA context, in terms of bacterial removal, turbidity reductions and filter efficiency in removing diarrheal disease in the area. Recontamination and safe water storage also needs to be addressed to avoid or mitigate a potential boomerang effect.

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Appendix

Introduction

We would like to thank you for participating in this group discussion. This discussion is part of ongoing research cooperation between the University of Calgary, Canada, the Catholic University of Health and Allied Sciences (Mwanza) and the communities that live in the Ngorongoro Conservation Area. The research project aims at understanding water availability and quality in the NCA, as well as perceptions of water treatment options. The reason for this group discussion is to get a better understanding of opinions and experiences of various people in the community so that future programs can be better designed to suit your needs.

The discussion will take about one hour. If you feel that there are related issues that are relevant and important, you are most welcome to raise these issues. With your permission, the discussion will be audio recorded, but we will not use your name in any project publications. Do you agree to allow us to record this conversation? We will share a summary of our findings with the ward counsellor and the village executive officer at the end of the project, but we will not report specifically what you have said.

General themes

1. Perceptions of water-related issues in the Ngorongoro Conservation Area (both historical and current)
2. Stakeholders engaged in water-related issues in the NCA
3. Current strategies to address water scarcity and quality
4. Awareness, knowledge and perceptions of the biosand water filter
5. Perceptions regarding community feasibility of the biosand water filter
6. Perceptions regarding community acceptability of the biosand water filter

Perceptions of water-related issues in the Ngorongoro Conservation Area

   a) What are the main challenges related to water in the Ngorongoro Conservation Area? (probes: water scarcity, quality, management/conflict ect)

b) Are the current challenges any different from challenges faced by communities in the Ngorongoro in the past? (probe: 5 years, 10 years)

Stakeholders engaged in water-related issues in the NCA

a) Who are the main actors involved in water-related issues in the NCA and what are their roles? (Probes: NCAA, World Bank, NGOs, church, ect)

b) How, if at all, do these actors coordinate their efforts?

c) What are the past efforts/activities from each of these actors related to water in the NCA? What are the current efforts/activities from each of the actors?

d) Are you aware of any gaps or challenges with the projects that are currently working to address water-related issues in the NCA?

Current strategies to address water scarcity

a) Is there enough water to address the needs of people living in the NCA? Can you elaborate? (Probes: seasonality, climate change, water management, ect)

b) How does it rank in relation to other challenges in the area?

c) If this is a concern, how are pastoralists living in the area adapting to this challenge? What supports, if any, are available to them in this regard?

d) Does water scarcity affect men, women and children equally and in the same way?

e) Do people in the NCA have to pay for water? How do people generally feel about this?

Current strategies to address water quality

a) Is water quality a concern in the NCA? Can you elaborate? (Probes: health/social/economic impacts, seasonality, water management including human and animal use and needs ect)

b) How does it rank in relation to other challenges in the area?

c) How do people in the NCA understand the link between water and health? What kinds of health problems can unsafe water cause?

d) If this is a concern, how are pastoralists living in the area adapting to this challenge? What strategies are most commonly used in the area to improve the quality of water? (Probes: SODIS, chlorination, sedimentation, cloth filtration, ect).

e) Do water treatment strategies vary by season?

f) What supports, if any, are available to them in this regard?

g) Does water quality affect men, women and children equally and in the same way?

Awareness, knowledge and perceptions of the biosand water filter

a) Have you ever heard of the biosand water filter? If yes, what have you heard? If yes, do you know how the filter works to clean water?

b) Have you ever seen a biosand water filter (show picture)? Please elaborate on where you saw it and what you learned about it.

Perceptions regarding community feasibility of the biosand water filter

a) Do you think the biosand water filter could be an option for cleaning water in the NCA? Why or why not?

b) What do you think would be the main challenges to household use of the biosand water filter in the NCA? (Probes: logistics of and permission to get materials in the NCA, cost, options for water storage, ect)

c) What, if anything, do you think could be done to overcome these challenges?

Perceptions regarding community acceptability of the biosand water filter

a) What method do you think communities in the NCA would prefer to treat their water?

b) Do you think the community would support the use of biosand water filters to treat their water?

c) What do you think would be the main challenges to widespread community acceptance and adoption of biosand water filters? (Probes: perceptions of effectiveness, perceived value, cost, ease of use, effort required, preference for other methods, taste/smell/appearance of water after treatment, maintenance, knowledge, skills, ect)

d) Is there anything that we haven't mentioned or asked you about these issues that you would like to tell us about?

Thank you for your participation. Please let us know if you have any questions.

<u>**Appendix B – Biosand Filter Evaluation Unintended Harm "Think Tank" Discussion Guide**</u>

Introduction for Participants
_____

*Have participants introduce themselves (round table introduction)

Thank you for being a part of this group meeting that aims to promote open discussion for the sanitation and hygiene project (SHINE) in the Ngorongoro Conservation Area (NCA) of Tanzania. This meeting will facilitate a conversation to identify benefits and minimize potential unintended harms associated with Project SHINE (*we don't want to hurt the community). Specifically, we would like to discuss a pilot evaluation of the biosand water filter as a low cost option to provide safe water to the community. This is a sub-study as part of Project SHINE that came about as a result of our research and dialogue with the community which shows that while there are projects and efforts to address water scarcity in the area, such as drilling wells, there is little or nothing being done to address water quality. In this study, we want to understand community perspectives on the biosand water filter and if it is a good option for communities in the NCA as a means to clean their water so that it is safe to drink and to reduce water borne illness.

The biosand water filter has been shown to work very well in other areas around the world, but we need to carefully examine local challenges to using the filter in the NCA given the uniqueness of the context. This will allow us to plan for success.

We anticipate the discussion will take a maximum of 2 hours.

Why are we holding this discussion? If we begin with a discussion of both the beneficial and harmful outcomes of trying to implement the biosand water filter at the household level in the NCA and work backwards to examine how the local context may influence its use, we may be able to minimize any harm to the community.

Ground rules: We want to promote equal voices, a spirit of openness and respect for one another. We will be having discussions as a group and also dividing into smaller groups for discussion.

*Any Questions?

*Introduce Sheri (Project Leader)

Describe the Proposed BSF evaluation
_____

1. *What social change do you hope to achieve (Why)?*

2. *Who is currently involved in the project (Who and Where)?*

3. *What are the key activities to get the BSF set up and maintained (What and How)?*

Step #1: Brainstorm potential worries

Ask the question: What worries you after hearing about introducing the BSF in the NCA?

1. As a large group identify and prioritize unintended harm according to their perceived likelihood, importance and ability to act.
   a. At the end – get the group to decide the top 3 worries that they would focus on.

Sheri - What worries you about this project?

- Competition, power dynamics, inequity, push back from NCAA, sustainability and access to soap making materials, access to clean water to make soap
- Not achieving our goal (underachievement)
- Trade-offs in other social problems (malnutrition as a neglected area – the problem may get worse)
- Does this project reflect the actual needs on the ground?
- Integrating upstream solutions (water, economic growth)

Step #2: Discuss the role of the underlying factors and archetypes: when we are trying to generate social change we need to know a lot of information about: what works and why, the community and environment and priorities and needs of the community. If we do not know enough about these areas it may lead to harm in the community.

1. Examine how the introduction of the BSF in the NCA may be influenced by the underlying factors and archetype considerations. Below are questions that will guide this process (10-15 minutes per factor).

Unintended Harm Underlying Factors	Questions to Consider	BSF implementation Unintended Consequence Archetypes (Appendix A)
Limited Knowledge (what works and why?)	*Ask the project leader:* • How has the BSF worked in other areas to improve health? *Ask the group:* • What can be learned from previous water based interventions in the area? • What has worked well? • What were some of the challenges?	**Mixture of Archetypes** *Understanding of the complex social problems is often gained progressively and required constant evaluation and re-evaluation of action, outcomes and choices to constantly assess what it working and what is not*

Unintended Harm Underlying Factors	Questions to Consider	BSF implementation Unintended Consequence Archetypes (Appendix A)

Ignoring Context AND "One Size Fits All Fallacy" (unique aspects of the community and environment)	*Ask the project leader:*
	• What are some of the unique characteristics that need to be considered for implementation of the BSF in the NCAA?
	   ○ Social, physical, political, economic and cultural context
	
	Ask the group:
	• What unique characteristics of your community (and surrounding influences) are important to consider?
	   ○ Other social problems
	• Who are the important collaborating parties?
	• What are the potential challenges between collaborating parties (NGO, non-profit, private, government)?
		Underachievement Archetype
		This section serves to examine the system boundaries and influences that lay within and outside.
		
		Factors outside of the perceived boundary system may lead to underachievement of goals to improve health

Unintended Harm Underlying Factors	Questions to Consider	BSF implementation Unintended Consequence Archetypes (Appendix A)
Basic Values AND Boomerang Effects (priorities and needs of the community)	*Ask the project leader:* • Why do you think implementing BSF's in the NCA is a good idea at this time? o Discuss needs and priorities as understood *Ask the group:* • Are the other areas that could be focused on instead of the BSF? • Where does water quality and diarrheal disease fit in your priorities? OR: Conduct pile-sort analysis to understand priority area. Poverty Hunger/Malnutrition Education Diarrhea Typhoid Syphilis	**Relative Achievement Archetype** *Choosing one decision over the other can also be a result of our inability to recognize the relative importance and priority of problems. It could also be the result of resource constraints or simply our inability to devise alternative solutions. Hence, the action oriented towards one outcome is fulfilled at the expense of an alternative outcome. The consequence is that the favored outcome improves while the neglected outcome worsens.* **Relative Control Archetype** *We see such an archetype in practice in many international programs addressing social problems because the solutions to problems are based on the NPO's or development agency's interpretation of the community needs without knowledge of their actual needs*

Unintended Harm Underlying Factors	Questions to Consider	BSF implementation Unintended Consequence Archetypes (Appendix A)
Immediate Interest (will the short-term benefits be sustainable?)	*Ask the project leader:* • What are the potential long-term benefits of implementing the BSF? • What will need to be done to ensure long-term change is achieved? *Ask the group:* • What will need to be done to ensure long-term change is achieved? • What are the larger influences need to be addressed to see long-term change?	**Out of Control Archetype** *There is always a tension between devising a symptomatic solution to visible problems versus devising a long-term fundamental solution that requires deeper understanding of the structures that produce the pattern of behavior in the first place. Fundamental solutions require deeper understanding, more time, greater commitment, more resources and greater patience.*

Step #3 – Adapting and Redesigning

Ask the question: how can we minimize the prioritized potential harm to the community?

1. As a group, discuss potential actions that could be implemented to minimize the top 3 worries.

Step #4 - Aspirational Conclusion
What are my hopes for my community? And what is my role in helping my community?

Appendix C – NSD Approval

Sheri Bastien
Institutt for landskapsplanlegging Norges miljø- og biovitenskapelige universitet

1430 ÅS

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 15.08.2016. Meldingen gjelder prosjektet:

49452	*Neglected Voices, Neglected Diseases: Igniting Youth Driven Innovation in Sanitation Solutions for Maasai Pastoralists in the Ngorongoro Conservation Are, Tanzania*
Behandlingsansvarlig	*Norges miljø- og biovitenskapelige universitet, ved institusjonens øverste leder*
Daglig ansvarlig	*Sheri Bastien*
Student	*Tina Paasche*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 23.02.2017, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen   Katrine Utaaker Segadal   Siri Tenden Myklebust

NSD Approval continued

AFFIRMATION

Referring to change request form received 08.09.2016.

The Data Protection Official has registered that Lise Hovden will have access to the data material.

We presuppose that the project otherwise remains unchanged. You will receive a new status inquiry at the end of the project.

Please, do not hesitate to contact us if you have any questions.

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Yours sincerely,
Siri Tenden Myklebust
rådgiver/adviser
Tel: +47 55 58 22 68
nsd.no | twitter.com/NSDdat

X