Measuring Outcome in Household Water Treatment and Safe Storage Programs

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Preface

Six months ago I stepped into Aqua for All's office in the Hague with an idea. Inspired by my dad and pondered on extensively, I sat with Hester Foppen and Astrid van Agthoven in early February and presented them with exactly this. An idea. How this idea, a new means of monitoring and furnishing proof for program outcomes, was going to take shape, how and where research was going to be conducted, and why Aqua for All would benefit from hosting such a research, was far from certain. Timing of this idea, however, could not have been better, as Aqua for All had just started a new program in Ethiopia surrounding household water filter distribution through a market-based approach by water utilities, one in which my MSc thesis research could potentially have a place. A pilot was just being finished in Finote Selam in West Gojjam zone in Amhara region, which was proving to very promising and plans were already being made to launch a very similar program in Malawi. In spite of aforementioned uncertainties, Hester agreed to supervise me at Aqua for All, with Astrid in an advisory role.

As time progressed, my research began to increasingly take shape and in late March it was already time for me to go to Ethiopia, meet our local Aqua for All consultant, Gashaye Chekol Yihunie, and conduct research in Finote Selam. Gashaye's positivism, his enthusiasm, and his endless love for his people was and continues to be truly inspirational. Working together with Gashaye and the Finote Selam and Debre Markos water utilities was a great experience, further motivating me to make this thesis a success.

Returning to Aqua for All in early April with renewed energy, I had some very productive discussions with Hester about how my research should take shape and how it could benefit the program in Ethiopia and Malawi. Hester and I work very well together and her extensive experience in the sector was proving to be both invaluable for my thesis and very educational for me. Hester managed to motivate me a lot and gave me a lot of freedom in exploring how I could make my thesis a success and benefit the household water filter program in Ethiopia and Malawi at the same time. Additionally, everyone chipped in at Aqua for All, which gave me a lot of different perspectives.

In early June, it was time for me to conduct the second part of my research in Malawi. This time, however, there would be no Gashaye and no water utility to help me in my research. In Malawi, however, I met some very inspirational and friendly people from partner organizations, who helped me a lot in my research. I talked to many program partners and my time there taught me a lot about my capacities and my shortcomings. Most of all, however, it proved to really benefit my thesis. After conducting my research in Malawi, I was supposed to only meet with Gashaye in Addis Ababa for a mere 2 days on my way back to the Netherlands. When he called asking if I would be interested in conducting more research in a new distribution area, Injibara in Awi zone, however, I didn't have to think for a second.

Before you lies a journey that taught me a tremendous amount. I am incredibly thankful for everyone's help at Aqua for All, for my supervisor, Femke van Noorloos's helpful instructions and the detail she managed to put into them, for Hester's and Gashaye's guidance and belief in me and the great teamwork between us, for my dad's counselling, and for the fantastic time I had in Ethiopia and Malawi.

Abstract

This research focuses on the development of a Household Water Treatment and Safe Storage (HWTS) Outcome Monitoring Framework. Research is performed in a program surrounding a large-scale, market-based approach to administration of HWTS in Ethiopia and Malawi. Aqua for All, the host organization for my MSc thesis, has the lead in this ambitious HWTS program. Through literature review, quantitative, and qualitative assessment, and extensive consultation of important actors in the program, relevant parameters pertaining to HWTS outcomes and their subsequent means of assessment are identified and analyzed, in order to unveil those concepts most relevant for outcome assessment. After unveiling of these outcome parameters, their potentials for achievement and monitoring are translated to existing Outcome Monitoring Frameworks, in order to arrive to a specified HWTS Outcome Monitoring Framework that can be extrapolated to HWTS programs that employ an outcome- and market-based approach. It was found that the discussion pertaining to outcomes and their monitoring is one that is characterized by high levels of ambiguity in terms of what kind of outcomes pertain to whom. This necessitates clarification, which is what this research ambitions to realize. Additionally, it was found that myriad intermediating variables invalidate the ambition of unveiling statistically significant relationships between HWTS programs and their outcomes for their beneficiaries, thus necessitating rich qualitative data that sketches an elaborate account of the inner workings between HWTS programs and achieved outcomes. It is ambitioned for the HWTS Outcome Monitoring Framework to be able to be extrapolated to other market-based HWTS programs, in order for these programs to more easily and consistently delineate their outcome ambitions and monitor these during the succession of a program. This is to benefit the delineation of mutual expectations between relevant local and international partners and improve their collaboration, allowing for the creation of more sustainable means of distributing HWTS.
Keywords: Household Water Treatment and Safe Storage, Outcome, Monitoring, Market-Based Approach

Contents

1) Introduction

This research focuses on creating a novel framework to monitor Household Water Treatment and safe Storage (HWTS) programs. New paradigms of development are promoting the creation of sustainable business cases surrounding interventions, using funds not as a means to an end, but rather as a means to a beginning; a stepping stone for the conception of a situation wherein monetary funds continue to flow and projects sustain themselves long after project deliverables have been met. Making such paradigms a discernible, tangible reality, however, necessitates new methods of monitoring and evaluation (Ambrose, 2004; Earl, Carden, & Smutylo, 2001). These methods ought to refrain from focusing on direct project outputs – on amounts of hand pumps built or on people provided with clean water – but focus on outcomes instead – on changes in behaviors, actions, opportunities, and benefits that come into being because of the succession of a program.

When outcomes can be measured and monitored, investors interested in their achievement can be incited to invest. Philanthropists will know the parameters of what their funds realize in an elaborate and exhaustive manner, NGOs focusing on gender empowerment will know to what extent an intervention empowers women and which socio-economic factors are important to effectuate positive change, companies investing in CO_2 mitigation will know how much CO_2 an X amount of money will offset, and insurance companies will know why and to what extent people are healthier and deserving of a lower premium. Furthermore, when outcomes can be measured, they can be predicted. This will attract investors before a project is in full swing, helping with its succession and working in synergy towards its outcome objectives in a more effective manner.

HWTS programs are employed as a locus of research as these programs are proven to be an effective method of assuring safe water at point of use, empowering households to protect themselves against waterborne diseases such as diarrhea (Mintz, Reiff, & Tauxe, 1995; Ojomo et al., 2015). Contrary to HWTS interventions, interventions focusing on supply, such as constructing piped water systems, are susceptible to not account for recontamination of drinking water, thus inhibiting the potential for such interventions to produce discernible and measurable outcomes (Hasan & Gerber, 2016). This very measurability of outcomes, however, is proving to be a big hurdle for HWTS interventions, as measuring a specific HWTS intervention's contribution to outcomes and providing evidence of this very contribution is found to be exceedingly challenging (Ramesh et al. 2015). Myriad external variables mediating the influence of interventions on outcome parameters make the discernment of contribution to outcomes exceedingly difficult. As such, there is need for a method of mapping outcome that refrains from claiming achievement of certain outcomes, but rather focuses on measuring its contribution to those very outcomes. Furthermore, mediation of these myriad variables invalidates the ambition of wanting to unveil statistically significant relationships between interventions and outcomes (Holzapfel, 2014; Smutylo, 2005). It instead begets a need to test if indicators work for indicating contribution to outcomes, enriching this inquiry with qualitative data that expounds the multifarious lives of IDC beneficiaries. The question this research thus aims to answer is: How do you best map outcomes for HWTS programs?

Aqua for All, the non-profit organization where I conducted my research, is an organization that employs a strong focus on effectuating outcomes and, subsequently, monitoring them. Working together with local governments and private sector, outcome investors, and other non-profit organizations, Aqua for All is facilitating a novel approach that focuses on the large-scale production and distribution of household water filters in Ethiopia and Malawi. Local water filter production and -maintenance provision, no free handouts, NGO support for the poorest of the population, and a detailed and novel outcome mapping framework are four of the pillars of this project. This novel outcome mapping framework is the deliverable of my MSc thesis and encapsulates the relevant ambitioned outcomes and their means of monitoring, as to provide a means for other, similar HWTS programs, to employ it as well as expatiate upon it.

Data for the research was gathered using akvo Flow, an online tool to capture, monitor, and coordinate data, and visualized using akvo Lumen, a tool that transforms and visualizes the data gathered using Flow. Using a water quality assessment tool called akvo Caddisfly, data is enriched with in situ E. coli tests and the subsequent degree of necessity for water treatment is assessed.

Aqua for All HWTS program

Household water treatment comprises any method of treating and safely storing drinking water right before consumption, most often in a household setting. This implies removing any potential harmful bacteria and storing the water in such a way as to prevent any harmful bacteria from entering the water. HWTS programs are increasingly being advocated as a viable means to substantially decrease the global burden of diarrhea and other waterborne diseases (WHO, 2013). Aqua for All started with a novel approach to HWTS distribution in Ethiopia in late 2016. People could buy different types of household water filters through their water utility. The household water filters cost 660 Birr or =/- 20 Euro and customers could pay for the device in up to 4 installments, through their monthly water bill. As such, a 'market-based approach' was set up – meaning that a local supply chain for the selling of household water filters was developed, to help solve the problem of diarrhea and other waterborne diseases. The program started with a pilot in Finote Selam, in Amhara region in the west of Ethiopia. Within less than 18 months' time, over 1000 water filters had been sold and the program was ready to scale up to other parts of Ethiopia. During that time, in early 2018, the government of Malawi signed an official decree that endorses HWTS as a viable option in solving the vast water problems existing in Malawi. Consequently, the program was also extrapolated to Malawi. The program is currently being developed, upholding the fundamentals of the market-based approach seen in Ethiopia. In Malawi, however, filters will be sold through local entrepreneurs supported by NGOs such as United Purpose and PumpAid.

Aqua for All's efforts of distributing household water filters through a market-based approach in Ethiopia and in Malawi are in line with Sustainable Development Goal 6.1 – By 2030, achieve universal and equitable access to safe and affordable drinking water for all.[1] The use of HWTS at point of use offsets the necessity for piped water systems, which, notwithstanding their merit in effectuating sustainable provision of clean water, require a level of institutional-, technical-, and financial capital that many developing countries do not possess. The market-based approach to HWTS distribution is proving promising in helping decrease the global burden of diarrhea and other waterborne diseases, while also helping to develop local economies. Sound assessment of outcomes produced by the approach, of the benefits that it brings to its beneficiary population and of the contextual circumstances produced by involved actors by which these benefits are premised, however, is lacking. Means of monitoring these benefits to a beneficiary population and of understanding and monitoring important contextual circumstances brought about by behaviors and actions of important actors are imperative in uncovering evidence on acceptability and scalability of the approach as well as on the potential adverse effects it could have on local development. This thesis is thus devoted to producing these means, developing an HWTS monitoring framework that helps in mapping out the potential benefits in a beneficiary population of a market-based HWTS program and in monitoring the behaviors and actions of important actors by which realization of these potential benefits are premised.

[1] Sustainabledevelopment.un.org

Theoretical Framework

Between 2000 and 2015, the number of people in the world having access to piped water rose by 1.2 billion, from 3.5 billion in 2000 to 4.7 billion in 2015. At the hands of the strong worldwide population growth during these 15 years, however, the number of people not having access to piped water also rose; from 1.7 billion in 2000 to 2.1 billion in 2015. Furthermore, in 2015, 71% of the world population (5.2 billion people) used a safely managed water source (defined as a source that is located on premises, available when needed and free from contamination) and 89% (6.5 billion people) used at least a basic drinking water service (defined as having an improved source, protected from contamination, within a 30 minutes' round trip) (WHO, 2017). The majority of those not having access to at least basic drinking water services lives in rural areas, where poverty is often most severe and where delivering safe water is most challenging (WHO, 2013). In 2016, nearly 500,000 worldwide under five deaths could be attributed to diarrheal disease; 8% of the total under five deaths. This figure dropped from over 1.2 million under five deaths or 12% of the total in 2000 (UNICEF, 2018). Nearly 90% of diarrheal deaths are linked to unsafe drinking water or poor sanitation and hygiene (WHO, 2013).

In most developing countries, like in the developed world, responsibility for water supply lies in the hands of public authorities and Water Service Providers. In the global South however, these institutions often lack the institutional capacity and financial means to adequately carry out their task of continually providing safe water. Furthermore, these institutions often operate in a politically volatile environment, face high urbanization rates, and lack the necessary technical soundness in their infrastructure. Consequently, providing continuous access to safe drinking water is a vast challenge. Furthermore, in rural areas, handpumps and boreholes are used without having to pay any fee. This means that re-investments and maintenance are completely subsidy-driven; a notion that also applies to NGOs involved in local water supply programs, as their drinking water programs are primarily subsidy, i.e. donor, driven. This means that after the subsidy period has ended, there are hardly any financial funds left to continue the program and adequately institutionalize it, heavily impacting its sustainability.

This lack of institutional, financial, and technical capacity renders water providers in the global South unable to provide safe water in a continuous manner. Poorly constructed sanitation and breakage in pipes can cause water to be contaminated, with improved water sources delivering contaminated water as a result. Furthermore, groundwater reservoirs can get contaminated, with improved water sources such as protected wells, which are protected by means of a wall around the water hole so no contaminated (rain)water can get in and a cover to seal the well, or boreholes delivering contaminated water as a result (WHO & UNICEF, 2007). Additionally, much of recontamination happens either during collection, transport, or storage at home, due to e.g. contaminated hands or utensils (Hasan & Gerber, 2016; Wright, Gundry, & Conroy, 2004). In many settings in the developing world, both rural and urban, people have sufficient access to water. Due to contamination, however, the water is not safe for consumption (WHO, 2013). Consequently, notwithstanding the merit in the ambition of improving water supplies in general and providing safe piped water to every household in particular, prominent institutions such as the WHO are increasingly implementing temporary solutions, providing immediate and targeted solutions to unsafe water supplies, in the transition to increasing the necessary institutional, technical, and financial capital to improve infrastructure and make these water supplies safe (Sobsey, 2002).

Household Water Treatment and Safe Storage

One such temporary solution is HWTS, which provides an immediate solution in the transition to providing safely managed water sources. Treating and safely storing water at home, focusing at point of use rather than point of delivery, minimizes the potential for recontamination that that even improved water sources such as protected wells, boreholes, or piped water systems can present (Hasan & Gerber, 2016; Wright, Gundry, & Conroy, 2004). HWTS comprises any treatment- and storage method 'at point of use' – meaning right before of consumption, most often in a household setting. Examples of household water treatment methods are filtration (through e.g. a carbon or ceramic block) or disinfection (through e.g.

chlorine or boiling). Storage is considered safe when it has a strong and tightly sealing lid or cover, a tap or narrow opening at the outlet for access, a stable base so it does not tip over, is durable and strong, and is easy to clean (WHO, 2013). Wolf et al. (2018) show with a systematic review of 135 studies on the effect of water, sanitation, and hygiene interventions on prevalence of diarrhea that point of use filter treatment combined with safe storage reduces diarrhea risk by 61%. The WHO (2013) vouches for the use of the 'multi-barrier approach' to ensure safe water in developing countries, in which each barrier, i.e. step "provides an incremental protection against unsafe drinking water" (WHO, 2013, p.3). The multi-barrier approach comprises source protection, sedimentation of any turbidity in the water, filtration, disinfection, and safe storage. The last three steps of the multi-barrier approach are thus part of HWTS. In practice, however, HWTS most often includes only one type of treatment, such as chlorination or ceramic filtration.

Figure 1: The multi-barrier approach. Source: WHO (2013).

HWTS has been around for decades but has only recently started being recognized as a key strategy for improving drinking water quality and, subsequently, health, after extensive testing proved its effectiveness in treatment of microbial contamination (WHO, 2013). Adoption of the approach, resulting in sustained usage of HWTS, however, seems difficult. HWTS requires people to use it daily. With children spending much of their day at school and parents spending much of their day at work, making sure people drink only treated water is highly challenging. Arnold et al. (2009), for example, tested HWTS uptake and health impact of a 3-year HWTS- and handwashing promotion program in Guatemala, led by different NGOs. The HWTS solutions included boiling, solar water disinfection (SODIS; the treating of water by putting it in PET bottles and placing it out in the sun for at least 6 hours, often on a roof), and chlorination. All HWTS solutions were given away for free and uptake and acceptance was generated through promotion and education. Despite their efforts in educating the test group and promoting the HWTS products, Arnold et al. (2009) found no meaningful difference in adoption between the test group and the control group and, subsequently, no difference in health impact, such as child diarrhea, respiratory infections, or child growth, between the groups.

Market-based approach

In the effort to create more sustainable models of development programs, an increased focus on 'market-based approaches' is employed. Increasingly, rather than only incorporating government into a program, the private sector is involved heavily, to cooperate with the government in effectuating development programs. These public-private partnerships have a strong focus on synergizing the efforts and ambitions of government and private sector, following notions of 'from aid to trade', spurring economic growth and helping developing countries to integrate into the world economy and, subsequently, develop (Shama & Bindal, 2014). This approach is to lessen the dependency of the developing world on the developed world and facilitate more sustainable notions of development than an approach focusing on single, subsidy-driven interventions (Desai & Potter, 2014).

Market-based approaches thus focus on finding demand for a certain product or intervention and capacitating the local private sector to answer in this demand. For infrastructure provision in water and sanitation programs, successfully carrying out a market-based approach is highly difficult, as it often necessitates knowledge and technology from the global North, with the local private sector in a developing country lacking the institutional, technical, and financial capacity to produce and maintain the infrastructure by local means. For HWTS, however, this is not the case. Treatment means such as chlorine can be produced locally as well as safe storage means such as plastic buckets. For these HWTS solutions to reach their target population and produce both health benefits and economic development, however, supply chains need

to be developed, local production facilities need to be assisted and potentially improved, and local entrepreneurs and companies need to be financially supported to buy stock and market the product.

Practically, this implies that for market-based HWTS programs, HWTS solutions are not given away for free, as was the case in e.g. the aforementioned 3-year NGO program in Guatemala, analyzed by Arnold et al. (2009). Rather, local demand is found and a local supply chain is set up. Through an increased sense of ownership and the conscious decision to purchase the HWTS solution, e.g. a household water filter, uptake is improved and a local functioning and sustainable supply chain is set up (Yami, Sabatini, & Busenitz, 2017). This means that distribution of the household water filters is exercised not through (an) NGO(s), but through local actors and institutions such as entrepreneurs, health workers, and shops. 'Beneficiaries' can thence be redefined as 'customers', who are incentivized to buy a water filter or any other type of HWTS solution because of, primarily, improvements to their health, but also because of it saving costs from having to visit the clinic less often because of experiencing fewer waterborne diseases or not having to buy bottled water anymore. In an assessment of a market-based approach to the distribution of fluoride treatment methods through small local firms in the Rift valley of Ethiopia, Yami, Sabatini, and Busenitz (2017) found that reduced medical costs and productivity losses averted due to the access to safe water, led to an average annual cost saving of $67 per household. As such, the study "demonstrated that a business model is a useful tool to address the prevailing challenges encountered by safe-water supply services. Business models can help develop and expand safe-water technologies that strive to realize both social and financial returns, and thereby ensure sustainability of the safe-water supply services" (Yami, Sabatini, & Busenitz, 2017).

The Dutch development cooperation sector is exemplary in the shift 'from aid to trade' and is highly engaged in stimulating private sector development and increasing private sector involvement. Notwithstanding the merit in ambitioning and effectuating this private sector development and involvement, in an analysis of Dutch development projects in the Kenyan water supply, Savelli, Schwartz, and Ahlers (2018) found that "both private sector involvements and investment do not materialize in practice" (p. 1). Instead, promoting private sector development and involvement, focusing strongly on economic growth rather than only on drinking water provision or poverty alleviation, leads non-profit organizations to adopt behavior most often associated with the private sector. This Dutch push in private sector development and involvement thus leads to the paradoxical situation of not actually stimulating the private sector, but of changing the very nature of non-profits operating in an area of intervention, making them act more like a private company and blurring the lines between non-profit organizations and private companies. Furthermore, Savelli, Schwartz, and Ahlers (2018) argue that this paradoxical situation is actually promoted by the Dutch government, as it needs these 'hybrid organizations' – operating somewhere in the grey area between private and non-profit – to claim success for its push for private sector development and involvement.

For more sustainable interventions to take hold, interventions that focus on effective uptake of HWTS solutions through e.g. cost saving and averted productivity losses (Yami, Sabatini, & Busenitz, 2017) and promote local economic and private sector development without actually promoting non-profits to become 'hybrid' organizations, operating somewhere in between the non-profit and private sector, as identified by Savelli, Schwartz, and Ahlers (2018), effective monitoring schemes need to be birthed that show such benefits as cost saving and averted productivity losses and monitor the behavior of such important organizations in development programs. These monitoring schemes are thus to focus on 'outcomes', on the secondary implications of a development program. This as opposed to 'outputs', which are the direct results of a program, such as amounts of water filters or chlorine tablets distributed or boreholes installed (Earl, Carden, & Smutylo, 2001).

Defining outcomes

There exists, however, significant disparity surrounding the definition and delineation of what outcomes actually entail. This disparity can be characterized by a bilateral creed pertaining to, firstly, beneficiaries of IDC programs, and, secondly, to those organizations and institutions that work in unison to effectuate change in development programs. Those pertaining outcomes to beneficiaries often define them as the changes that can be connected to the efforts of one's development program (Fritz, 2018). Moreover, those adhering to this definition of outcomes even construe a depiction of outcomes that limits itself to the positive ambitions entailed in a program, defining outcomes as "the benefits that a project or intervention is designed to deliver" (Parsons, Gokey, & Thornton, 2013, p. 6). This as opposed to outputs, which are defined as "the tangible and intangible products that result from project activities" (Parsons, Gokey, & Thornton, 2013, p. 6).

Those who pertain outcomes to organizations and institutions that work in unison to effectuate change in development programs employ a definition of outcomes that focuses on changing the way these organizations and institutions operate and relate to one another, rather than the group of beneficiaries that the program is targeted at. Outcomes are thusly defined by Earl, Carden and Smutylo (2001) as "changes in the behavior, relationships, activities, or actions of the people, groups and organizations with whom a program works directly" (p.1). 'Outcome Mapping' subsequently is an assessment of the contribution to those changes that are linked to a program, rather than the changes themselves.

According to Roduner and Schläppi (2008), who uphold a notion of outcome in accordance with Earl, Carden and Smutylo (2001), an approach that employs a primary focus on outcome rather than outputs can be legitimized on the following three accounts:

- It is important to the poor, for they have an interest in knowing the extent to which their situation will be improved as a result of the measures carried out by development practitioners.
- Organizations working in the development field need to know whether the resources they invest in and the activities and services they finance have indeed made the greatest possible contribution to poverty reduction.
- It is important to know not only whether a contribution was made but also what the resulting changes are. Furthermore, it is important to know what is being done differently by whom. Clear indicators of behavioral change, and hence of sustainable development, are important and thus required.

These definitions of outcomes seem to be used interchangeably by scholars throughout the field of development. This research upholds a definition of outcomes that pertain both to the long-term changes that exist in a beneficiary population, and to the changes in the behavior, relationships, activities or actions of those with whom a program works directly, for development programs, which exist in a highly complex socio-economic and political context, can be argued to effectuate both.

Notwithstanding the legitimacy of employing a primary focus on outcomes rather than outputs, pressure to quantify, measure, and demonstrate direct program results has resulted in donors focusing more on direct outputs, using tools that "seek a linear cause and effect relationship between a problem and the identified 'solution' to that problem" (Earl, Carden, and Smutylo 2001, p.7). Development, however, is an eminently complex process, one that cannot be isolated with the vast diversity of actors and factors with which it is shaped by. This very complexity thus necessitates a characterization of the relationship between an IDC program and the development achievements it produces not by cause and effect but by contribution. This binary can be conceptualized in the notion of attribution versus contribution; a development achievement can never be attributed fully to one intervention or program, but the intervention or program can, to a large extent, be contributive thereto (Earl & Carden, 2002; Earl, Carden & Smutylo, 2001; Holzapfel, 2014; Smutylo, 2005).

This impossibility of full attribution of change to one specific program is elucidated further by Smutylo (2005), who vouches for measurement of development outcomes as changes in behavior and relationships of actors with whom a program interacts directly. As such, "performance is assessed as the program's contribution to influencing those changes" (Smutylo, 2005, p. 1). For example, a project focusing on promoting agro-biodiversity, exploring possibilities of integrating natural and agricultural biodiversity into a region, can use Outcome Mapping as an effective tool for monitoring and evaluation. By using Outcome Mapping, "changes in attitudes of stakeholders toward the forest, their agricultural land, environmental innovation and participation" (Smutylo, 2005, p.3) can be identified. As such, Outcome Mapping provides a space for social learning among relevant project stakeholders, approaching monitoring of project succession as looking closely at the facilitation, support, and execution of development, sustainable use of biodiversity, and community-based resource management. Rather than focusing on direct results, approaching monitoring and evaluation from an Outcome Mapping perspective allows for a focus on encouraging local actor development and interactive models of both research and development initiatives – focusing on "how we are performing well, and also how others are performing well, towards a common goal and not only for the final achievement of that goal" (Ambrose, 2004).

Next to the outcomes as changes in behavior, relationships, activities, and actions, as presented by Earl, Carden and Smutylo (2001), Earl and Carden (2002) expound upon the potential of Outcome Mapping as a tool for evaluative thinking. This propagates the aspect of learning as an important factor in development programs, and, subsequently, of monitoring and evaluation therein. As presented by Earl and Carden (2002), the International Development Research Centre (IDRC) has, next to the notion of not being able to simply attribute a development improvement to one specific intervention, encountered 3 fundamental challenges regarding monitoring and evaluation in IDC, which inhibit learning by organizations working in the IDC field:

- For significant and lasting change to take root, ownership and control has to shift from the IDC organization to the local context of its intervention. If an intervention is successful, its ideas and approaches have integrated thoroughly with a local context's customs, laws, and policies. This implies that the influence of an IDC organization is actually low in the outcome stages of a project. As such, dominant influences associated with outcomes may overlook the antecedent efforts responsible for the effectuation of these actual dominant influences (Earl, Carden, & Smutylo, 2001).
- Assessment of one's outcomes and/or impacts rarely provides information useful for improving an organization's performance. This 'clueless feedback' (Earl & Carden, 2002) does not provide an organization with data on how to improve its efforts in the future – there is no learning process involved in the M&E process of the intervention.
- Due to the prominent focus on providing evidence for and demonstrating the outcomes and impacts of one's IDC program, developing learning capacities within IDC organizations themselves has been shifted to the background.

Overcoming these challenges and making sure that a program's monitoring and evaluation encourages learning is achieved through upholding 3 fundamental principles intrinsic to OM as an evaluative learning tool: planning and assessment is done for both external results and internal performance; planning, monitoring, and evaluation is a cyclical process; and self-assessment is necessary for raising consciousness, building consensus, and empowering those working directly in a program (Earl and Carden, 2002).

Outcome Monitoring is, according to Earl and Carden (2002), "built on the premise that behavioral change is fundamental to sustainable development" (p. 4). Looking at development as behavioral change is deemed a key innovation of outcome mapping throughout literature devoted to the topic (Earl and Carden, 2002; Smutylo, 2005, p.5). The premise of behavioral change being fundamental to sustainable development (Earl & Carden, 2002), in addition to the notion of true sustainable development being premised by ownership and control being placed in the local context of intervention (Earl, Carden, &

Smutylo, 2001), necessitates the formulation of indicators that adequately indicate whether these very intended changes in behavior and capacities have been achieved. These indicators are to be identified at the planning stage of a program but must frequently be adapted during the course of project implementation for the program to continue to be effective (Roduner & Schläppi, 2008).

Logical Framework Approach

Frequent adaptation of indicators, the notion of behavioral change being the fundament of sustainable development, the necessity of building capacity and placing ownership and control in the local context, and placing an emphasis on evaluative thinking into a program necessitates tools for program monitoring and evaluation that are flexible and account for external forces that can intermediate in the succession of outcomes of a development program. Birthed by USAID in the 1960s, The Logical Framework Approach, also known simply as a 'The Logframe Approach', is one of the classic tools of monitoring and evaluation in IDC programs. A logframe provides a list of objectives, its indicators, the sources of data for these indicators, and the assumptions and risks associated thereto. The Logical Framework Approach thus provides a coherent overview in the planning stage of a development program. Attention in the logframe is put on outputs and achievement of development results through intended routes. At the hands of aforementioned increased pressure to quantify, measure, and demonstrate direct program results to development achievements (Earl, Carden, and Smutylo 2001), the Logical Framework Approach rigidifies planning and approaches to evaluation that employ a short-term fixation. This, however, also means that the approach sees causality in a manner that is excessively rigid. Furthermore, cultural adaptation is often left out of the equation. Using a logframe in project the planning stage of a program forces one to plan in inflexible manner, facilitating an avoidance of modification of goals or indicators during implementation, making it an intrinsically unrealistic basis for planning and program management (Roduner & Schläppi, 2008). The inability to attribute development achievements to a program or intervention fully at the hands of myriad intermediating variables calls for a monitoring and evaluation tool that is much more flexible than the Logical Framework Approach; one that incorporates learning and evaluative thinking and on capacity building and local ownership. Furthermore, it calls for an approach that elucidates a program's contribution to different outcome parameters; something that is unachievable when upholding a monitoring and evaluation scheme provided by the Logical Framework Approach (Holzapfel, 2014; Smutylo, 2005). Notwithstanding this notion, a logframe is an adequate framework for delineating project implementation in its early stages: "Development organizations are torn between increasing levels of stakeholder participation and accountability and ever greater requirements to demonstrate that they have performed according to expectations and to provide evidence of impact. The Logical Framework Approach, while deeply flawed, seems to provide some middle ground, as it is both a component of results-based management and also allows scope for intensive stakeholder participation, at least at the planning stage" (Bakewell & Garbutt, 2005, p.8). The following table depicts a typical layout of a logframe, delineating ambitioned long-term visions, direct program effects, and its outputs at the hands of the activities performed during the program. Furthermore, indicators that conceptualize and quantify these long-term visions, direct effects, outputs, and activities are displayed as well as the assumptions that are necessary to successfully accomplish them.

	Hierarchy of objectives Summary of Project Strategy	**Indicators**	**Assumptions** **(External Factors, Risks)**
Long-Term Visions	Goal/Overall Objective/Impact Improvement in the living conditions of people and/or the situation of natural resources to which the projects makes a contribution.	Indicate whether improvements have been achieved.	-
Direct Effects	Project Objective/Outcome (Purpose) Changes in the behavior and in the capacities of key persons, people and/or organizations (target groups).	Indicate whether intended changes in behavior and capacities have been achieved.	Framework conditions necessary to achieve the goal or overall objective.
Operational Domain of Project	Outputs Products and services provided in the project.	Indicate whether project outputs have been provided in sufficient quantity and quality.	Framework conditions necessary to achieve project objectives or outcome or purpose.
	Activities Within the Project to provide outputs.	Means, Costs (Inputs): Financial, material, and human resources.	Framework conditions necessary to provide the outputs.

Figure 2: Logframe. Source: Roduner & Schläppi (2008).

Theory of Change

Comprehensively understanding a change process necessitates a monitoring and evaluation approach that not just depicts long-term visions, direct effects, outputs and activities, but also identifies and addresses questions of 'why, what, who, when, and how' within these components. Birthed in the United States in the early 1990s, a Theory of Change Approach addresses "how practitioners believe individual, inter-group, and social/systemic change happens and how, specifically, their actions will produce positive results" (Shapiro, 2006, p. 3). In practice, it differs from the Logical Framework Approach by sketching a bigger picture that relates to a context that cannot always be controlled. Furthermore, it shows not one, but different pathways that lead to change and these pathways do not necessarily have to be part of one's development program. The approach expounds the connection between activities and outcomes, focusing on this connection rather than the activities and outcomes themselves. Most fundamental, however, is the difference in flexibility. A Theory of Change does not have a set format and can include, for example, cyclical processes and feedback loops (Fforde, 2017). Basic Theory of Change components however, most often "include a big picture analysis of how change happens in relation to a specific thematic area; an articulation of an organization or program pathway in relation to this; and an impact assessment framework which is designed to test both the pathway and the assumptions made about how change happens" (Intrac, 2012, p.2).

This inclusion of cyclical processes in the approach is, as argued by Earl and Carden (2002), fundamental in the facilitation of learning as an important aspect in monitoring and evaluation specifically and ones IDC program in general. It is no surprise then that a Theory of Change Approach has 'learning' as one of its main purposes, next to strategic planning, description, and monitoring and evaluation – purposes which will, in practice, overlap substantially (Stein & Valters, 2012). At the hands of its flexibility and its prominent inclusion of the context it is placed in, definitions of the Theory of Change Approach vary widely. Stein and Valters (2012) categorize this spectrum of definitions into three categories: the first is a very technical interpretation of the Theory of Change, using it as a narrow and rigid tool for planning. It is then used, most likely, as an extension of the assumptions box in a logframe (figure 1), elaborating on the inner workings of the conditions necessary for the achievement of the different levels of the logframe. The second category is classic 'Theory-of-Change-thinking'. The Theory of Change is then used as a 'way of thinking' about how and why a project is expected to work and why change happens, as described by Shapiro (2006). This is considered by many as a key element of the Theory of Change

process. The third category emphasizes the need for a "complex and nuanced understanding of how change happens" (Stein and Valters, 2012, p. 5), which is described by Stein and Valters (2012) as developing 'political literacy'. This final category moves away from technical approaches to development and sees a Theory of Change Approach as a more reflexive approach, placing an emphasis on evaluation.

Provided below is an example of a brief Theory of Change Approach employed to assess the 'Accountability Tanzania' (AcT) program, a development program that has the purpose of "increasing government responsiveness and accountability and strengthening civil society" (Vogel & Stephenson, 2012, p. 42) in Tanzania. The example is adopted from Vogel and Stephenson (2012, p.42).

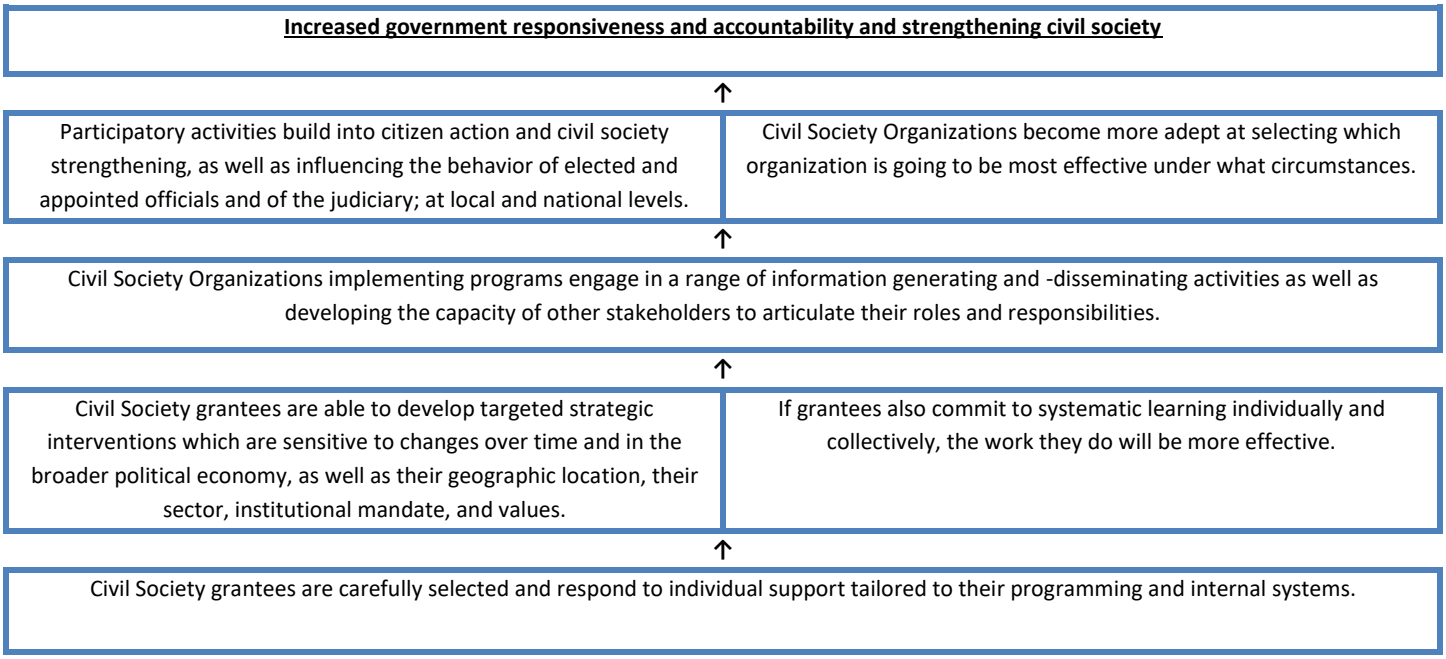

Figure 3: Theory of Change method Accountability Tanzania program. Source: Vogel & Stephenson, 2012, p.42).

This Theory of Change was subsequently translated into a short logframe, in order to delineate this Theory of Change narrative more concisely in the planning stage of the AcT program (Vogel & Stephenson, 2012, p.42):

Purpose	Increased accountability and Responsiveness of the Government		
Outputs	Behavioral Change in Civil Society		
Process Outputs	Citizen Action	Influence on Behavior of elected representatives, government officials, and judiciary	Civil Society Strengthened
	Knowledge Generated	Information Disseminated	Capacity Built
Process	Targeted Strategic Interventions for Individual and Shared Learning		
Inputs	Selection of-, Facilitation of Tailored Individual Support for-, and Provision of Grants for Civil Society Organizations		

Figure 4: Revised logframe for the Accountability Tanzania program. Source: Vogel & Stephenson (2012, p.42).

As depicted in the Accountability Tanzania case, a Theory of Change Method can be translated into a logframe, where a Theory of Change depicts the inputs, processes, outputs, and outcomes in a more detailed manner, whereas the logframe depicts a coherent overview of outputs and achievements of intended development results through their relevant development routes (Earl, Carden, and Smutylo, 2001). A Theory of Change Approach and Logical Framework Approach can then be complementary, with indicators of development achievements being derived from a logframe, and their inner workings elaborated upon in the program's Theory of Change.

The flexibility of the Theory of Change, its different interpretations (as categorized in the three categories put forward by Stein and Valters (2012), and its different overlapping purposes, however, make for a monitoring and evaluation approach that is interpreted in an entirely different manner by different organizations. Critics of the Theory of Change method argue that, at the hands of its endless variations in style and content, the Theory of Change cannot be tied down to anything that has tangible meaning, leading organizations employing the approach to make unrealistic promises on its behalf. In order to overcome this ambiguity and inconsistency, greater clarity is needed, firstly, on the common terminology employed in, secondly, on the use of, and, thirdly, on the expectations of the Theory of Change Approach. Furthermore, the strength of the Logical Framework Approach, that of facilitating results-based management, allowing for greater levels of accountability and demonstration of performance, is also the weakness of the Theory of Change, for combining evidence-based policy with the requirement of providing a Theory of Change from grantees "may privilege the inclusion of donor requirements or politically preferable approaches in the ToC <Theory of Change> and in wider project planning. These approaches may ultimately supersede the concerns of the implementing organization and/or the needs of the program's intended beneficiaries" (Stein and Valters, 2012, p. 7). Additionally, at the hands of donors requiring a Theory of Change from grantees, the approach is often used to meet donor demands rather than using it to rationalize one's efforts. Adapting a Theory of Change for it to be as 'sellable' as often to donors can therefore seriously harm a program's potential for helping accomplish development achievements; a paradoxical situation that seriously impedes the adoption of a Theory of Change Approach in monitoring and evaluation of one's IDC program. Lastly, a Theory of Change rarely addresses the implications of truly honest and transparent approach to examining and explicating power relations in a region of intervention. International development is inherently political. Organizations that expound a political environment and present the different power relations existing therein can potentially alienate partners and endanger staff. This issue is especially salient when development organizations are required to publicize their Theories of Change and raises serious questions with regard to larger tensions relating to aid transparency and aid effectiveness (Stein and Valters, 2012).

Appreciative Inquiry

Developed in great part by David Coopperrider in the late 1980's, Appreciative Inquiry is another evaluation tool that engages in evaluation in a unique manner. "Appreciative Inquiry refers to a research perspective that is uniquely intended for discovering, understanding, and fostering innovations in social-organizational arrangements and processes. Its purpose is to contribute to the generative-theoretical aims of social science and to use such knowledge to promote egalitarian dialogue leading to social-system effectiveness and integrity" (Cooperrider & Srivastva, 1987, p. 25). Social system effectiveness is defined by Cooperrider and Srivastva (1987) as a mix between social-organizational values ('how should we organize ourselves?') and everyday social-organizational practices. Appreciative Inquiry is an elaborate and holistic approach to assessing development, one that can be characterized as pragmatic, as well as scientific, metaphysical and normative. As such, Appreciative Inquiry can be used not only discover, understand, and foster innovations, but also to develop and help evolve our normative visions of groups, organizations, and society as a whole.

Using Appreciative Inquiry to analyze and understand a 'system' – be it a community, organization, or group of people – in terms of strengths, weaknesses, challenges, etc., can unleash information that produces a catalytic effect on leadership

and system change. This change can be illustrated by the case of how Appreciative Inquiry was used to organizationally change British Airways after 9/11. After 9/11, at the hands of significantly reduced demand for air travel, most airlines had to reduce organizational headcount and cut costs drastically in order to survive. British Airways had prior experience with employing Appreciative Inquiry to analyze and instigate organizational change. This experience was used to facilitate a culture of "discovery and cooperation", rather than a culture of "command and control" (Whitney & Trosten-Bloom, 2010, p. 4). This led the organization to create a context for voluntary sabbaticals, job sharing, and part-time positions. Practically, a culture of how to improve the challenging situation surrounding the fall in demand for air travel was facilitated. Rather than looking at the problem itself, Appreciative Inquiry allowed British Airways to look at the problem in a positive and solution-driven manner. As put forward in the USAID 2003 Appreciative Inquiry Training Manual, a problem-focused approach vs. an appreciative approach to development differs according to the following comparisons:

Problem-Focused Approach to Development	**Appreciative Approach to Development**
Identification of problem	Appreciating and valuing the best of 'what is'
Analysis of causes	Envisioning 'what might be'
Analysis of possible solutions	Dialoguing 'what should be'
Action planning to treat problem	Innovating 'what will be'

Figure 5: Problem-Focused Approach vs. Appreciative Approach. Source: USAID (2003).

Central to the Appreciative Inquiry Approach lies the 4-D Cycle, which comprises Discovery, Dream, Design, and Destiny. In practice, this implies identifying and appreciating what works, imagining what might be, developing systems and structures to achieve these things, and implementing the proposed system respectively. in more detail, in a group setting where Appreciative Inquiry is employed to assess an organization's program, the Discovery stage comprises a reflection and discussion of what is best concerning the subject, e.g. an organization's Water, Sanitation, and Hygiene (WaSH) programs in East Africa. Participants are interviewed about their 'best of' stories concerning their WaSH programs and their responses shared. This, in combination with the organizational members and other participants in the group acting as both interviewers and interviewees, is a key innovation of the Appreciative Inquiry Approach. In the Dream stage, the group is inquired on how their organization would be at its best regarding WaSH in East Africa. Commonalities of envisioned scenarios and ambitions are identified. This second phase of the 4-D cycle often results in a more symbolic depiction such as graphical representations, rather than a serious mission statement, as is the case in the first, Discovery, part of the 4-D cycle. In the Design stage, group participants are requested to develop more concrete plans for the new state of the organization regarding the topic of WaSH in East Africa. A term labeled 'provocative responses' by Cooperrider and Srivastva (1987), participants are prompted to organize themselves around and create proposals for positive change regarding their WaSH interventions in East Africa. these proposals are also called 'possibility statements' or 'design statements'. In the final stage of the 4-D cycle of the Appreciative Inquiry Approach, the Destiny stage, widespread agreements among group participants are identified, and a subsequent event is facilitated wherein participants make commitments to take action in implementing the designs crafted in the earlier cycles. Important in this stage, typical of the Appreciative Inquiry Approach, is that instead of action plans and committees being formed, every group participant is authorized to take those actions they believe will bring positive change to the organization, as identified in the Discovery, Dream, and Design stages. Leaders in the organization are to merely monitor and support both the innovations they want to nurture, and the self-organizing change that has come into fruition in the organization (Kessler, 2013).

According to Jacobsgaard & Nørlund (2011), Appreciative Inquiry has great potential for improving the development sector, for it can bridge the gap between the notion of Western institutions to have the knowledge, capacity, and money to save Third World problems and the notion of the Third World to take ownership of their own development. The

ambiguity in many of the aspects of the Appreciative Inquiry Approach in general and the 4-D cycle in particular, however, has provoked confusion among both Appreciative Inquiry theorists and practitioners. Paradoxical to the Appreciative Inquiry Approach is that the very thing it produces – outcomes of the first, Design stage of the 4-D cycle – creates new targets, new gaps to fill, and new objectives for the organization to achieve. This "may be counter to the very philosophy of Appreciative Inquiry" (Kessler, 2013). Appreciative Inquiry thus potentially serves as an effective tool for monitoring and evaluation of one's IDC program when it is approached from an improvisational standpoint, rather than an implementational one (Kessler, 2013).

Outcome Mapping

Answering in the need for more flexible tools to illustrate a project and expound its merit in effectuating development, new frameworks that omit a linear causality and cause-effect logic upheld by outdated notions of development cooperation in general and the Logical Framework Approach in particular, have been conceived – Outcome Mapping Frameworks. As aforementioned, such frameworks uphold a notion of development and a project's effect therein as dynamic, subsequently employing monitoring and evaluation throughout the succession of a project: "Outcome Mapping establishes a vision of the human, social, and environmental betterment to which the program hopes to contribute and then focuses monitoring and evaluation within that program's direct sphere of influence. (…) By using Outcome Mapping, a program is not claiming the achievement of development impact; rather the focus is on its contributions to outcomes" (Roduner & Schläppi, 2008, p.12). Additionally, Outcome Mapping assesses development as behavioral change, complementing more quantifiable parameters such as crop yield or water quality (Earl & Carden, 2002). The method therefore is particularly valuable when development achievements cannot be understood through quantitative assessment alone (Earl & Carden, 2002). Outcome Mapping thus is a method that is of a complementary nature rather than an exhaustive one in and of itself: "Outcome Mapping will not help a program create generic lists of 'lessons learned' or 'best practices'. Instead, it will help it weave the plots of the three elements related to its work: first, the changes in the behaviors, actions, activities, and/or relationships of the people, groups, and organizations with whom a program works directly; second, the strategies that a program employs to encourage change in its partners; and third, the internal effectiveness of that program" (Earl and Carden, 2002, p. 523).

Outcomes, however, are exceedingly difficult to monitor. A process characterized by ambiguity and estimation rather than measurability and calculation, assessing the contribution of change at outcome level is highly challenging. A vast multitude of factors come into play that effectuate and facilitate different factors of development, making it highly difficult to assess the contribution of one intervention on the relevant factors of development that have been realized in a beneficiary population. The economic- and political environment, and the activities of other development agencies are but examples of factors that influence the correlation between interventions and the development outcomes that they help realize. Consequently, overcoming this question of contribution necessitates new notions of development and monitoring and evaluation thereof (Ambrose, 2004; Holzapfel, 2014).

Outcome Mapping, as described is divided into three stages (Earl, Carden, & Smutylo, 2001; Roduner & Schläppi, 2008):

1. Intentional Design	**2. Outcome & Performance Monitoring**	**3. Evaluation Planning**
Helps a program establish consensus on the macro level changes it will help to bring about and plan the strategies it will use. Answers: why (is the vision going to contribute to the program's ambition)?; who (are the partners)?; what (are the strategies)?; how (will the program contribute to change)?	Provides a framework for the ongoing monitoring of a program's actions and partners' progress toward the achievement of ambitioned outcomes.	Helps the program identify evaluation priorities and develop an evaluation plan.
Step 1: Vision	Step 8: Monitoring Priorities	Step 12: Evaluation Plan
Step 2: Mission Statement	Step 9: Outcome Journals	
Step 3: Partners	Step 10: Strategy Journal	
Step 4: Outcome Challenges	Step 11: Performance Journal	
Step 5: Progress Markers		
Step 6: Strategy Maps		
Step 7: Organizational Practices		

Figure 6: The three stages of Outcome Mapping. Source: Roduner & Schläppi (2008).

This first step, the Intentional Design, of the three stages of Outcome Mapping, are elaborated upon in the Outcome Mapping Framework:

The vision reflects the broad human, social & environmental betterment in which the program is engaged and to which it is contributing.		
The mission statement describes in a broad way the contribution of the donor program to the vision. It describes how the program intends to operationalize its role in support of the vision and support the achievement of outcomes by its partners		
Outcome Challenge: Boundary Partner A The outcome challenges describe the changed behaviors (relationships, activities, and/or actions) of a boundary partner; and how they would be behaving if they were contributing ideally to the vision. **Set of progress markers:** Progress Markers are a gradual set of statements (milestones) describing a progression of changed behavior in a boundary partner. They describe changes in actions, activities & relationships leading up to the ideal outcome challenge statement.	**Outcome Challenge: Boundary Partner B** **Set of progress markers**	**Outcome Challenge: Boundary Partner C** **Set of progress markers**

Support strategies from the program / project: The strategies outline the approaches of the project team in working with the partners. They indicate the relative influence the program is likely to have on a project partner. An overview of the strategies helps to pinpoint strategic gaps in the approach or determine whether the program is overextended; it also suggests the type of evaluation method appropriate to track and assess the performance of the project.	Support strategies for Boundary Partner B	Support strategies for Boundary Partner C
Organizational practices describe the efforts of the project team in order to remain innovative, efficient and relevant for the program purpose.		

Figure 7: Outcome Mapping Framework. Source: Roduner & Schläppi (2008).

In this Outcome Mapping Framework, "boundary partners are those individuals, groups, or organizations with whom the program interacts directly and with whom the program can anticipate opportunities for influence. These actors are called boundary partners because, even though the program will work with them to effect change, it does not control them" (Earl, Carden, & Smutylo, 2001, p. 41). Boundary partners, i.e. those 'interacting directly' with a program, are further described by Earl, Carden, and Smutylo (2001) to be in a program's 'sphere of influence'. Beneficiaries of an IDC program fall outside of this sphere of influence, into the 'sphere of interest' (Hearn, 2011).

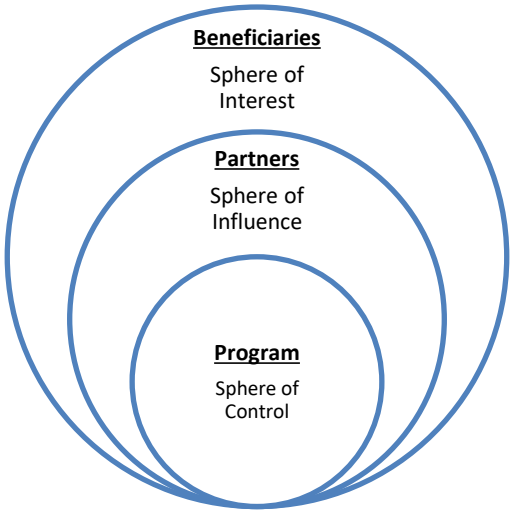

Figure 8: Spheres of control/influence/interest of a program. Source: Hearn (2011).

As aforementioned, however, fundamental changes in behavior, activities, opportunities, etc. – "the human, social, and environmental betterment to which the program hopes to contribute" (Roduner & Schläppi (2008, p. 12) - can also be found in the beneficiary population of a program. This can for example be in increased school enrolment, reduced <5 mortality, reduced growth stunting, et cetera, and these very changes, notwithstanding existing in the sphere of interest, can be and are being identified as outcomes (Fritz, 2018; Parsons, Gokey, & Thornton, 2013). Assessment of the performance of an IDC program can subsequently be assessed not only on the contribution to changes existing in the sphere of influence, as described by Smutylo (2005), but also on the contribution to the very changes, i.e. outcomes, produced in the beneficiary population. For this reason and to untangle the heavily intertwined disparate notions of what

outcomes entail, outcomes will henceforth be divided into either 'beneficiary outcomes'; pertaining to the beneficiary population of a program, and 'boundary partner outcomes'; pertaining to boundary partners of a program.

Further monitoring of performance of boundary partners, of support strategies for boundary partners, and of organizational practices employed, are monitored in stage 2 of the three stages of Outcome Monitoring.

2. Outcome & Performance Monitoring Provides a framework for the ongoing monitoring of a program's actions and partners' progress toward the achievement of ambitioned outcomes.
Step 8: Monitoring Priorities
Step 9: Outcome Journals
Step 10: Strategy Journal
Step 11: Performance Journal

Figure 9: Second stage of the 3 stages of Outcome Mapping. Source: Roduner & Schläppi (2008).

In order to monitor these parameters effectively and employ productive and useful monitoring methods, however, monitoring priorities are to be set. Based on these priorities, data collection sheets can be developed to track the boundary partner progress (step 9), support strategies (step 10), and organizational practices (step 11) related to the program. Monitoring priorities are set to not waste human and financial resources. For the monitoring within the HWTS Outcomes Monitoring Framework, setting priorities in the monitoring of boundary partners' progress markers, support strategies, and organizational practices can be based on the uses of the information.

The worksheet related to prioritizing the monitoring parameters in stage 2 looks as follows:

Prioritizing Monitoring Parameters							
Monitoring priority	**Who will use the info**	**Purpose of the info**	**When is the info needed?**	**Who will collect the info?**	**How often will it be collected?**	**How will it be collected?**	**Proposed monitoring tool**
Boundary partner's achievement of outcomes							**Outcome Journal**
Program's strategy							**Strategy Journal**
Program's organizational practices							**Performance Journal**

Figure 10: Worksheet for prioritizing monitoring. Source: Earl, Carden, & Smutylo (2001).

The boundary partners' achievements of outcomes are monitored in the Outcome Journal, as part of step 9 in the second stage of Outcome Mapping (Earl, Carden, & Smutylo, 2001). It includes the relevant progress markers as identified in stage 1, a description of the change as low, medium or high, and who among the boundary partner exhibited the change. Considering the importance of the program context, however, the data collected on the progress markers shall need to be contextualized and explained thoroughly, in order to be sufficiently useful in the monitoring process. Furthermore, these very progress markers are not rigid. In fact, it is essential that it is continually asked whether the progress markers adequately reflect the desirable change in the boundary partner (Earl, Carden, & Smutylo, 2001).

Outcome Journal #1		
Work dating from/to:		
Contributors to monitoring update:		
Outcome challenge:		
Progress Marker #1	Low/Medium/High	Who?
Progress Marker #2	Low/Medium/High	Who?
Progress Marker #3	Low/Medium/High	Who?
Progress Marker #4	Low/Medium/High	Who?
Progress Marker #5	Low/Medium/High	Who?
Etc.	Etc.	Etc.

Figure 11: Outcome Journal #1. Source: Earl, Carden, & Smutylo (2001).

The exhibited change is subsequently elaborated upon and contextualized in the second part of the Outcome Journal:

Outcome Journal #2
Description of Change:
Contributing factors & actors:
Sources of evidence:
Unanticipated change:
Lessons/required program changes/reactions:

Figure 12: Outcome Journal #2. Source: Earl, Carden, & Smutylo (2001).

"Outcome Mapping is based on the premise that the program has to be prepared to change along with its boundary partners" (Earl, Carden, & Smutylo, 2001, p. 97). This program change can be discussed during regular monitoring meetings, asking questions to relevant boundary partners on what is being done will and should be continued, what should be improved, what strategies need to be added or given up, how are and should be responding to changes in the behaviors, relationships, activities, and actions, et cetera of Boundary Partners. The answers produced from these meetings comprise the Strategy Journal, which is visualized as follows:

Strategy Journal	
Work dating from/to:	
Contributors to Monitoring Update:	
Strategy to be Monitored	
Description of activities (What/who/when?)	**Effectiveness** (How did it influence change in the boundary partner(s)?
Outputs	**Required program follow-up or changes**
Lessons	

Figure 13: Strategy Journal. Source: Earl, Carden, & Smutylo (2001).

The Performance Journal, pertaining to monitoring organizational performance in the program, is produced as a last step in stage 2 of 3 stages of Outcome Mapping. Having to change along with the program, the Performance Journal paves the way of how and why the program is to change along with its boundary partners in order to arrive to the vision, as formulated in the first stage of Outcome Mapping (Earl, Carden, & Smutylo, 2001; Roduner & Schläppi, 2008). The Performance Journal thence focuses on monitoring how the program is, as an organization, operating to fulfill its mission. With the aforementioned ambition of remaining "relevant, innovative, sustainable, and connected to its environment" (Earl, Carden, & Smutylo, 2001, p. 76), the Performance Journal reviews questions of previous performance but also asks how a program is to improve. Substantiated by information gathered in steps 9 and 10, the program will have acquired ample data on performance and Boundary Partner results. Analysis of this data is to provide the stepping stone for the program to reflect on its context of operation and contextualize its achievements and failures.

Answering questions of what is being done well as an organization, for suggestions of organizational growth, for activities to modify organizational practices and regularities, and for edification on the division of responsibilities and accountabilities, the Performance Journal conceptualizes those organizational practices put forward in the Outcome Mapping Framework (figure 6). It is thus visualized as follows, with examples for Organizational Practices as put forward by Earl, Carden, & Smutylo (2001):

Performance Journal	
Work dating from/to	
Contributors to Monitoring Update:	
Practice 1: Prospecting for new ideas, opportunities, and resources Example or indicators: Sources of evidence: Lessons:	

Practice 2: Seeking feedback from key informants Example or indicators: Sources of evidence: Lessons:
Practice 3: Obtaining the support of your next highest power Example or indicators: Sources of evidence: Lessons:
Etc.

Figure 14: Performance Journal. Source: Earl, Carden, & Smutylo (2001).

In the 12th and last step of Outcome Mapping the program, in stage 3, an evaluation plan is produced. It "outlines the evaluation issue, the way findings will be used, the questions, the information sources, the evaluation methods, the evaluation team, the dates for evaluation, and the approximate cost" (Earl, Carden, & Smutylo, 2001).

3. Evaluation Planning Helps the program identify evaluation priorities and develop an evaluation plan.
Step 12: Evaluation Plan

Figure 15: Last of 3 stages of Outcome Mapping, Evaluation Planning. Source: Earl, Carden, & Smutylo (2001).

This evaluation can be performed simply for the virtue of meeting donor or outcome payer requirements, but it can also be used to create new knowledge and insights and to motivate future, improved endeavors related to the program. A visualization of an evaluation plan might thence look as follows:

Evaluation Plan

Evaluation Issue:						
Who will use the evaluation? How? When?	**Questions**	**Information sources**	**Evaluation methods**	**Who will conduct and manage the evaluation**	**Date (start & finish)**	**Cost**

Figure 16: Evaluation Plan. Source: Earl, Carden, & Smutylo (2001).

HWTS Beneficiary Outcomes

A large multitude of studies have been dedicated to finding statistically significant relationships between WaSH interventions, health parameters, and secondary parameters such as school attendance and social capital – i.e. outcomes pertaining to beneficiaries of WaSH programs (Fritz, 2018; Parsons, Gokey, & Thornton, 2013). In a review of 135 WaSH studies, Wolf et al. (2018) found that "point-of-use filter interventions with safe storage reduced diarrhea risk by 61%" (p. 508). Sanitation interventions were found to reduce diarrhea risk by 25%, promoting handwashing with soap by 30%. Greatest reductions in diarrhea risk, however, were found to result from improving the quality of premises supply – 75% (Wolf et al., 2018). Improving quality of premises supply, however, requires vast amounts of institutional, financial, and technical capital, much more so than HWTS distribution. As such, legitimacy of HWTS distribution as a solution for providing safe drinking water is backed up thoroughly by the meta study provided by Wolf et al. (2018).

Ellis and Schoenberger (2017) assessed the effect of six predictors – Piped Water to Premises (PWTP), Other Improved Water source (OIWS), Unimproved Water Source (UWS), Improved Sanitation (IS), Filtered and Bottled Water in the Household (FBH), and Hand Washing (HW) – on mortality rates. The assessment was carried out using the World Health Organization (WHO) database on drinking water quality and sanitation in the developing world. It was found that Unimproved Water Source (UWS), Improved Sanitation (IS), and Filtered and Bottled Water in the Household (FBH) correlate statistically significantly with mortality rates ($P<0.05$). Counter intuitively, an increase in Improved Water Source (OIWS) was found to increase mortality rates, albeit in a non-statistically significant manner:

	Estimate	Std.Error	t value	Pr(>|t|)	Bonferroni	H-B	B-H
(Intercept)	0.51629	0.07942	6.5	2.20E-09	1.54E-08	1.32E-08	7.69E-09
PWTP	-0.0297	0.05215	-0.57	0.57006	1.00000	0.57006	0.57006
OIWS	0.06585	0.0413	1.594	0.11363	0.79542	0.34089	0.15908
UWS	0.19281	0.04733	4.074	8.58E-05	0.00060	0.00043	0.00020
IS	-0.27231	0.04037	-6.744	6.67E-10	4.67E-09	4.67E-09	4.67E-09
FBH	-0.06739	0.02175	-3.098	0.00246	0.01719	0.00982	0.00430
HW	-0.11035	0.09532	-1.158	0.24939	1.00000	0.49879	0.29096

Residual standard error: 0.04656 on 114 degrees of freedom.
Multiple R-squared: 0.8606, Adjusted R-squared: 0.8533.
F-statistic: 117.3 on 6 and 114 DF, p-value: < 2.2e-16.

doi:10.1371/journal.pone.0170451.t006

Figure 17: effect of six WaSH predictors on mortality rates. Source: Ellis and Schoenberger (2017).

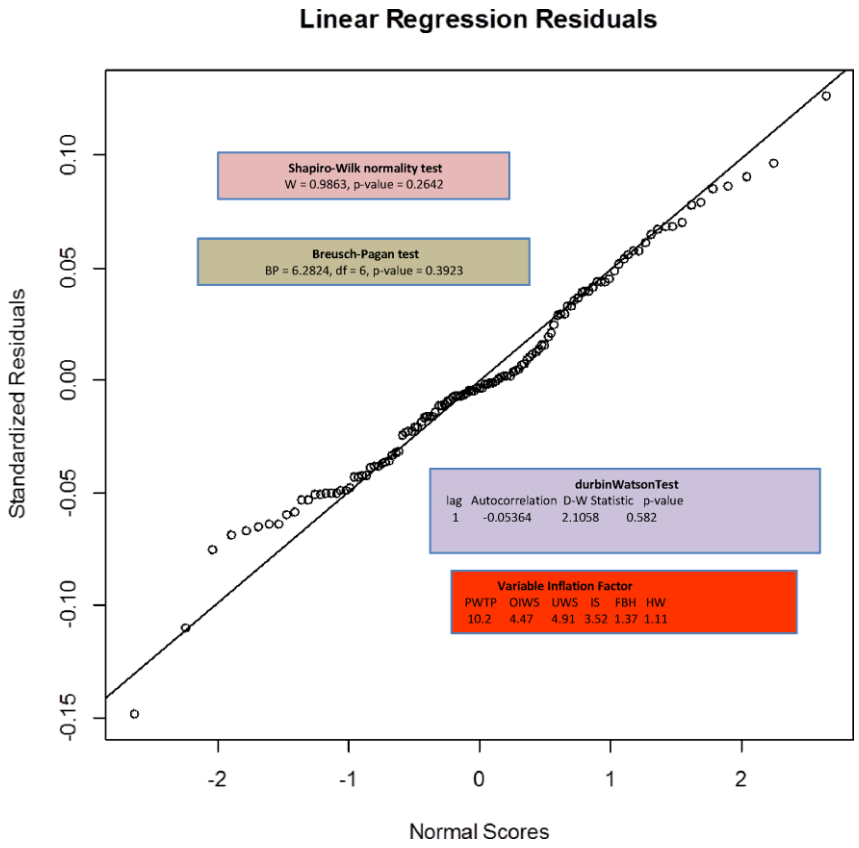

Figure 18: Linear Regression of Six Predictors on Mortality Rates. Source: Ellis and Schoenberger (2017).

Investigating the outcomes of piped water on water quality, sanitation, hygiene, and health outcomes in Bangladesh, Hasan and Gerber (2016) found that having access to piped water had a statistically significant positive effect on distance traveled and thus time spent on collecting drinking water. No improvement on drinking water quality, conceptualized as E. coli count per 100 mL of water, however, was found at point of use. Moreover, food utensils were tested positive for E. coli for both the treatment group as well as the control group, which did not have access to piped water. Households started to use significantly more water after being connected to the piped water system. Neither decreased diarrhea nor prevalence of underweight children was found to be subject to having access to piped water or not. This could suggest that contamination of water occurs predominantly between source and consumption, thus supporting and underlining the merit of safe storage in a HWTS solution such as water filters.

The notion that finding associative, let alone causal, relationships between WaSH interventions and health outcomes is challenging is profoundly supported by Ramesh et al. (2015). Conducting a systematic literature review of 3963 studies on relationships between WaSH interventions and health outcomes, Ramesh et al. (2015) only found six studies that measured a statistically significant change in health outcomes as a result of a WaSH intervention. All six studies revolved around point-of-use (POU) interventions, such as water filters. Health outcomes were conceptualized as reported diarrheal prevalence, number of visits to clinics, and reported incidence of bacterial infection such as the shigella bacteria.

Access to safe drinking water is especially important to the HIV-positive population of Ethiopia and Malawi, for “close to 100% of HIV-positive patients in the developing world may suffer from chronic diarrhea” (Elfstrand & Florén, 2010, p. 2). And diarrhea “increases mortality of <HIV> infection” (p. 1). This is especially important for Malawi, where nearly 10% of the adult population is HIV positive. In Ethiopia approximately 2.5% of the population lives with HIV.[2] Furthermore,

[2] www.unaids.org

chlorine treatment is ineffective for those living with HIV, as many protozoan parasites are chlorine-resistant, such as cryptosporidium and giardia (WHO, 2011). Programs focusing on people living with HIV are therefore recommended to only consider HWTS options that focus on filtration, rather than chlorination (Rowe, 2012).

Next to health benefits, HWTS programs can aid in CO_2 emission mitigation at the hands of one not having to boil their water to make it safe. Consequently, an HWTS program eligible for carbon credit funding, which. Carbon credits are quantified sets of averted CO_2 emissions, quantified as 1 ton of CO_2 per carbon credit. These carbon credits can be bought by e.g. companies that want to offset their emitted CO_2, be it on the basis of (inter)national regulations or by virtue of a company's own initiative.[3] In a laboratory test, testing different cookstoves on their global warming potential, MacCarty et al. (2007) found that boiling and letting simmer 1L of water for 30 minutes produces 536g of CO_2 when done so using a wood-powered cookstove and 300g of CO_2 when done so using a charcoal-powered cookstove. Different carbon credit brokers uphold different figures of offset CO_2 for an HWTS program, taking into account figures of deforestation, socio-economic factors, and baseline water usage. For all HWTS programs to be eligible for carbon credit registration, however, one has to assure and furnish proof for correct and continuous usage of the HWTS solution in the area of intervention of at least 7 years, as conveyed by Aqua for All's carbon credit broker, Believe Green.[4]

Safe drinking water is, in spite of the difficulty in finding statistically significant relationships, thus found to be of crucial importance to the reduction of diarrheal disease, bacterial infection, mortality rates, school attendance, STH prevalence, and HIV treatment. Such beneficiary outcomes can subsequently be extrapolated to other important beneficiary outcomes, such as saving money because of less visits to clinics and more productive workdays, mitigation of plastic usage because of not having to buy bottled water, CO_2 emission mitigation because of not having to boil one's water, etc. These very outcomes are to be tested in the field and contribute to the manifestation of the research deliverable; the HWTS Outcome Monitoring Framework.

Knowledge Gaps

Mapping outcome successfully is highly dependent on adequate use of indicators. Conventional measurement systems of outcome, however, do not cover "the breadth and balance required in a science-based measurement system" (Moore, Lippman, & Brown, 2004, p. 125A). Impact of safe drinking water on health is thoroughly studied and a considerable amount of evidence has been found that supports the role of HWTS in reducing diarrheal disease, limiting trachoma infection, reducing schistosomiasis transmission, improving nutrition, et cetera (Bartram & Cairncross, 2010). In many cases, however, studies lack rigor and refrain from explicating the merit of specific types of interventions, such as point-of-use water treatment (Freeman et al., 2016). This research focuses specifically on water filtration at point of use in two loci of research – Ethiopia and Malawi – and aims to explicate the merit of this HWTS solution in terms of beneficiary outcomes it produces, the potential for furnishing of proof thereof and of subsequent outcome funding it can potentially attract for other HWTS programs. Furthermore, it aims to explicate the necessary changes in behavior, actions, activities, and relationships of boundary partners – boundary partner outcomes – in order to make these beneficiary outcomes a discernible and tangible reality (Earl, Carden, & Smutylo, 2001).

Appropriating Outcome Mapping to the realization of beneficiary outcomes through the effectuation and monitoring of boundary partner outcomes, for the merit of attracting outcome funding, and delineating an IDC program's monitoring and evaluation specifically thereto is an additional novel area in the IDC discourse; in the academic as well as the professional realm. As the paradigm shift in the IDC field materializes - from a focus on tangible project outputs to a focus

[3] www.goldstandard.org
[4] www.believegreen.org

on contribution to outcomes that effectuate long-term, sustainable change – the inception of novel monitoring and evaluation frameworks is as necessary as it is logical. Therefore, providing evidence for contribution to the realization of these very outcomes (Earl & Carden, 2002; Holzapfel, 2014) in a monitoring and evaluation framework fills in a hiatus that is to expedite this very paradigm shift. Additionally, it is to benefit both HWTS programs and the academic discussion surrounding HWTS and its merit in making SDG #6.1 a reality.

2) Research Framework

Considering the importance of Outcome Mapping within the WaSH sector in the IDC field and its merit in facilitating more sustainable notions of development, this research focuses on creating an innovative HWTS Outcome Mapping framework, one that ambitions to shed light on outcomes existing both in a beneficiary population as well as those existing in different boundary partners. The focus is HWTS, for the research locus is that of a project comprising large-scale provision of water filters through a market-based approach in Malawi and Ethiopia. In Malawi the HWTS program is in its inception phase. In Ethiopia, a pilot for the program was performed in an 80,000-inhabitant town called Finote Selam, in Amhara Region. In Finote Selam, approximately 1500 filters have been sold between December 2016 and June 2018. The research focuses on assessing the beneficiary- and boundary partner outcomes of the Ethiopia and Malawi HWTS program, before critically assessing the methodology to do so. These beneficiary outcomes are subsequently translated to the Outcome Monitoring Framework, as presented by Earl, Carden, and Smutylo (2001), in order to provide a means to monitor boundary partner outcomes for the merit of realizing the beneficiary outcomes. This process envelopes the HWTS Outcomes Assessment Framework that can potentially be extrapolated to other market-based HWTS programs. The research objective thus is the creation of an HWTS Outcome Monitoring Framework that delineates beneficiary outcome ambitions of an HWTS program, as well as performing monitoring and evaluation of boundary partners outcomes to arrive at these outcomes. The subsequent research question therefore is: How do you best map and monitor outcomes for HWTS programs? It is ambitioned for the produced framework to subsequently be extrapolated to other HWTS interventions, for the merit of furnishing proof of contribution to development outcomes. The sub questions are devised accordingly:

- What beneficiary outcomes can the HWTS program in Malawi and Ethiopia produce?
  - What beneficiary outcomes has the HWTS program in Finote Selam, Ethiopia, produced?
- What are the most relevant indicators to measure identified beneficiary outcomes?
- What potential negative outcomes might be found in Malawi and Ethiopia?
  - What potential negative outcomes have been found in Finote Selam, Ethiopia?
- What boundary partner outcomes are necessary to arrive at the identified beneficiary outcomes?

These sub questions are answered through literature analysis, talking to experts in the field and findings from the research in Ethiopia and Malawi.

The research is conducted in different regions in Ethiopia and Malawi. The reasons for choosing these 2 countries are 3-fold:

1) Both countries have significant drinking water problems that Aqua for All, my thesis host organization, is ambitioning to solve through an elaborate market-based HWTS program.
2) Both countries have high levels of government HWTS endorsement, with signed policy documents endorsing HWTS use as a solution for the significant drinking water problems that exist in both countries.
3) Ethiopia and Malawi are very different in economy and politics, making for a compelling comparison in terms of monitoring and evaluation for an HWTS program, making for a more complete and exhaustive monitoring and evaluation framework that is to be derived from the research.

4) Background information

In Malawi, research was performed in 8 different areas:
In Lilongwe:

1) Area 23
2) Area 24
3) Area 25
4) Area 36

In Kasungu:

5) Kaomba
6) Kawamba
7) Santhe

And in 8) Mzuzu.
In Ethiopia, research was performed in 3 different area's:

1. Amhara Region, West Gojjam Zone, Finote Selam
2. Amhara Region, East Gojjam Zone, Debre Markos
3. Amhara Region, Agew Awi Zone, Injibara

The 8 areas of inquiry in Malawi were based on their potential for market-based distribution of household water filters – for the household water filters to be in demand and have potential for effectuating merit in the lives of the people. Through talking to individuals from (potential) program partner organizations such as Vitens Evides International,[5] WaterAid,[6] United Purpose,[7] UNICEF,[8] and PumpAid,[9] who are all active in Malawi, and through talking to local inhabitants, these decisions were made and the potential development outcomes for the program were discussed. Upon inception of the research, the official HWTS program in Malawi as ambitioned by Aqua for All, officially called the Safe Water for All in Malawi (SWAM) program, was in its inception phase and not yet developed, with the program officially starting in early 2018. The uncovering of potential outcomes thus also served as a stepping stone for deciding where to implement a pilot for the SWAM program. Notwithstanding this inception phase, household water filters were already being sold successfully on a small scale in Lilongwe area 25 and 36, Kasungu, and Mzuzu (figure 18; figure 19), through local entrepreneurs facilitated by PumpAid[9] and the SMART Centre Mzuzu,[10] which did already show the potential for the program to be successful. At Aqua for All, Hester Foppen is responsible for leading the program.

[5] www.vitensevidesinternational.com/
[6] https://www.wateraid.org/uk/
[7] https://united-purpose.org/
[8] https://www.unicef.org/
[9] www.pumpaid.org/
[10] http://www.smartcentremalawi.com/

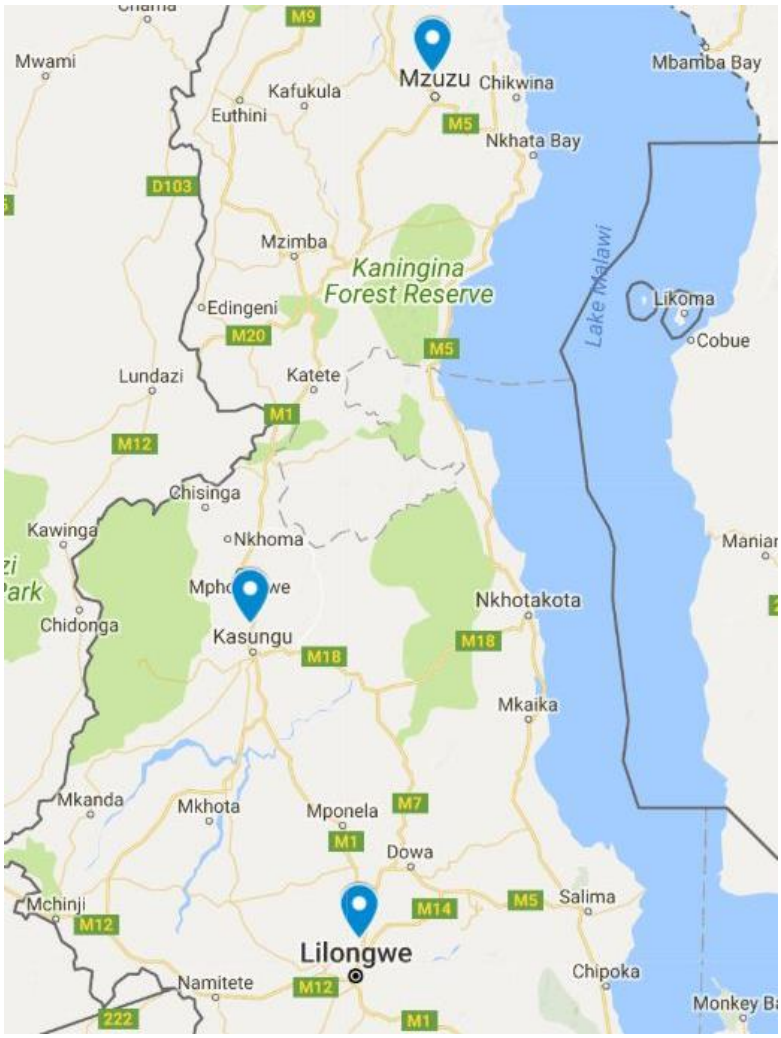

Figure 19: areas of research in Malawi/pilot areas for the SWAM program in Malawi.

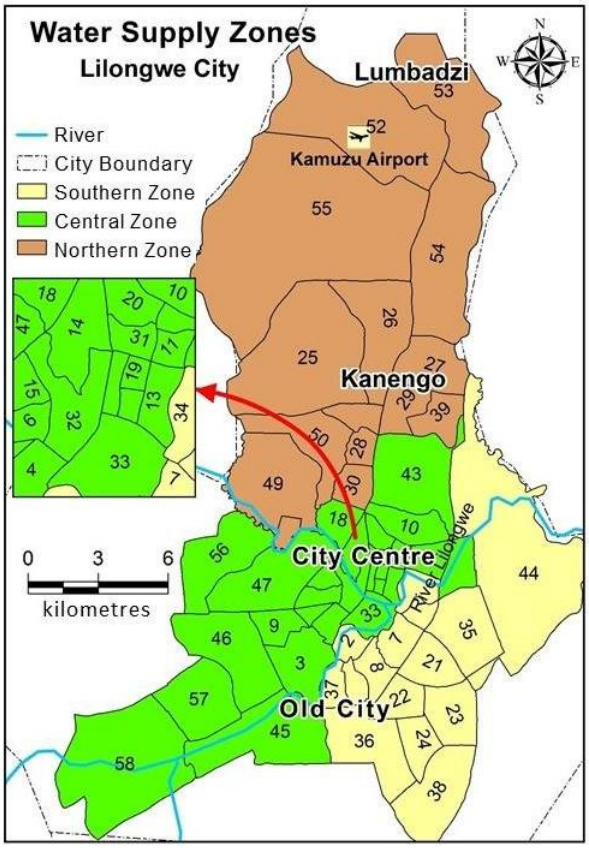

Figure 20: Map of Lilongwe showing locations of relevant areas. Source: www.researchgate.net.

In Ethiopia, where the program is already in full swing and household water filters are being sold through Ethiopia's many water utilities, 1,000 bigger utilities and 17,000 smaller utilities as reported by water numerous utility officials, the program is officially known as a 'Utility-Led Service Delivery Model for Safe Water at Point of Use.' Research locations were based on those locations where water filters were being sold through the relevant water utilities. The program started with a pilot in late 2016, in Finote Selam, a town with 80,000 inhabitants (as reported by staff of its water utility) in West-Gojjam zone in Amhara region. After this pilot was found to be successful and the approach of selling the water filters through water utilities, allowing people to pay for the household water filter through their water bill was found to be effective, as the program also started to take shape in Malawi, the approach was also expanded to Debre Markos in East-Gojjam zone and to Injibara in Agew Awi zone in Amhara region (figure 21), selling the household water filters through their respective utilities. In Ethiopia, the program is also led by Hester Foppen, in close collaboration with local consultant Gashaye Chekol Yihunie, who is based in Addis Ababa.

Figure 21: areas of research in Ethiopia/areas of distribution for the Ethiopia Utility-Led Service Delivery Model for Safe Water at Point of Use Program.

Malawi

Between 2000 and 2015, urban and rural coverage of at least basic services of drinking water and sanitation services has increased especially for Malawi's urban population. In terms of at least access to basic drinking water services, there exists a large difference between the urban and the rural setting, with urban coverage being notably higher. This difference between rural and urban settings is less extreme for at least access to basic sanitation services.[11]

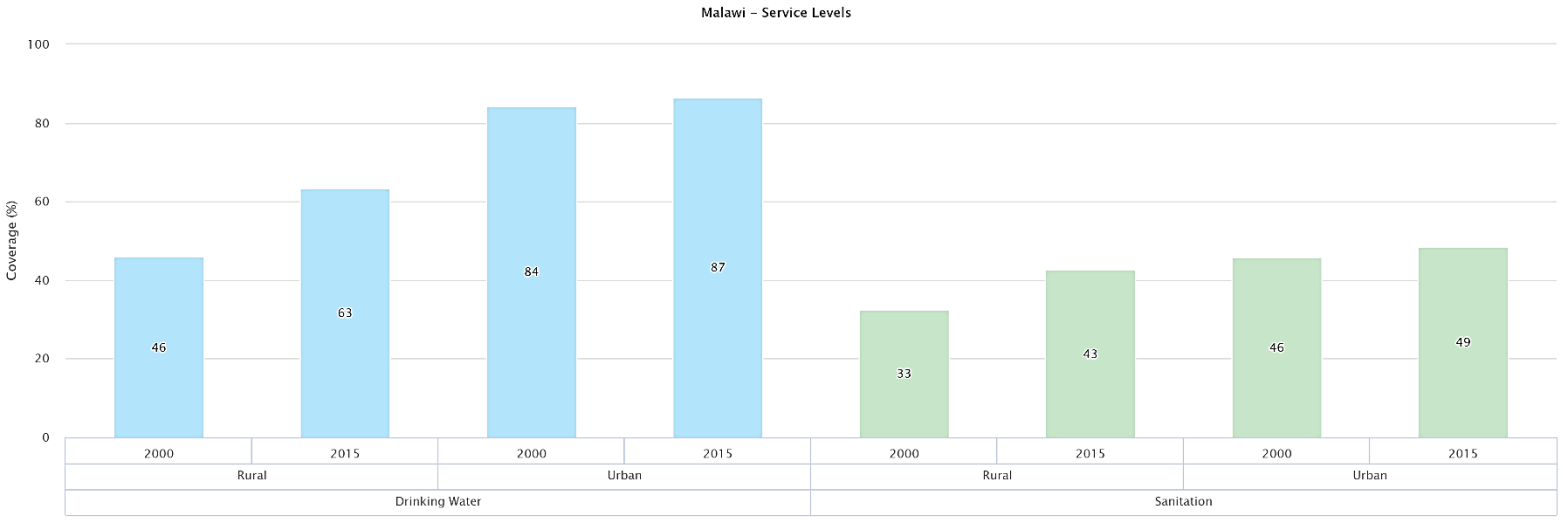

Figure 22: At least basic services coverage for drinking water and sanitation facilities in Malawi. Source: WHO Joint Monitoring Program (2015).

[11] Washdata.org.

Basic drinking water services are conceptualized as:

Service Level	Definition
Safely Managed	Drinking water from an improved water source that is located on premises, available when needed and free from fecal and priority chemical contamination.
Basic	Drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip, including queueing.
Limited	Drinking water from an improved source for which collection exceeds 30 minutes for a round trip, including queueing.
Unimproved	Drinking water form an unprotected dug well or unprotected spring.
Surface Water	Drinking water directly from a river, dam, lake, pond, stream, canal, or irrigation canal.

Figure 23: Service levels of drinking water services. Source: WHO Joint Monitoring Program (2015). Note: improved sources include: piped water, boreholes or tube wells, protected dug wells, protected springs, and packaged or delivered water.

Basic sanitation services are conceptualized as:

Service Level	Definition
Safely Managed	Use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or transported and treated offsite.
Basic	Use of improved facilities that are not shared with other households.
Limited	Use of improved facilities that are shared between two or more households.
Unimproved	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines.
Open Defecation	Disposal of human feces in fields, forests, bushes, open bodies of water, beaches or other open spaces, or with solid waste.

Figure 24: Service levels of sanitation services. Source: WHO Joint Monitoring Program (2015). Note: improved facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines, ventilated improved pit latrines, composting toilets or pit latrines with slabs.

Malawi is one of the poorest countries in the world. It has approximately 18 million inhabitants with a Gross National Income of $320/year/capita in 2017. Approximately 10% of the population has access to electricity. [12] Life expectancy at birth currently is 61 years for males and 67 years for females, with a probability of dying between age 15 and 60 of 31.2% for males and 20.3% for females.[13] Total fertility rate in Malawi is down to an average of 4.4 children per woman, from 6.7 children in 1992. Nonetheless, Malawi is expected to reach a population of 45 million by 2050.[14] Self-reported literacy rates are 81% for males and 66% for females. Half of the rural population in Malawi is considered poor, i.e. living on less than $1.90 per person per day[3]. HIV and AIDS is a big problem in Malawi, with approximately 1 million of its inhabitants living with HIV.[15] The vast majority of Malawi's population, including in the capital city of Lilongwe, lives in mud huts with a thatched roof or one made from sheet metal. Unemployment is high throughout the country, which is especially dire considering Malawi's median age of 17.5 years.[16] Most Malawians are farmers, in the cities people are primarily involved in the selling of items. Bikes, called 'ijinga's' in the Malawian native language of Chichewa, are the main form of transport in Malawi, with many people (virtually always men) also offering bike rides on the back of their ijinga for a small fee. Also called 'The Warm Heart of Africa', Malawi is a very welcoming and safe country with little political unrest. One can move around the country freely and tribal conflict is minimal. Water filter distribution channels are not yet developed in Malawi. Malawi only has a small amount of water utilities (called water boards in Malawi), which means that the household water filters will not be distributed through these channels, as is the case in Ethiopia. Negotiations surrounding the employment and empowerment of existing entrepreneurs that are in the portfolios of partnering NGOs, however, are under way. This will imply that the business case surrounding the market-based provision of water filters will be exceedingly different in

[12] Data.worldbank.org
[13] www.who.int
[14] www.worldpopulationreview.com
[15] www.unaids.org
[16] www.worldometers.info

Malawi compared to Ethiopia, with more diverse and small-scale enterprises selling the water filters in Malawi, and a large number of different NGOs working together to carry out the program in a successful manner. This high NGO involvement can prove opportune considering the fact that Malawi has one of the lowest GNIs per capita in the world, prompting the likely necessity of extra funding for people to be able to afford the household water filter, ensuring a successful adoption of a market-based approach. Furthermore, the high NGO involvement can prove opportune for the feasibility of the program, as different channels can be tested and subsequently employed. This large number of different NGOs working together, as well as the employment of a large number of entrepreneurs selling the household water filters, however, can potentially make the program disordered, posing problems for adequate monitoring of sales and subsequent outcomes.

Malawi's capital city of Lilongwe is home to approximately 1.2 million people, of which the majority belongs to Malawi's main tribe, the Chewa.[17] This number is disputable, however, considering that Lilongwe is a very stretched-out city with unclear city boundaries and is subject to constant expansion at the hands of Malawi's high urbanization rate of nearly 17%[18]. There are barely any high-rise buildings and city planning is virtually non-existent, with 58 different areas, named 'area 1', 'area 2', etc. dispersed across the city without any apparent order or according to any chronological or geographical metric, as corroborated by Lilongwe's inhabitants. Area 23 and 24 happen to be bordering each other in the southeastern part of the city, while area 25 exists on the other side of the city in the northwestern part. NGO involvement in the country is very high, which can be seen by the large amount of NGO offices in Lilongwe. Consequently, most high-regarded forms of employment revolve around NGOs and foreign aid. It is argued by some that this high NGO involvement creates and caters to a culture of aid overdependence, a situation that is only expected to exacerbate at the hands of Malawi's massive population growth[13] and that ought to be averted by diversifying the Malawian economy and stimulating domestic economic growth (Mwanamanga, 2015).

Mzuzu is Malawi's third city, after Lilongwe and Blantyre in the south. Home to around 250,000 people,[16] Mzuzu is situated in an agricultural region where especially coffee is cultivated. The North is more mountainous than the rest of Malawi and home to the Tumbuka people. Individuals from this tribe tend to be higher educated than those from e.g. the Chewa tribe[19], which is exemplified by the well-regarded Mzuzu University, founded in 1999, and the Mzuzu Technical College, founded in 1958. Through these institutions, Mzuzu has a relatively skilled labor force of recent graduates, more so than that of Lilongwe. Mzuzu has an airport that is barely used, with overgrown runways and run-down facilities.

Kasungu, a centrally-situated district, comprises several smaller towns, of which the biggest is Kaomba, which is home to approximately 50,000 people and is often referred to as Kasungu town. Kaomba is the only urban area of the district, with most other towns being substantially smaller and very remote. Kawamba, for example, is a rural town in the district with no electricity or running water. The vast majority of its inhabitants are subsistence farmers, whose cattle roams freely across the town. Rainy seasons make life hard in these rural places, impeding transport to larger towns for supplies, washing away houses, and opening up the possibility for waterborne diseases to thrive as they are washed from the latrines into the wells and boreholes.

As mentioned before, the SWAM program is still in its inception phase. Plans for a pilot for the program in Lilongwe and in Kasungu (figure 19), however, are well underway. Through local entrepreneurs already in the portfolio of United Purpose[7], household water filters are to be sold. Aqua for All will grant at least part of the funds necessary to create a

[17] http://www.citypopulation.de/Malawi
[18] www.statista.com
[19] www.earth-cultures.co.uk

revolving fund; for these entrepreneurs to be able to buy stock and set up and develop their business through the profit they make from selling the household water filters. This revolving fund will be managed and steered toward appropriate entrepreneurs through United Purpose's microfinancing brainchild, CUMO.[20] With the Malawian government having signed the official decree endorsing and supporting the distribution of HWTS in Malawi to help solve the dire issues related to water quality, governmental support can be expected. The appropriate Ministries, that of Health and of Water, however, have yet to have a place in the program. It is ambitioned for health workers of the Ministry of Health to be HWTS agents, educating people on the household water filter, its advantages and its usage, and promoting it among the people in their working areas.

Incentivizing the private sector, the entrepreneurs, and, potentially, the Ministry of Health's health workers is performed by dividing a 20% profit margin among these parties. The household water filters in Malawi are expected to be sold for 11,000 Malawian kwacha, or 13.30 Euro; notably less than the 660 Birr or 20 Euro in Ethiopia. In dividing the profit margin, 5% goes to the private sector, 15% goes to the entrepreneurs. Involving the Ministry of Health's health workers would imply dividing the 15% profit margin among these parties, with 6% going to the entrepreneur and 9% to the health worker selling the filter. This '5-6-9 principle' was birthed in Ethiopia, which will be elaborated upon in the following section. CUMO is paid for their efforts through program budgets from both United Purpose and Aqua for All.

Ethiopia

Coverage of drinking water- and saniation services has remained relatively low in Ethiopia and lower than in Malawi (Figure 21; Figure 24). Urban coverage of access to at least drinking water has increased between 2005-2015 from 74% to 77%, rural coverage from 15% to 30%. Access to at least basic sanitation services has remained staggeringly low, with only 4% of Ethiopia's rural population and 18% of Ethiopia's urban population having access to at least basic sanitation services in 2015.

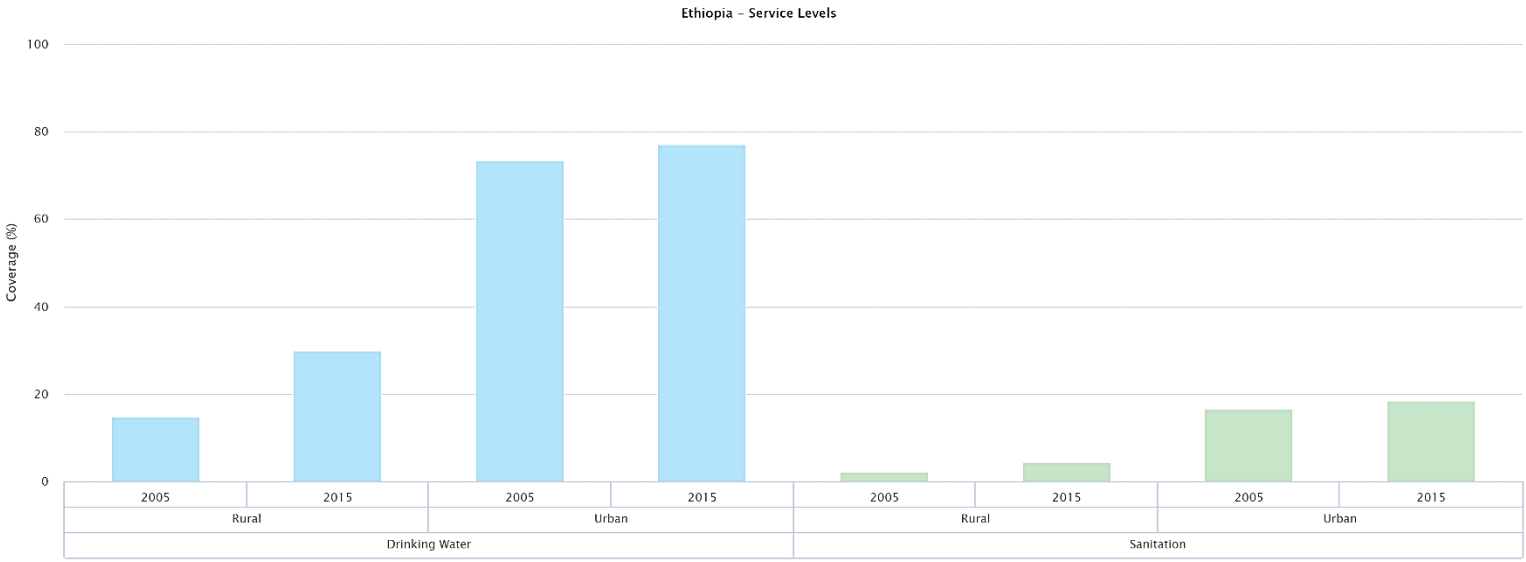

Figure 25: At least basic services coverage for drinking water and sanitation facilities in Ethiopia. Source: WHO Joint Monitoring Program (washdata.org).

Ethiopia is the tenth largest country and third largest landlocked country in Africa[21]. It is home to over 105 million people, making it the most populous landlocked country in the world[22]. Ethiopia has a Gross National Income per capita of

[20] http://www.mamn.mw/
[21] https://www.worldatlas.com
[22] https://www.cia.gov

$780/capita/year, making it notably richer than Malawi, yet still the poorest country in northeastern Africa. Its economic growth, however, has been one of the strongest in Africa for years, with economic growth figures averaging over 10% in the past 10 years. Life expectancy at birth in Ethipoia currently is 63.6 years for males and 67.4 years for females, up from 57.0 years and 60.0 years in 2007 respectively. In the past 20 years, Ethiopia's population has nearly doubled, its primary school enrollment has quadrupled, and child mortality has halved.[4] Notwithstanding this, nearly 8 million Ethiopians require emergency food assistance.[23] Ethiopia is politically extremely rigid, with representative leaders for different jurisdictions such as water and energy, infrastructure, education, etc. going from national bodies, to regional (such as Ahmhara region, which is home to approximately 32 million people) to zonal (such as West-Gojjam, which is home to approximately 4.5 million people), to woreda (similar to a municipality) to kebele (Ethiopia's smallest administrative unit, which requires at least 2,000 people to come into effect). This rigidity is enforced to combat corruption, which, notwithstanding the impressive stature of Ethiopia's political rigidity, especially considering the vastness of the country and its enormous population, remains rampant.[24] For the program, Ethiopia's political rigidity effectuates both opportunity and difficulty. It grants the opportunity to sell the household water filters through Ethiopia's many water utilities (approximately 1,000 larger ones and 17,000 smaller ones), where people can pay for the water filter in installments through their water bill, which makes for a unique and highly effective business model. Notwithstanding this, it also makes the program and its success highly susceptible to change in these water utilities. New water utility managers, who are changed often by effect of higher administrative bodies, could potentially not be on board with the program or not regard it a priority, impeding the success of the program. Dedication to the program and motivated individuals at participating water utilities are imperative to the success of the program in general. At the hands of its political instability, something the Ethiopian people are not unaccustomed to, important zonal leaders, utility managers, etc. can be displaced and continuity of the program can be endangered spontaneously. This is a highly pertinent issue not only for the program's success, but also for this research, as continuity of a program and the development achievements it helps achieve is imperative to the creation of outcomes and the subsequent monitoring thereof.

Community institutions are extremely important in Ethiopia and make up a large part of the sociopolitical system existing in the country. Institutions such as Idir, which is a group of people in a community that collectively raise money for emergencies such as deaths or illness (like insurance) and Iquib, which is established to raise money for providing substantial rotating funds to improve people's lives and living conditions, have been around for millennia. Iquib helps people to raise funds for a marriage, building a house, or starting a business. Idir is, next to a community safety net, a vehicle for people to convene monthly and discuss important matters pertaining to their community (Bekerie, 2003). It is thus vital for the effectiveness and the sustainability of the market-based HWTS program to adequately incorporate these community institutions into its agenda and for the program to be institutionalized adequately into these institutions and, subsequently, into the community. Currently, the program is in the early stages of carrying this out. High acceptance rates of both customers and government are proving promising in realizing effective institutionalization into Idir and Iquib.

In Ethiopia, as aforementioned, the Utility-Led Service Delivery Model for Safe Water at Point of Use program is already in full swing, with approximately 3,000 filters sold as of July 2018 among these 3 locations; 1,500 in Finote Selam, 500 in Debre Markos, 300 in Injibara, and a further 700 to smaller water utilities in smaller towns across the 3 regions. An important pillar of the program is the '5-6-9 principle', which entails that the 20% profit margin of the filter is divided by granting 5% to the private sector, 6% to the bigger water utilities, that of Finote Selam, Debre Markos, and Injibara, and 9% to the smaller water utilities or health workers selling the filter. If customers buy their household water filter directly from a bigger water utility, 14% of the profit is going to the bigger water utility. This division was found to adequately

[23] www.usaid.gov

[24] https://www.transparency.org/country/ETH

cover costs and leave every relevant part of the household water filter supply chain with a good profit, helping to incentivize them for further sales to be realized.

The program started with a pilot in Finote Selam in 2016. Finote Selam was chosen for a pilot because its water utility is known for its high performance and respected across the region, having won numerous awards for its service to the town. Finote Selam is a quickly growing town. Consequently, water provision through household connections is quickly expanding. This expansion is posing issues regarding the assurance of safe water provision. Furthermore, drinking water is often overchlorinated, as it proves difficult to administer adequate amounts, and it is often preferred to overchlorinate the water than run the risk of underchlorinating it. The Uility-Led Service Delivery Model for Safe Water at Point of Use was thus introduced as an intermediate solution, guaranteeing safe water at point of use, facilitated by the water utility, while the water utility works on assuring continuous provision of safe water through its pipes. The program pilot incorporated 3 different water filters:

1. The Sawyer membrane filter:

Figure 26: Sawyer membrane filter. Source: sawyer.com
Produced by Sawyer and distributed by Gemshat Household and Office equipment Importer PLC, Ethiopia.

2. The Tulip Siphon Filter:

Figure 27: Tulip Siphon Filter. Source: www.basicwaterneeds.com
Produced by Basic Water Needs (BWN).

3. The Tulip Table Top Filter:

Figure 28: Tulip Table Top Filter. Source:www.basicwaterneeds.com
Produced by Basic Water Needs (BWN).

The Tulip Table Top was found to be the most successful product of the 3 in Ethiopia, with the vast majority of respondents preferring it over the 2 other options. Consequently, the Utility-Led Service Delivery Model for Safe Water at Point of Use continued with only the Table Top Filter, with other potential filters being able to also penetrate the market in a later stage of the program.

Finote Selam is a quiet town in the center of Amhara region (Figure 20). With Amhara region being viewed 'the kitchen of Ethiopia', many of its 80,000 inhabitants farm outside of the town, growing vegetables and Ethiopia's staple crop, coffee. Research in Finote Selam was conducted in late march 2018, when the then-ruling government called out an emergency situation, authorizing the military to restore security throughout the nation, blocking roads, and shutting down internet connectivity in the entire country, with the exception of the capital city of Addis Ababa. This, however, did not translate into major upheaval or tension in Finote Selam. Coming back to Ethiopia in late June for research in Injibara (figure 20), I briefly visited Finote Selam. The hope for change that could be felt in March was answered and embodied in the new prime minister Abiy Ahmed. During this time, a massive but very peaceful demonstration was called and thousands were on the streets of Finote Selam to show their support to the new prime minister, their frustration with the old political situation, and their hope for substantial political transformation in the near future.

Figure 29: Demonstrations showing support for Abiy Ahmed, July 2018. Source: own photo.

Debre Markos, a city in East-Gojjam zone (Figure 20) joined the program in early 2018. The city has more extensive water provision problems than Finote Selam, with water sometimes not being available for over a week. Debre Markos has approximately 140,000 inhabitants, making it substantially larger than Finote Selam (Andarge 2017). At the time of assessment, in March 2018, approximately 500 Tulip Table Top household water filters (figure 27) had been sold in Debre Markos. Political instability and its effect on the continuity of the program was exemplified pertinently in Debre Markos, where 3 different water utility managers where put in place within the span of a year. The city is growing fast but is facing ample challenges regarding the continuous provision of drinking water, with water not flowing through the city pipes for up to a week at a time, as reported by its citizens.

Injibara, a city in Awi zone, joined mid-2018, just before the research had been conducted. Injibara is home to approximately 120,000 people, comparable to Debre Markos[25], and is expanding fast, even more so than towns such as Debre Markos, as reported by different employees of the Injibara water utility, including the manager. The city has water challenges different from Finote Selam and Debre Markos: the water is salty. Especially from 1 of 2 boreholes the water utility uses to pump water from, the water is excessively salty. As a solution, the water between the two boreholes is mixed. This, however, still leaves the water relatively salty, resulting in salty debris forming on taps and in pipes. Injibara officially joined the program in late July 2018, even after the research was already conducted there in early July. In spite of this, approximately 300 filters had already been sold in and around Injibara by the Injibara water utility, which were bought by the Injibara water utility from the Finote Selam water utility. Buyers reportedly heard about the filters through family members from Finote Selam and Debre Markos and went to the Inibara water utility to inquire on the possibilities for them to purchase them as well.

The Theory of change devoted to the Ethiopia program, devised by Aqua for All's Hester Foppen, is divided into parts of Demand, Supply, and Enabling Environment. The program has an objective conceptualized as 'All Ethiopians have access to safe drinking water at point of use', with a long-term impact of 'Increased health and economic well-being of the Ethiopian population.'

Outcome	**Households of different income groups in Ethiopia correctly and consistently use water filters**			
Intermediate Outcomes	Households are willing to invest in physical filtration at household level	Households are demanding water filters	The government is aware that distribution of filters through a business case will help them to reach their targets	The Health Sector is willing to support utilities in the process of demand creation
Intermediate Outcome	Zonal Water Authorities accelerate the distribution of physical filters to household level			
Outputs	Households are informed about the health risks of pathogens in untreated water	Households know that treating water makes water safe to drink	Regional and local government engages Health-, Water, and Education Sectors in the promotion of safe water at point of use	Health practitioners are aware of the availability of HWTS options
Problem Descriptions	Households suffer from waterborne diseases	Households are unaware of the solutions to prevent waterborne diseases	The government of Ethiopia has little awareness on mechanisms to ensure safe water at point of use	The Health Sector has little awareness on the availability of household water filters to prevent waterborne diseases
	DEMAND SIDE			

Figure 30: Theory of change Ethiopia HWTS program, demand side. Source: Foppen (2018).

[25] www.tageo.com

Outcome	**There is an extended and sustainable supply chain in Ethiopia for different household water filters reaching end-users in urban and rural areas**			
Intermediate Outcomes	Utilities take an active role in the promotion and sales of filters as a profitable business	A variety of affordable household water filters are available at local level		Physical filters are accessible and affordable for lower-income households
Intermediate Outcome	Government, water utilities, microfinancing institutions, and suppliers are willing to offer different payment options to enable the purchase of filters			
Outputs	Utility Boards are aware of the quality issue and of their responsibility to ensure safe water at point of use	Suppliers ensure the local availability of household water filters, spare parts, training, and user manuals	The government lowers taxes and prioritizes forex for physical filters	Payment mechanisms are developed to make filters affordable
Problem descriptions	There is little or no focus of water utilities on addressing water quality issues	The private sector suppliers of household water filters are unable to reach end-users	The sales price of household water filters is high because of forex and import tax	Household water filters are not affordable for all income groups
	SUPPLY SIDE			

Figure 31: Theory of change Ethiopia HWTS program, supply side. Source: Foppen (2018).

Outcome	**Outcome payers enable suppliers and intermediaries to sustain and increase the market for filters**		
Intermediate Outcomes	NGOs engage in making filters affordable for all without distorting the market	Agreements with outcome payers are made concerning evidence-based payments	There is a functioning monitoring system in place
Intermediate Outcomes	NGOs are willing to engage in a market-led approach	Outcome payers are willing to engage in payment for consistent use of filters	There is a monitoring system in place which will suffice for Carbon Credits and other outcome payment
Outputs	NGOs are aware of the negative impact of subsidies on household water filters	Outcome payers are identified and approached to pay for outcomes after evidence is created	Agreements are made around evidence creation through monitoring: tasks, responsibilities, and costs are identified
Problem Descriptions	NGOs give subsidies on household water filters, which distorts the market	Promotion and distribution of filters depends on donor funding	There is no monitoring of safe use of water at household level
	ENABLING ENVIRONMENT		

Figure 32: Theory of change Ethiopia HWTS program, enabling environment. Source: Foppen (2018).

This Theory of Change, however, was made from a perspective of legitimizing the merit of the program to a donor. This can raise questions surrounding the potential prioritization of donor demands rather than using the Theory of Change as a means to rationalize Aqua for All's efforts into achieving the ambitioned vision of all Ethiopians having access to safe drinking water at point of use, as discussed by Stein and Valters (2012).

Ethiopia's political and administrative rigidity is in stark contrast to Malawi as a country in general and Lilongwe's capricious expansion and apparent dearth of city planning in particular. Employing water utilities as distribution channels in Ethiopia is posing both unique opportunities as well as challenges, opportunities and challenges that are completely different from those in Malawi, where water utilities are not (yet) engaged and a large number of different NGOs will have to work in synergy and empower local entrepreneurs to sell the household water filters. Notwithstanding the managerial challenges inherent to realizing an effective synergy between a large number of NGOs and the local entrepreneurs they empower and employ, high NGO involvement is, through installment of complementary funds, likely to aid in overcoming the exigent issue of setting up a market-based distribution scheme in one of the poorest countries in the world.

5) Method

The research is divided into two parts; that of Ethiopia and of Malawi. In Ethiopia, research was conducted between March 17th and April 1st and between June 24th and July 5th 2018. In Malawi, research was conducted between June 2nd and June 24th 2018. In both research locations, the research was of both a quantitative and a qualitative nature, performing interviews as well as surveys. Furthermore, many meetings with NGOs, community institutions such as block leaders and female working groups, and government institutions such as the Ministry of Health and the Ministry of Water were held in Malawi, and many meetings with water utilities, community institutions such as Idir, and government institutions such as zonal administrative bodies of Water and of Health were held in Ethiopia. These meetings helped sketch the institutional context of the program both in Malawi and in Ethiopia, and with the subsequent sketching of achieved and ambitioned boundary partner outcomes. In order to produce the HWTS Outcome Monitoring Framework, an account of beneficiary outcomes relevant to the program is conceived through quantitative assessment. To provide an account of the contribution to these beneficiary outcomes and uncover the relevant boundary partner outcomes to produce and expedite these beneficiary outcomes, qualitative assessment is employed, through interviews with the beneficiary population and meetings with relevant institutional bodies (Roduner & Schläppi, 2008). An assessment of (potential) outcomes is thus sketched, employing Outcome Mapping to weave together, firstly, boundary partner outcomes, i.e. the changes in the behaviors, actions, activities and/or relationships of the people, groups, and organizations in the direct sphere of influence, secondly, the strategies that are employed in the program to encourage change, and thirdly, the internal effectiveness of the program (Earl and Carden, 2002). Both in Ethiopia and Malawi, in situ water quality tests, testing for E. coli per 100mL, were performed, elaborated upon in the Results section. Logic behind the application of these in situ tests was not of an outcome nature, but rather one of verifying the legitimacy of the uptake of household water filters in the first place, furnishing proof of E. coli levels in important drinking water sources. In summary, the performed surveys and interviews and their relevant dates of assessment are as follows:

Date	Country	Location	Assessment
03/17/2018 – 01/04-2018	Ethiopia	Finote Selam	Surveys; interviews
		Debre Markos	Surveys; interviews
04/01/2018 – 24/07/2018	Malawi	Lilongwe, area 36	Interviews; E. coli tests
		Lilongwe, area 23 & 24	Surveys; interviews; E. coli tests
		Lilongwe, area 25	Surveys; interviews; E. coli tests
		Kasungu area, Kaomba	Surveys
		Kasungu area, Kawamba	Surveys; E. coli tests
		Kasungu area, Santhe	Surveys
		Mzuzu	Interviews
06/25/2018 – 07/05/2018	Ethiopia	Injibara	Surveys; E. coli tests
		Debre Markos	E. coli tests
		Finote Selam	E. coli tests

Figure 33: Timeline of research.

Sampling Strategy

Research was performed on household level. Mostly women were surveyed and interviewed, as they were the ones regarded as responsible for the provision of drinking water in the households, were found to be and regarded as most knowledgeable regarding the topic of drinking water, and were most often prompted by e.g. husbands or children to answer the questions. Sampling in the research was performed through stratified random sampling, stratified according to location and subsequent shared characteristics pertaining to (potential) outcomes for HWTS intervention. Different research locations demonstrate different welfare levels, socioeconomic and -political settings, degrees of access to infrastructure, population densities, and water-related challenges. Consequently, comparison of these groups allows for

the sketching of an elaborate account of the potential outcomes produced by an HWTS program and the situational factors important therein. Stratified sampling allows for observation of existing relationships between the different locations of research, i.e. strata, which were found to differ extensively in terms of aforementioned characteristics (Dawson, 2005). A simple random sample was taken from each of the strata. Representativeness in terms of the population for each of the strata was upheld as much as possible but not prioritized, considering the extensively multi-faceted nature and consequent necessity of complementary qualitative data in outcome monitoring of HWTS programs (Holzapfel, 2014; Smutylo, 2005).

Randomness of sampling was upheld by taking an area of research and diversifying the sample as much as possible in terms of where the house is situated (conducting surveys and interviews dispersed around a locus of research), respondent age, and income (as predetermined by assets of the house). This was verified by asking the ages of the relevant household members and the type of main income of the household and rendered conclusive differentiation of these factors.

Surveys and Interviews

In Ethiopia, a total of 294 surveys and 30 structured interviews were administered over 3 different cities; Finote Selam, Debre Markos and Injibara. In Finote Selam a baseline survey in December 2016 and a mid-term review in April 2017 had been performed by the local water utility, as part of the HWTS program in Ethiopia. As part of this research, a subsequent end-line survey is administered, to uncover which beneficiary outcomes are and will be a reality and thus be viable for monitoring. Structured interviews expound the processes related to realized outcomes and the attribution of the HWTS therein. As such, for Finote Selam, expected outcomes are described and put forward through the baseline survey performed in November 2016 and through literature. These outcomes are subsequently elaborated upon and respondents are assessed for more outcomes through qualitative assessment. This qualitative assessment further elaborates on contribution to these outcomes and how to make use of these findings. The results are substantiated through quantitative assessment, depicting trends in the outcomes.

Assessment of most salient outcomes was performed through quantitative research, delineated using the Logical Outcome Assessment Framework as presented by Roduner and Schläppi (2008). This assessment can be found in Appendix 1. These salient outcomes are subsequently complemented by the semi-structured interviews, enriching the data and unveiling those factors important in HWTS outcomes and the upscaling of HWTS administration. In Debre Markos, a baseline survey pertaining to potential HWTS outcomes was conducted and complemented by structured interviews in March 2018. In Injibara, an improved baseline survey was also conducted in June 2018 that combines quantitative and qualitative assessment in order to sketch a comprehensive account of the potential outcomes for HWTS administration.

In Malawi, an improved baseline study was performed, improved upon on the basis of findings in Ethiopia in March. In total, 8 different areas were incorporated in the research, with 110 surveys conducted across 6 different areas and 24 interviews conducted across 7 different areas. The survey was structured similarly to the three steps of Ethiopia. Furthermore, the in-depth semi-structured interviews with interviewees with different socio-economic characteristics and water-related challenges illustrate additional outcomes – which pertain chiefly to the beneficiary population but also produce necessary boundary partner outcomes - and elaborate on the different facets therein. Interviews in Malawi were coded due to their semi-structured nature. Interviews were coded using open coding, allowing for the uncovering of trends and the ability to compare and find relationship among different salient topics (Dawson, 2005).

Data analysis

Data from the surveys was analyzed using akvo Lumen, a data analytics tool developed by akvo Lumen, complementary to akvo FLOW, its survey tool, and akvo Caddisfly, its water quality evaluation tool. Considering the extensively multi-

faceted nature of outcome monitoring and the inability to attribute outcomes to a specific intervention Holzafel, 2014; Smutylo. 2005), regressions are not used in this research. Instead, patterns are sought to sketch an account of outcomes to monitor for and the means to do so are investigated.

Research Ethics

All respondents in both the surveys and interviews in Malawi and Ethiopia will be given full anonymity. Their privacy is protected completely and all responses are completely confidential. Consent is conveyed through inclusion of a statement in the surveys, which because of its complete anonymity negates the necessity of signed participant consent (UWA, 2018). All interviewees are inquired on their consent at the inception of every individual interview. All respondents have the right to withdraw from the research at their desire. All respondents are informed truthfully of the ambitions of the research and their role therein. All potential harm is mitigated as much as possible, preventing potential psychological or social harm occurring as a result of participating in the research.

6) Results

The results section is divided into two parts; that of Malawi and Ethiopia. In both parts, ambitioned and/or expected beneficiary outcomes are first put forward, which are derived from the literature and the performed surveys and interviews. These beneficiary outcomes are subsequently related to their relevant boundary partner outcomes, in order to see which boundary partner outcomes to monitor for in order to achieve the beneficiary outcomes. Secondly, the methodology to assess these beneficiary- and boundary partner outcomes is critically reflected upon. Thirdly, these boundary partner outcomes, premised to realizing the ambitioned beneficiary outcomes, are mapped in the Outcome Mapping Framework. This comprises the first stage of the 3 stages of Outcome Mapping, with relevant outcome challenges for relevant boundary partners illuminated therein, as presented in the Outcome Monitoring Framework byRoduner & Schläppi, 2008. Appropriating the Outcome Mapping Framework specifically to HWTS, specifying the outcome challenges for boundary partners and their respective parameters necessary for attaining beneficiary outcomes, establishes the HWTS Outcome Monitoring Framework.

Results Malawi

Average household size in the 110 surveyed households in Malawi is 5.44 persons. 40 out of 110 have retail as a main source of income, conceptualized as selling any type of item. 42 out of 110 do not work in retail nor are farmers, mainly doing ‘piece works’, which implies doing any form of labor for one day and receiving payment at the end of said day, or are unemployed. Main source of drinking water was found to differ significantly among the 8 different assessed parts of Malawi. For example, in area 25 in Lilongwe, drinking water was mainly coming from household connections, with 16 out of 19 surveyed households reporting using a household connection as their main source of drinking water. In area 23 and 24 in Lilongwe, 10 out of 22 respondents mentioned getting their water from water kiosks, with only 3 respondents getting their water form household connections. In Kaomba, the urban part of Kasungu area, 12 out of 19 respondents mentioned getting their water from a household connection. These household connections were not present in the other, rural assessed parts of Kasungu area, named Santhe and Kawamba. In these areas, out of 50 respondents, 27 use a borehole as a main source of drinking water, 7 use a water kiosk, the remaining number uses (un)protected wells or another source.

Source of drinking water was found to heavily correlate with amount of time spent fetching water. Household connections were left out of this aggregate, as these all reported spending less than 15 minutes to go their water source, fetch water, and come back.

	What is the main source of drinking water for your household?					
How long does it take to go there, get water and come back?	**Borehole**	**Water kiosk**	**Unprotected well**	**Surface water**	**Other…**	**Total**
<15 minutes	21	12	12	0	8	53
15-30 minutes	6	2	3	0	0	11
30-60 minutes	3	4	1	0	1	9
60-120 minutes	1	1	0	1	2	5
120+ minutes	1	0	0	0	0	1
Total	32	19	16	1	11	79

Figure 34: Main source of drinking water vs. time fetching water in all surveyed parts of Malawi.

Taking much time to go to a water source, fetch water, and come back was especially salient in area 23 and 24 in Lilongwe, where many people take, as aforementioned, take their water from water kiosks. Of this time, the following chart depicts the time spent in a queue waiting at the water source. 'No data' represents those having a household connection, thus not having to queue. Only one respondent mentioned not having to queue at all. Same as time spent going to a water source, fetching water, and coming back (figure 33), the initial maximum category of queueing, 30+ minutes, was later expanded to 30-60 minutes and 60+ minutes, as it was found that queueing for such long periods is no rarity. The majority of respondents, however, only queues for 1-10 minutes, which is in line with the majority of respondents spending less than 15 minutes fetching water (figure 33). 6 out of 22 respondents mentioned having to queue for over 30 minutes.

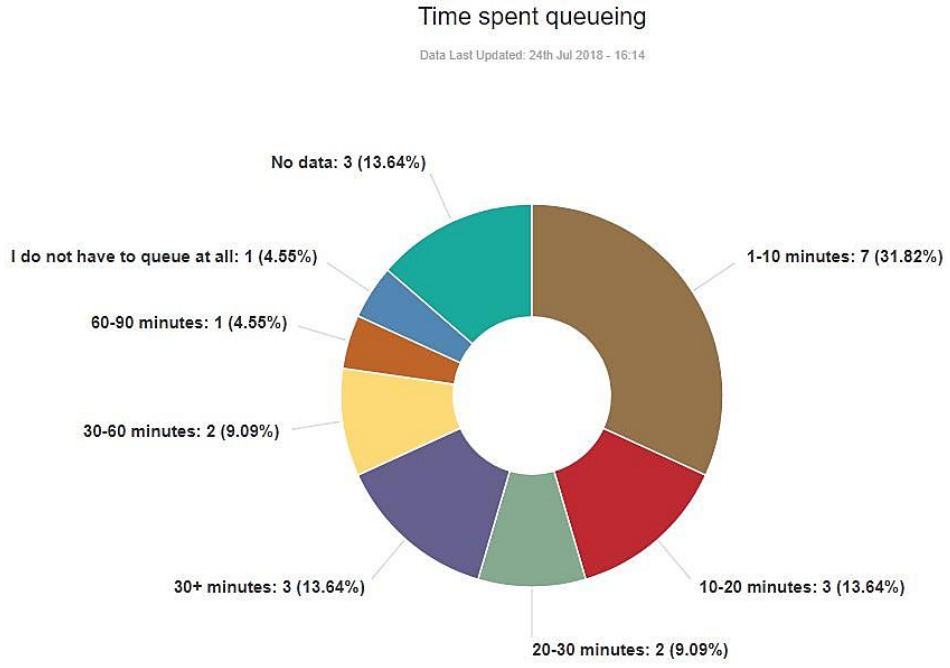

Figure 35: Time spent queueing for drinking water in Lilongwe, area 23 and 24.

This means that 22 respondents in area 23 and 24 in Lilongwe spent a total of between approximately 360 and 735 minutes fetching water for one +/- 20L bucket, of which between approximately 287 and 490 minutes were spent queueing. For each respondent, this means an average of between approximately 16 minutes and 33 minutes spent fetching water, of which between approximately 13 minutes and 22 minutes spent queueing.

$$Average\ time\ spent\ fetching\ water\ per\ trip = \frac{360<x<735}{22} = 16 < x < 33\ minutes$$

$$Average\ time\ spent\ queueing\ per\ trip = \frac{287<x<490}{22} = 13 < x < 22\ minutes$$

The following chart depicts the average time spent fetching water by respondents. The majority of respondents, 9 out of 22, fetch water over 5 times per day. If this number is counted as simply 5 times, $\bar{x} = 4.41$. This makes the average time spent fetching water per day and average time spent queuing per day for every inquired household in area 23 and 24 in Lilongwe:

$$Average\ time\ spent\ fetching\ water\ per\ day = 4.41 * \frac{360<x<735}{22} = 70.6 < x < 145.5\ minutes$$

$$Of\ which\ average\ time\ spent\ queueing\ per\ day = 4.41\ \frac{287<x<490}{22} = 57.3 < x < 97\ minutes$$

Times per day fetching water	Amount of respondents in Lilongwe, area 23 and 24
2	1
3	3
4	4
5	5
5+	9

Figure 36: Times per day fetching water in area Lilongwe, area 23 and 24

In 103 out of 110 surveyed households, the female adult was responsible for fetching water for the household. Notions of females spending a lot of time on fetching water were corroborated by interviews. It was reported that "the biggest concern is time, we spend so much time fetching water." (interviewee 10, area 24 Lilongwe). This concern over time can by and large be attributed to the fact that water often has to be fetched 5 or more times per day: "We spend 5 times 1 hour fetching water, so 5 hours a day" (interviewee 10, area 24 Lilongwe). This, however, seems to only be the case in densely populated areas without household connections, such as areas 23 and 24 in Lilongwe.

The majority of respondents reported buying no or at least less than 3L of bottled water per week:

Amount of bottled water per week in household	Number of respondents
0-3 Liters	57
3-6 Liters	16
6-9 Liters	15
9-12 Liters	5
12-15 Liters	8
15+ Liters	9

Figure 37: Amount of bottled water purchased per week in the household.

When inquired on the source of drinking water when one is outside of the house, 45/110 respondents mentioned carrying water from home, 30/110 respondents mentioned drinking bottled water. Were this custom of bringing water from home be continued upon adoption of drinking filtered water, it would mean less exposure to other, potentially contaminated sources. More respondents having a household connection reported buying bottled water regularly than those using e.g. a borehole as a main source of water. Notwithstanding the notion that those having a household connection are expected to be financially better off than those fetching water from e.g. a borehole, this indicates that respondents receiving drinking water from a household connection do not regard this as the 'cleanest' option, consuming bottled water as a preferred alternative.

	What is the main source of drinking water for your household?					
How much bottled water do you buy per week in Liters?	**Borehole**	**Household Connection**	**Surface Water**	**Unprotected Well**	**Water Fountain**	**Other…**
0-3 Liters	20	6	1	12	0	5
3-6 Liters	3	3	0	2	1	0
6-9 Liters	4	8	0	2	0	0
9-12 Liters	2	1	0	0	0	0
12-15 Liters	1	6	0	0	0	0
15+ Liters	1	2	0	0	0	6
Total	31	31	1	16	1	11

Figure 38: Main source of drinking water vs. amount of bottled water bought per week.

In area 23 and 24 in Lilongwe, 6 out of 22 respondents mentioned buying more than 15L+ of bottled water per week in their household. One 1L bottle of water costs 500 kwacha in Lilongwe. Thus, on the premise of this bottled water being sold in 1L bottles, a household consuming 15+ Litres of bottled water per week will spend 7500+ kwacha on bottled water per week.

Upon inquiring whether people treat their drinking water, 85 out of 110 respondents mentioned not doing so. When further asked why they refrain from doing so, most respondents mentioned in a fashion of not having to do so "because the water is already treated with chlorine" (respondent #29). In the rural towns of Kawamba and Santhe, however, where residents mainly get their drinking water from boreholes, respondents predominantly reported not treating their water "because we don't get any chlorine from the HSA <Health Safety Assistance> anymore but I did use to" (Respondent #54). The majority of respondents reported treating their water if they could: "There is no chlorine, otherwise we would" (Respondent #69). The severity of the scarcity of chlorine was underlined by respondent #84: "There is no chlorine, they only distribute once a year. Then we can only use it for one week. Only during the rainy season they supply it."

This notion could also be found in the interviews, where interviewees in Kawamba and Santhe mentioned that "the biggest problem related to water quality is the supply of chlorine; there is not any chlorine" (interviewee #16, Santhe). Respondents would put chlorine in the water from the borehole in their house, in order to guarantee its safety and prevent recontamination, but were unable to do so at the time of assessment, for chlorine was unavailable. "When we fetch water from the borehole we put chlorine in it in our house to keep it safe, but there is no chlorine available anymore" (interviewee #17, Santhe). Residents of Kawamba and Santhe thus currently rely on the Health Safety Assistance for them to provide them access to safe water, which is what the Health Safety Assistance was unable to do so at the time of assessment.

A similar pattern could be found in area 36 of Lilongwe. In this area, as part of a large UNICEF program, safe water was being sent by trucks to curb the spread of cholera, otherwise known as water bowsers.[26] Cholera is a recurrent problem in Lilongwe and in Malawi in general.[27] Cholera outbreaks have been occurring every year since 1998, which can be attributed to, among other things, "unsafe water sources, lack of maintenance of broken boreholes, frequent

[26] https://www.unicef.org/malawi/reallives_21348.html
[27] https://edition.cnn.com/2018/04/12/africa/malawi-cholera-outbreak/index.html

interruptions of piped water supply, low coverage of pit latrines, lack of hand washing facilities (<5%), salty borehole water, fishermen staying on Lake Chilwa, cross-border Malawi-Mozambique disease spread, and socio-cultural issues" (Msyamboza et al., 2016, p.2). Solving the problem through water bowsers, however, is very expensive. "For those villages without adequate water, water bowsers/tankers are used to supply the villages. Delivering water by tanker truck is very expensive. Sandy roads also make access difficult and hence the need to identify more sustainable sources of water" (Swatuk & Kgomotso, 2007). In area 36, people mainly get drinking water from the local boreholes. There are no water kiosks or household connections present in area 36. As such, safe water is scarce and people are often forced to drink water from unprotected wells, which are often contaminated (figure 39). "The borehole is too overcrowded. We fight for the water. What we do to solve it, we have no way. If the borehole is overcrowded we go home and get water from this <unprotected well> source." (interviewee #1, Lilongwe area 36). This knowledgeability on unprotected wells often being contaminated was found in the interviews as well. "This water is safe, it is from the borehole, it is protected. We've been drinking from it for a long time. No one has found any problems with the water. The other unprotected wells are bad. To solve it is through chlorine, which we have gotten from Lilongwe District, but not enough." (Interviewee #3, Lilongwe area 36). Interviewees were found to have high levels of understanding on water quality, but unable to do anything about the situation. "No, the water is not clean from disease. The biggest problem is that it is not chlorinated, so it is not safe. We do not get enough chlorine, we get it once per month." (Interviewee #1). "Some wells are close to latrines. It contaminates the water. This is a large concern. We get sick. Our main concern is that people contaminate the wells." (Interviewee #2, Lilongwe area 36). As such, water filter distribution could, in area 36 in Lilongwe, improve not only the situation on drinking water quality, but also lessen people's dependency on receiving chlorine form the Health Safety Assistance (HSA) and reduce the burden of this governmental institution to hand out chlorine, as the interviews in area 36 show that the handed-out chlorine is inadequate in quantity.

Notwithstanding respondents believing the water from the waterboard (i.e. water kiosks and household connections) is safe, water supply was reported to often be interrupted, with water not being available for an average of approximately 3 days per week. "The connection often dries up – 3 times per week. This happens to everyone, three days per week no water." "sometimes it will take 2 days before the water starts running again" (interviewee #10, Lilongwe area 24). As a solution, water from the kiosk or household connection is stored in a container for use during such times of water not being available. "When the water dries up we go to the well. We don't drink this. We store the water from the household connection" (interviewee #14, Lilongwe area 25). This, however, poses a threat of recontamination, especially considering the fact that the majority of respondents reported using dipping, as opposed to pouring, when fetching water from said container (Bartram & Cairncross, 2010; Freeman, Strunz, Utzinger,& Addiss, 2016). Water is stored predominantly in containers with lids but without taps. 27 of 110 respondents store their water in containers with no lids and no taps. Only 3 respondents reported storing their water in a container with both a lid and a tap.

All respondents were asked how they go about preventing said potential recontamination in a qualitative manner in the survey. 55 out of 110 respondents mentioned not undertaking any measures to prevent recontamination. Most answers simply underline the treatment- and storage methods, such as keeping a lid on the container and chlorinating the water, even after it has already been chlorinated by the water board. Other responses included not keeping the water for too long, in order to not expose it to potential recontamination. "We don't keep the water for a long time. we change it in daily basis to prevent recontamination" (respondent #22). Respondents that have access to refrigeration mentioned bottling water in closed bottles and cooling it for consumption. "We bottle our water and put in fridge" (respondent #12). As aforementioned, however, both in the rural towns of Kawamba and Santhe in Kasungu area it was found that this lack of preventing recontamination was not at the hands of it not being deemed necessary by respondents. Instead, it was found that this is not the case because Kawamba- and Santhe residents do not receive any chlorine from the Health Safety Assistance, which used to be the case before.

E. coli tests

Necessity of treatment was verified and underlined through akvo Caddisfly E.coli tests. Different parts of Lilongwe and Kasungu were tested for E.coli through the test, which works by using a growth medium for E. coli and by putting the water for testing in a bag containing 5 different compartments of 5 different volumes – 10, 30, 56, 3, and 1 mL. The water initially turns yellow because of the growth medium. Depending on which, if any, compartments in the bag turn green because of the growth of the E. coli, one can determine the most probable number of coliform units, i.e. number of single bacteria able to multiply and colonize and the upper 95% confidence interval of coliform units/100 mL, implying a 95% certainty that the actual number of coliform units/100 mL is below this number.

Figure 39: E. coli test in Malawi. All compartments have turned (partly) green, indicating a most probable number of coliform units/100 mL of >100.

In area 23 in Lilongwe, five sites were tested for E. coli; two household connections directly from the tap, one container with water from one of these household connections, one borehole directly from the borehole itself, and one water kiosk directly from the kiosk tap. The two household connections, the borehole, and the water kiosk were found to be safe, with a most probable number of 0 coliform units/100 mL. The container containing water from one of the household connections, however, was found to be unsafe, with a most probable number of 4.7 coliform units/100 mL and an upper 95% confidence interval of 22.75 coliform units/100 mL. This indicates that either the household connection contained contaminated water when this water was dispersed into the container, or that recontamination took place in the container, with E. coli being present before the water was put into the container or during the time water was present in the container.

In area 24, three sites were tested for E. coli; one unprotected well, one water kiosk that was dried up so a large bucket containing water from the kiosk was tested, and one container containing water from the kiosk before it had dried up. The second and third site were found to be clean, the first site was found to be very unsafe, having a most probable number of >100 coliform units/100 mL with an upper 95% confidence interval of 9435.1 coliform units/100 mL.

In area 25, 3 sites were tested for E. coli; one household connection, one container from said household connection, and one unprotected well. The container was found to be safe. Both the household connection and the unprotected well had maximum levels of E. coli contamination, with a most probable number of coliform units of >100/100 mL and an upper 95% confidence interval of 9435.1 coliform units/100 mL. Upon inquiry, the water from the container was fetched from the household one day prior to assessment. This indicates that at the time of fetching water from the container, the household connection produced clean water, but sudden high levels of contamination occurred in the short time thereafter.

Three E. coli water quality tests (two unprotected wells, one borehole) and three interviews were performed in area 36. Both unprotected wells were found to be unsafe (i.e. contaminated with E. coli), with a most probable number of 1.2 and 2.6 coliform units per 100 mL respectively and an upper 95% confidence interval of 5.61 and 5.64 and 8.61 coliform units per 100 mL respectively. This implies that, for example for the former unprotected well, there is a 95% probability that the true mean of coliform units/100 mL of the sample will be less than 5.64 (Rao & Statistiker, 1973). The borehole was found to be safe.

In summary:

Lilongwe area	Type of source	Most probable number of coliform units/100 mL	Upper 95% confidence interval of coliform units/100 mL	Health Risk Category
23	Household connection	0	2.87	Low Risk/Safe
	Household connection	0	2.87	Low Risk/Safe
	Container with water from household connection	4.7	22.75	Intermediate Risk/Possibly Safe
	Borehole	0	2.87	Low Risk/Safe
	Water kiosk	0	2.87	Low Risk/Safe
24	Unprotected well	>100	9435.1	Very High Risk/Unsafe
	Water kiosk	0	2.87	Low Risk/Safe
	Container with water from water kiosk	0	2.87	Low Risk/Safe
25	Household connection	>100	9435.1	Very High Risk/Unsafe
	Container with water from household connection	0	2.87	Low Risk/Safe
	Unprotected well	>100	9435.1	Very High Risk/Unsafe
36	Unprotected well	1.2	5.61	Intermediate Risk/Possibly Safe
	Unprotected well	2.6	8.61	Intermediate Risk/Possibly Safe
	Borehole	0	2.87	Low Risk/Safe

Figure 40: Results of in situ E. coli tests in Lilongwe, Malawi.

Kasungu area, Kawamba

In the rural town of Kawamba in Kasungu area, 5 Caddisfly E. coli tests were performed; 1 borehole, 2 unprotected wells, 1 protected well, and 1 container with water from said borehole. Only the water directly from the borehole was found to be completely safe and not contain any E. coli. The other 4 test sites:

	Most probable number of coliform units/100 mL	Upper 95% confidence interval of coliform units/100 mL	Health Risk Category
Unprotected well #1	>100	9435.10	Very High Risk/Unsafe
Unprotected well #2	48.3	351.91	High Risk/Probably Unsafe
Protected well	48.3	351.91	High Risk/Probably Unsafe
Container, water from safe borehole	4.7	22.75	Intermediate Risk/Possibly Safe

Figure 41: In situ E. coli results in Kasungu area, Kawamba.

Respondents were subsequently inquired on the prevalence of waterborne diseases in their households, by asking if anyone in the household had experienced diarrhea or any other waterborne disease in the past year. 24 out of 110 respondents mentioned one or more persons in the household having experienced diarrhea at least once in the past year. When respondents were inquired on whether any individual in the household had experienced diarrhea or any other waterborne disease in the past two weeks, only 2 respondents mentioned that this was the case. Consequently, after uncovering of the extent of the relative subjectivity of the concept of 'feeling ill', as well as finding that respondents are often unknowing of whether an illness is waterborne, it was found that this method of uncovering prevalence of waterborne diseases is ineffective. It was subsequently changed, after finishing the surveys in area 23, 24, and 25 in Lilongwe, to 'Do you or does anyone in the household ever feel sick from drinking the water?' and employed in Kasungu area. Similarly, the questions 'How many days of potential effective labor were lost in your household due to diarrhea or any other waterborne disease in the past month?', 'How much Kwacha has this loss of effective labor days cost your household in the past month?', 'How much Kwacha have you spent on health care, hospital visits, medicine, etc. in the past month because of diarrhea or any other waterborne disease?', and 'How many schooldays did your child(ren) miss (per child) last year because of diarrhea or any other waterborne disease?' were found to be of a too quantitative nature, with respondents not giving answers that were not exact enough to get reliable feedback. As such, such effects of waterborne diseases were operationalized after the research in area 23, 24, and 25 in a more qualitative and inexact manner, rather than a quantitative and exact one.

In Kawamba and Santhe in Kasungu area, the results after inquiry on ever feeling sick from drinking the water consequently were as follows:

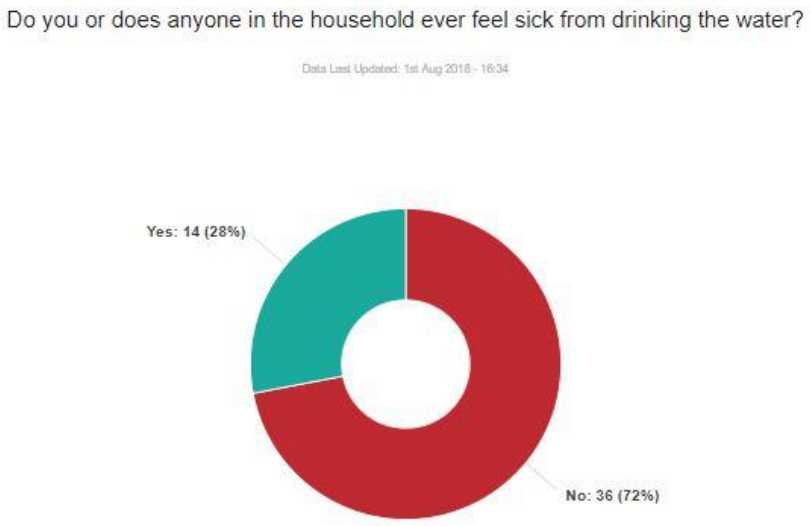

Figure 42: Do you or does anyone in the household ever feel sick from drinking the water in Kasungu area, Kawamba and Santhe.

Respondents were subsequently asked to elaborate on who was feeling ill, when, and for how long, and what impact this had on the household. This granted richer data, from which better conclusions could be drawn regarding waterborne diseases and their effects on the household. It was found that in household #45 "For a long time, my kids <were sick>. Man had cholera." In household #47, the respondent mentioned "I get diarrhea and I feel sick. Once every year maybe." Respondent #73m mentioned that "my child was sick for 1 week." In spite of respondents not being prompted to do so, consequent impacts on the household mainly revolved around children not going to school and the price of treatment. Respondent #51 reported that "for one week the child did not go to school." Respondent #76 mentioned that her household "spent 500 kwacha" on treatment. Respondent #73, however, mentioned that in her household "we spent no money as he went to government hospital." Respondent #87, however, sketched a very different picture, saying that "treatment can cost up to 6000 <kwacha> per child."

As aforementioned, because it is no longer necessary to boil water in order to make it safe for consumption, an HWTS solution such as a household water filter can reduce CO_2 emissions. It is then necessary to know what kind of cookstoves are primarily used by Malawians, in order to know the amount of offset CO_2. It was found that of 110 households, 51 used a charcoal stove, 58 used a 3 stones with wood cookstove. These numbers can be linked to CO_2 emissions (MacCarty et al, 2007) and adoption of HWTS thus of aversion thereof.

Figure 43: A typical '3 stones with wood' cookstove. Source: https://tzpartners.files.wordpress.com.

Boundary partner outcomes Malawi

In order to realize and expedite the succession of aforementioned potential beneficiary outcomes, boundary partner outcomes, i.e. their changing in behavior, actions, and activities, need to be mapped and monitored for in Malawi. For the reduced amount of time spent fetching water as a result of being able to fetch water from any source nearby to increase autonomy in females and produce beneficiary outcomes that could be categorized as 'empowering' to females, community institutions are to make sure this time is utilized in an effective manner. Female working groups, which were found to be widespread across Malawi, are to incorporate HWTS into their agendas, as a means to complement their existing endeavors. HWTS can complement business endeavors from female working groups by lessening the drinking water-related burden of females, granting the possibility to engage in these business endeavors. This, however, requires said female working groups to understand and appreciate the potential for HWTS to save time and benefit their agenda.

For NGOs focusing on saving women time or promoting female autonomy and empowerment, this notion is very similar; taking up HWTS into their agendas can complement their programs and expedite the realization of their ambitions. This, however, requires NGOs to be open to collaborate with HWTS programs and synergize their efforts. This necessitates a high amount of flexibility from NGOs, both in the sense of their programs as well as in an organizational sense. In Malawi, NGO presence is very high, with NGOs playing a big role in a socioeconomic, political, and cultural sense. Their prominence thus makes it imperative for them to be open to collaborative efforts with HWTS programs and be flexible to encapsulate HWTS into their programs. From the meetings with different NGOs such as WaterAid, United Purpose, PumpAid, Amref, and Vitens Evides International, it was found that different levels of flexibility are upheld, as well as different philosophies toward HWTS distribution. Synergizing these philosophies, making sure all relevant NGOs are on the same page regarding the market-based distribution and their role therein are important boundary partner outcomes, which are thus imperative to the effectiveness and institutional sustainability of the program and the realization of lasting beneficiary outcomes.

HWTS was found to be able to significantly relieve governmental burden of having to provide free chlorine through the Health Safety Assistance, especially in the more remote areas of Kawamba and Santhe. Here, chlorine tablets were found

to be necessary the most but handed out the least. HWTS can offset the necessity of having to use chlorine and grant continuous provision to safe water at point of use. For HWTS to be able to relieve the Health Safety Assistance, however, the Health Safety Assistance and its overseeing governmental body, the Ministry of Health, need to be educated on the possibilities of HWTS. These governmental bodies thus need to be receptive to be educated on HWTS possibilities and to working together with HWTS programs to reach the mutual goal of providing safe drinking water. Then, rather than focusing only on handing out free chlorine, the Health Safety Assistance can also steer its efforts toward supporting the development of a market-based approach to HWTS distribution, e.g. through selling and/or promoting the product through its health workers.

In any case for the SWAM program in Malawi, and other market-based HWTS programs alike, to successfully result in ambitioned beneficiary outcomes, it is imperative that the government endorses and supports the program, that NGOs understand and appreciate its potential and that they are open to collaboration, that the private sector understands its role and does not let its own ventures hamper the ventures of NGOs or other institutions responsible for the promotion and distribution of household water filters, and that the water utilities do not actively oppose the program. This last factor is still in an issue in Malawi. As the water utilities in Malawi are heavily privatized, they have a stake in selling water at their kiosks or through their household connections. With people with a household water filter being able to drink the water out of any (un)protected well, their profits could go down. Even though water utilities in developing countries such as Malawi will often not be able to continually provide clean water (WHO & UNICEF, 2007) and notwithstanding the notion that much of recontamination of drinking water happens either during collection, transport, or storage at home (Hasan & Gerber, 2016; Wright, Gundry, & Conroy, 2004), water utilities are dependent on their profits to survive as a business. Consequently, it was found that significant governmental reform is required before Malawi's institutional environment can promote the collaboration between water utilities and HWTS programs.

Results Ethiopia

In Ethiopia, 294 surveys and 30 structured interviews were performed across the 3 locations of inquiry; Finote Selam, Debre Markos, and Injibara (figure 20; figure 32). Furthermore, results from a baseline survey performed in Finote Selam in 2016, designed and conducted by the Finote Selam water utility are used, which contains 84 surveys, putting the total amount of surveys used in Ethiopia at 378. Most households have 4 or 5 people living in the household, with $\bar{x} = 4.54$, thus almost 1 child on average less per household than in Malawi. This was found to be relatively similar across the three areas of inquiry. Number of children in the household, as aforementioned conceptualized as anyone under the age of 15, in the 294 surveyed households was found to be an average of $\bar{x} = 1.24$, thus on average 1 child per household less than in Malawi. This, in accordance to household size, was also found to be similar across the three areas of inquiry in Ethiopia. Dissimilar to Malawi, most respondents mentioned having a government employment, 110 out of 294, as their main source of income. When inquired further on their specific type of government employment, respondents responded with answers such as being a teacher, banker, college dean, or engineer, which are thus all deemed 'governmental' employment. This could be by reason of Ethiopia's rigid and far-reaching government and the tight control it has on the professional and social environments in Ethiopia.

The vast majority of the Ethiopian respondents, 277 out of 294, have a household connection as a main source for drinking water. This in contrast to the respondents in Malawi, where 31 out of 110 respondents reported having a household connection. Consequently, the vast majority of respondents in Ethiopia take very little time fetching water, in contrast to a lot of parts in Malawi. Queues were also found to be non-existent among respondents in Ethiopia. In line with the results in Malawi, female adults are primarily the ones responsible for fetching water, as inquired in the surveys in Debre Markos and Injibara. They, however, do not spend a lot of time in their day fetching water, dissimilar to those fetching water from

kiosks and boreholes in Malawi. The vast majority of Ethiopian respondents, 266 out of 294, mentioned buying less than 3 Liters of bottled water per week. Respondents were found to get their drinking water from a large variety of sources when outside of the house across all surveyed parts of Ethiopia, or simply not knowing what kind of sources they would use, which is dissimilar to the findings in Malawi. 54 out of 294 respondents mentioned only taking water from home with the exception of the Finote Selam test group (i.e. those who have a water filter), all respondents (251) were asked if they treat their drinking water. Only 13 mentioned treating all of their drinking water. 225 respondents mentioned not treating any of their drinking water. When inquired on why respondents refrain from treating their drinking water, the majority of respondents respond doing so because they feel the water they consume is clean. In Injibara, for example, 92 out of 106 respondents mentioned not treating any of their water. For these 92 respondents, 79 responded not doing so because the water is already treated, and thus deemed clean or 'pure'. 32 respondents reported that the water is 'so good', which was found to be a quite literal translation from Amharic, translating to the water being good, i.e. clean, for drinking.

In the interviews, however, a different picture is sketched. 20 interviewees, in Debre Markos and in the Finote Selam control group, were asked 'is the water you drink clean from disease?', which rendered responses incrongruent with aforementioned notions of not treating the water because it is already treated and thus safe."No I know that the water is not always clean. I buy bottled water as well to prevent disease. I know there is typhoid in the water. My daughter is ill often" (interviewee #13). One HIV-positive individual in Finote Selam underlined the importance of clean drinking water for his health. "I am HIV poitive, my wife is as well. Therefore I need to drink clean water. I boil my water. I get typhoid and other diseases … I know that water that looks clean is not necessarily clean, there can be microbes that are dangerous" (interviewee #14). Turbidity and overchlorination was a frequent topic in the structured interviews. "The water is not clean. even when we fetch water in a glass, you can see the debris. Even it becomes turbid sometimes, it becomes muddy (…) Sometimes the water is extra chlorinated, you can even see the chlorine, the water is white" (interviewee #23). "The water quality monitoring and surveillance system is not good. Sometimes there is extra chlorine, it is turbid, all these things. This is next to the availability" (interviewee #23).

This notion of the drinking water not being safe was corroborated by the 2016 baseline survey performed by the Finote Selam water utility and local Aqua for All consultant Gashaye Chekol Yihunie, where 80 out of 84 respondents (95.2%) indicated buying a filter because they know their water source is not safe. This furthermore illustrates the high level of awareness that exists in Finote Selam. Furthermore, respondents in the Finote Selam test group were asked what the most important reasons are for buying a water filter. Of 56 respondents using a water filter, 43 report using the water filter for, among other things such as removing turbidity and preventing disease, because it makes the water safe. Preventing disease and making the water safe can be argued to be interchangeable. Of the 43 inquired individuals in the March 2018 Finote Selam test group, 24 households had the filter one year or more, 11 households had the filter for 9-12 months, 1 household had it for 6-8 months, and 7 households had it for 0-2 months. Respondents from both this test group and the control group were inquired on whether they experienced any waterborne diseases in the past year and virtually no difference was found between these two groups. Similarly, when inquired on anyone in the household having experienced diarrhea in the past two weeks, no difference was to be found – in the test group, 2 out of 43 respondents mentioned having experienced diarrhea in the household in the past two weeks, in the control group, 2 out of 45 respondents mentioned having experienced diarrhea in the household in the past two weeks. Consequently, no difference was found in school attendance, work productivity, spending money for healthcare, etc., which is incongruent with results found by Yami, Sabatini, & Busenitz (2017). These findings, however, do not match the findings of the November 2016 Finote Selam baseline, where 13 out of 84 respondents mentioned having experienced diarrhea or any other waterborne disease in the past two weeks. For the second part of the Ethiopia research between June 24-July 5 in Injibara, just like in Kaomba and Kawamba in Kasungu area in Malawi, a more qualitative approach to assessing prevalence of waterborne diseases was upheld, as responses were found to be unfit for adequate representation of prevalence of diarrhea or any

other waterborne disease. 6 out of 106 respondents reported ever feeling sick from drinking the water. Upon further inquiry, these respondents were ill for 1 day up to 21 days, with minimal consequences related to work and/or school.

To verify the water quality in Finote Selam, Debre Markos, and Injibara, a total of 7 in situ E. coli tests were performed; a test just after treatment of the water in the treatment plant and a test right out of a household connection close to the treatment plant, as well as a test of a natural spring in Injibara, which was heavily used but suspected of being contaminated at the hands of cattle grazing nearby on a frequent basis. All sources were found to be clean, except for the suspectedly contaminated natural spring in Injibara, which was found to have a most probable number of 4.7 coliform units/100 mL and an upper 95% confidence interval of 22.75 coliform units/100 mL, rendering it to have intermediate/possibly safe level of risk.

Upon discussion with research colleagues from the Finote Selam water utility, another salient issue pertaining to water filter usage and prevalence of waterborne diseases was uncovered. One research colleague, who used a Tulip Table Top Filter (figure 27) himself, reported feeling more ill from drinking untreated water than he would before using the filter; a notion corroborated by his other colleagues who used a water filter. Upon discussion with other household water filter users, the research colleague reported finding a similar pattern with them; they became quickly adjusted to drinking filtered water, their bodies less able to cope with drinking untreated water and thus feeling ill more quickly than they would before starting to use the household water filter. This notion thoroughly underlines the importance of adequate after sales service, allowing for users to continue using the water filter would a certain part break or their filter candle to be replaced by a new one – the Tulip Table Top Filter ceramic filter candle, for example, typically has a lifespan of approximately 7000L, depending on the turbidity of the water that is generally put in the filter.

In Debre Markos and Injibara, respondents were inquired on their storage of drinking water. Drinking water was mainly reported to be stored in containers with lids but without taps, with 189 out of 2017 respondents storing their water in such a container. This is in line with the results in Malawi, where 80 out of 110 respondents reported storing their drinking water in containers with lids but no taps. As opposed to the results in Malawi, however, most respondents in Debre Markos and Injibara in Ethiopia, 192 out of 207, reported fetching water from said container by pouring, as opposed to dipping; most respondents used a jerrycan. Not having to dip to fetch water from a container significantly reduces the threat of contamination (Bartram & Cairncross, 2010; Freeman, Strunz, Utzinger,& Addiss, 2016). A jerrycan, however, is difficult to clean properly, posing potential problems with keeping them safe from bacteria. When inquired on how respondents go about preventing recontamination of their drinking water, most answered with washing hands and/or cups, illuminating their hygiene awareness and the difference between treatment, storage, and recontamination: “We wash our hands <and> cups properly” (respondent #26). The issue of recontamination is especially salient considering the problems with continuous water provision in Injibara in particular and in Ethiopia in general. This was corroborated in the qualitative parts of the Injibara survey, where respondents mentioned that “sometimes <the> water is not enough” (respondent #26) or “sometimes there is scarcity” (respondent #40). Furthermore, in Injibara (between June 24 and July 5), respondents were asked how much water they drink on a daily basis, similar to the survey in Malawi, as this was found to be an important topic after the inquiry in Finote Selam in March 2018. Of the 106 respondents, over half, 63 respondents, reported drinking 1L or less water per day. Only 10 respondents reported drinking at least 2L per day.

All 294 households in Ethiopia were assessed on cookstove usage for carbon credit registration (Locatelli & Pedroni, 2004). 247 out of 294 households mentioned having a ‘3 stones with wood’ cookstove. 90 of these households have a 3 stones with wood cookstove exclusively, 157 households have a 3 stones with wood cookstove in combination with a charcoal and/or electric stove. As aforementioned, carbon credit registration necessitates correct and continuous use of the HWTS solution for at least 7 years, which is proven through a yearly assessed representative sample of HWTS users, which checks

if the filter is still in working condition and present in the household. This notion was taken into account for the Finote Selam test group end-line survey of March 2018. To assess the probability of a representative sample proving correct and continuous usage, respondents were asked if respondents still use the filter, if respondents used the filter in the past 24 hours, and if respondents will keep using the filter for the next 10 years. It was found that customer satisfaction is high, with 42 of 43 respondents mentioning still using the water filter and having done so in the past 24 hours. 38 out of 42 respondents still using the filter and having done so in the past 24 hours, 38 respondents mentioned continuing to use the filter for the next 10 years. 5 respondents mentioned not knowing whether they will use the filter for the next 10 years. This response was elaborated upon by multiple research assistants of the Finote Selam water utility, with them mentioning that this response can be attributed to a component of Ethiopian culture, one of virtually never looking that far ahead in life and thus approaching the next 10 years with uncertainty in any component of life. As such, the ability to prove at least 7 years of continuous usage through yearly assessment of a representative sample can be expected. Correctness in this use is to be assured through adequate education and an exhaustive manual, which is provided in Ethiopia in the Amharic language.

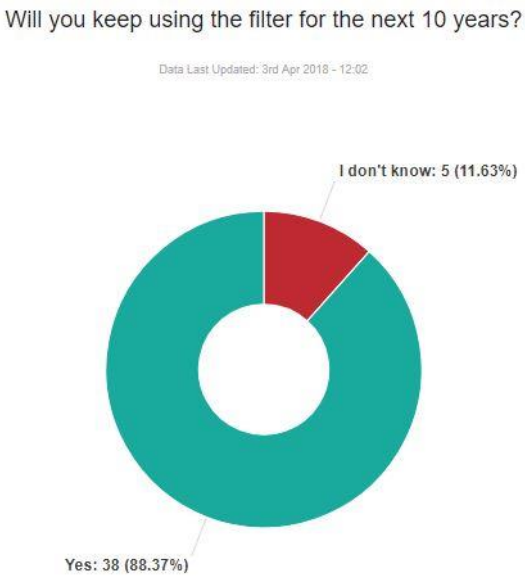

Figure 44: Will you keep using the filter for the next 10 years in Ethiopia, Finote Selam.

Boundary partner outcomes Ethiopia

In Ethiopia, necessary boundary partner outcomes are already showing and expediting the realization of beneficiary outcomes. The government is highly cooperative of the program and its upscaling is being endorsed and supported throughout Amhara region. This is the result of the successful pilot in the city of Finote Selam in East Gojjam zone, which showed and convinced government officials of other woredas and zones and even up to the regional level to participate in the program. As a result, the program is scaling up quickly and is discussed in high-level government meetings, converting into policy and the incorporation of HWTS in yearly budgets. The Ethiopian government is appreciating the potential for HWTS in fighting diarrheal disease and curbing the spread of waterborne diseases such as cholera.

Important boundary partner outcomes can also be seen in water utilities. In contrast to the water utilities in Malawi, water utilities in Ethiopia are owners of the program, responsible for the sales and promotion of the household water filters. The water utilities that are part of the program, that of Finote Selam, Debre Markos and Inijibara, are showing important changes in behavior pertaining to the prioritization of water quality, are acknowledging the problems related to water

quality and their root causes such as poor infrastructure and recontamination through inadequate storage, and are committed to improving said water quality. There is still room for progress in these boundary partner outcomes, however, as it continues to be imperative that the selling of household water filters is prioritized adequately. Furthermore, careful documentation of sales is a pressing need, especially as it is a requirement for carbon credit registration, that can still be professionalized more. It was found, however, that water utilities are willing to learn how to effectuate this professionalization of documentation, which is an important behavioral pattern for the Ethiopian water utilities, and any utility engaged in market-based HWTS distribution alike.

As mentioned in the background information, community institutions play a vital role in the sociopolitical landscape of Ethiopia. For HWTS to adequately permeate a community and produce beneficiary outcomes such as long-term health benefits from solving the problem of water being contaminated with disease, which was a salient topic especially in the interviews, help people living with HIV to improve their health, and relieve the burden of health workers and of the water utility, community institutions such as Idir and Iquib need to be receptive to being educated on the benefits of HWTS and on their potential part in the dissemination of the household water filters. In Ethiopia, it was found that people talk openly about HIV, even HIV patients themselves about their condition, as was found in the interviews. Interviewee #21, in Debre Markos, was, at the time of assessment, a leader of an HIV working group. This individual supported the program fully and was given a household water filter to show at her working group and educate others living with the condition on the benefits of clean drinking water and of using the household water filter. Boundary partner outcomes such as this are vital in realizing the important beneficiary outcome of improving the lives of people living with HIV.

Progress in boundary partner outcomes in the private sector is important in Ethiopia. Public private partnerships are new to Ethiopia's very rigid political landscape. Consequently, working in collaboration with the private sector and synergizing efforts and ambitions related to the promotion and distribution of water filters is challenging. It is therefore important that the private sector seeks to be informed and educated on their role in the supply chain. In Ethiopia, the private sector has already agreed on being paid on consignment basis, meaning that they produce water filters but are paid for them when they are sold by the relevant water utility. This is an important boundary partner outcome for the private sector and significantly expedites the selling of household water filters and, subsequently, the realization of beneficiary outcomes such as health benefits (Wolf et al., 2018) and reduced governmental burden in curbing the spread of diarrhea and waterborne diseases. More progress on transparency on the ambitions of the private sector and synergizing efforts related to the promotion of household water filter usage among the potential customers, however, can be made. Currently, much of the promotional work for the household water filters is being performed without including water utilities, hampering the effectiveness of the promotion, the selling of household water filters, and the succession of subsequent beneficiary outcomes. Furthermore, effectuating sustainable changes in health and other beneficiary outcomes necessitates the correct and continuous usage of the household water filters, which is highly challenging (Arnold et al., 2009). Consequently, the private sector is to understand its role in providing adequate after sales service and synergizing efforts with water utilities to make sure household water filter customers are educated sufficiently on the use of the filter, have access to spare parts when a part of the household water filter breaks, and have access to a new filter candle after it has worn out, which typically happens, as mentioned in the background information, after 7000 - 1000L, or about 1.5 - 2 years.

Critical Reflection on Methodology

From operationalizing the research and uncovering potential outcomes for the HWTS programs to be monitored for in both Malawi and Ethiopia, it was found that explicating a detailed, qualitative narrative is paramount in uncovering important potential beneficiary outcomes. For all researched areas, outcomes pertaining to preventing recontamination and providing continuous access to safe water can be expected. The extent of the benefits that this brings, however, is

dependent e.g. on the drinking water facilities, such as kiosks/boreholes/household connections and on the storage facilities of the households that a HWTS program is implemented in. Furthermore, the extent of these benefits is highly dependent on boundary partner outcomes; on the way important boundary partner outcomes adapt their behaviors, actions, and activities to benefit the development of the program. These boundary partners and their relation to the HWTS program thus make up an integral part of this very context.

Sketching an exhaustive context is thus important for a complete and thorough assessment of beneficiary outcomes that are of a direct but especially for those of a more indirect nature, and how they relate to boundary partner outcomes. Specifically, this context was found to be important for an especially salient topic in the research; that of saving time. Mainly women are expected to benefit from an HWTS intervention, for they are virtually always the ones held responsible for drinking water in the household. A more complete account of what can potentially be done with this saved time, however, is to be sketched. It is then essential to sketch an account of which boundary partners are important in this issue of making sure saved time is used in an efficacious manner and, subsequently, which boundary partner outcomes are to be ambitioned and monitored for within these boundary partners. Furthermore, (potential) negative outcomes also play an important role in this context. The social capital gained surrounding the fetching of water could for example be of great value to women and taking this necessity of having to fetch water away of negative influence to them. Implementation of an HWTS program could therefore take this away from women, hindering rather than empowering them and disrupting the social dynamism in a community. This calls for a more complete sketch of a community and the role of women fetching water therein, better being able to anticipate- and monitor on the implications of HWTS adoption. Furthermore, it was found that many other social dynamisms surround water kiosks and boreholes. Communal groups that control and/or vandalize water points to exert power on a community, as could be found on boreholes in area 36, are to be taken into account. Their exertion of power onto different aspects of a community, or an active opposition toward HWTS adoption, could potentially be a negative outcome of implementation of an HWTS program. As such, uncovering which boundary partners are prominent in a community in general and in these issues in particular, and understanding which behaviors, actions and activities, which boundary partner outcomes, are salient and could either benefit or hinder your HWTS program, is essential.

It was found that monitoring health benefits and furnishing proof for achieved health outcomes a result of one's HWTS intervention is to a great extent a subjective matter. Many respondents are apprehensive in deeming a stomach ache or short episode of diarrhea an actual 'disease', or are unsure of the cause of an illness being waterborne. Consequently, approaching health outcomes for an HWTS program in a quantitative manner was found to be futile. Rather, it is to be approached in a qualitative manner, sketching a story surrounding water-related health issues rather than ambitioning to quantify prevalence of waterborne disease and subsequent healthcare costs, school days missed, etc. In Ethiopia, prevalence of waterborne diseases such as diarrhea was found to be low, yet the vast majority of respondents that were part of the Finote Selam test group, thus having bought a filter, reported buying the filter because of its health benefits. This suggests that respondents do not conceptualize health benefits as 'not being ill', but rather as a more comprehensive account of physical well-being. It is expected that qualitative assessment sketches a more comprehensive account of (potentially waterborne) illness. In the interviews, however, an altogether higher prevalence of health-related accounts were given that relate to drinking water, higher than when respondents were asked 'if they ever feel that the water makes them sick'. As such, when monitoring for health benefits and sketching an account of potential health benefits to be effectuated upon implementation of one's HWTS program, one is to uphold a qualitative, rather than a quantitative, approach.

The following list depicts a brief aggregation of 10 expected beneficiary outcomes for the HWTS programs in both Ethiopia and Malawi, as well as a short description pertaining to their relevant situational factors, as identified in the research.

Expected Outcome	**Situational Factors & Monitoring Parameters**
No recontamination potential	-Drinking water storage facilities -Fetching water from storage container
Health Benefits	-Subjectivity of health and/or illness -Closeness of latrines to water sources -People living with HIV -Availability of healthcare services -Contamination of water sources *In situ E.coli testing*
Time Saving	-Time spent fetching water -Queue Time -Drinking water facilities → in and outside of the house -Population density -Potential opportunities for productive time spending -Mapping of relevant contextual factors pertaining to the fetching of water
Female Empowerment	-Responsibility for water in the household -Time saving potential -Amount of children in the household -Opportunities existing in the community
Reduced Governmental Burden	-Extensiveness of governmental intervention -Understanding of what burdens HWTS can alleviate
Increased Population Autonomy	-Authority and control over treatment method -Access to treatment methods
Reduced Plastic Usage	-Affluence of population -Amount of bottled water consumed per week
CO_2 Emission Reduction	-Kind of cookstove *Rates of deforestation, socio-economic factors, baseline water usage* -Correct and continuous use of HWTS solution
Conflicts of Interest	-Main source of drinking water -Does the water utility cooperate with the HWTS program?
Adverse Health Effects	-Adequate after sales service -Continuous HWTS usage -Source of drinking water outside of the house

Figure 45: Beneficiary outcomes for the HWTS program in Malawi and Ethiopia.

HWTS Outcome Monitoring Framework

These beneficiary outcomes and their relevant means of achievement and assessment through boundary partner outcomes can subsequently be extrapolated to the Outcome Monitoring Framework, which pertains the beneficiary outcomes to relevant boundary partner outcomes. As such, this first stage in the 3 stages of Outcome Monitoring, named the Intentional Design, specifies the relevant parameters that pertain to market-led HWTS distribution and produces the means for assessing the necessary "changes in the behavior, relationships, activities, or actions of the people, groups and organizations with whom a program works directly" (Earl, Carden, & Smutylo, 2001, p.1). These necessary changes are , as aforementioned, conceptualized by Earl, Carden, and Smutylo (2001) as 'outcome challenges'. These outcome challenges, their relevant progress markers, support strategies, and organizational practices (Figure 7; Earl, Carden, & Smutylo, 2001) produce a generalizable HWTS Outcome Monitoring Framework. This framework can be employed to guide the structuring of a market-based HWTS distribution program in a country or region of intervention, conceptualize the relevant monitoring parameters, and determine the contribution of relevant boundary partners to the beneficiary outcomes that are ambitioned and have been mapped. This framework is not exhaustive but can be employed as a stepping stone for effective monitoring of outcomes as existing in boundary partners.

1. Intentional Design
Helps a program establish consensus on the macro level changes it will help to bring about and plan the strategies it will use. Answers: why (is the vision going to contribute to the program's ambition)?; who (are the partners)?; what (are the strategies)?; how (will the program contribute to change)?
Step 1: Vision
Step 2: Mission Statement
Step 3: Partners
Step 4: Outcome Challenges
Step 5: Progress Markers
Step 6: Strategy Maps
Step 7: Organizational Practices

Figure 46: First stage of 3 stages of outcome monitoring. Source Roduner & Schläppi (2008)

The vision: Every household has access to safe water at point of use.

The mission statement: In support of the vision, the HWTS program will facilitate a conducive environment for change and promote collaboration between relevant boundary partners. It will contribute to the production, organization, and dissemination of data relevant for apprising of boundary partners. It will open the environment for productive discussion and uphold a flexible approach to both program development and progression.

1) Outcome Challenge: Government

The government recognizes the importance of clean drinking water, the potential for HWTS distribution to facilitate clean water access at household level, and cultivates a conducive environment for market-based distribution

Set of progress markers:

1) Government is sufficiently informed of the factors pertaining to the HWTS program.
2) Government understands the relevant parameters influenced and enhanced by the program.
3) Government appreciates the potential of HWTS distribution and the subsequent necessity of program implementation.
4) Government endorses the program and supports its ambitions.
5) Government develops policy conducive to program implementation and progression.
6) Government implements policy in the appropriate areas of jurisdiction to effectuate regulatory change.
7) The Ministry of Health and -Water are informed on the potential of HWTS in their areas of jurisdiction.
8) The Ministry of Health and -Water appreciate the necessity of adoption of HWTS policy in their relevant areas of jurisdiction and institutionalize efforts for effective program implementation.
9) Roles and responsibilities between the Ministry of Health and the Ministry of Water are adequately agreed upon and divided.
10) Both the Ministry of Health and the Ministry of Water act upon their agreed roles and responsibilities and show accountability of said roles and responsibilities.
11) The Ministry of Education is adequately engaging schools and other educational institutions into the program.
12) Budget is adequately allocated to program essentials such as trainings, sales monitoring, after sales service, etc.
13) Political stability facilitates authoritative stability and continuity.
14) Governmental staff is sufficiently informed of program intentions and its relevant components.
15) Relevant program factors are discussed frequently in government meetings.
16) Taxes and forex do not inhibit the successful progression of the program.
17) Steps for moving forward are continually adapted and implemented.

2) Outcome Challenge: Water Utilities

Water utilities understand, appreciate, and act upon the necessity of household water filter distribution, act as owners of the program, and accept the responsibility and accountability related thereto.

Set of progress markers

1) Water utilities acknowledge the challenges they have with assuring the provision of safe drinking water
2) Water utilities understand the concept of recontamination and the problems that existing containers pose regarding this.
3) Water utilities do not prioritize only quantity
4) Water utilities devise a water quality monitoring system
5) Water utilities regularly monitor water quality
6) Water utilities have a clear and unambiguous view of their institutional objectives
7) Water utilities understand and appreciate the potential for HWTS in achieving their institutional objectives
8) Water utilities are transparent in their organizational practices, challenges, and ambitions.
9) Water quality at point of use is institutionalized in the organization by regularly incorporating it in meetings.
10) Water utilities regularly hold trainings pertaining to monitoring water quality.
11) Water utilities feel and hold themselves accountable for continuous provision of safe drinking water.
12) Water utilities prioritize the sales of household water filters adequately and divide roles and responsibilities in the organization accordingly.
13) Registering sales of household water filters is institutionalized in the water utilities.
14) Sales of household water filters are prioritized sufficiently.
15) Continuity of the program is seen as a chief responsibility of the water utilities.
16) Water utilities are feel accountable for continuity of the program.
17) Water utilities hold themselves accountable for continuity of the program.

Support strategies for Government	Support strategies for Water Utilities
1) Set up a standardized HWTS government sensitization tool. 2) Set up a meeting with other government representatives that have already endorsed market-based HWTS distribution. 3) Set up a knowledge-sharing platform between different governmental bodies to share insights, challenges, questions, and best practices. 4) Set up regular meetings between Ministry of Health and Ministry of Water representatives. 5) Provide the Ministry of Health and the Ministry of Water with ideas and tools for best practices pertaining to dividing roles in particular and to market-based HWTS distribution in general. 6) Set up a blueprint for the Ministry of Education to implement the program into schools. 7) Set up a division of roles and responsibilities paramount to program continuation that is not contingent on potential political instability.	1) Run workshops on water quality challenges, specified on factors relevant for the water utility. 2) Provide tools -software and hardware – to monitor water quality in the area of intervention. 3) Provide HWTS sensitization tools such as brochures, booklets, video's, etc. 4) Provide technical assistance where necessary. 5) Establish a mentorship program that links inexperienced staff with experienced staff. 6) Provide tools – software/hardware – necessary for adequate monitoring of sales. 7) Incentivize sales of household water filters and monitoring of sales e.g. through commission payment.
3) Outcome Challenge: NGOs NGOs support a market-led approach and educate, inform, and build capacity in their sphere of influence, expediting the development of a successful market-led HWTS distribution model. They help develop mechanisms to reach all population groups but prioritize the creation of a sustainable supply chain. **Set of progress markers** 1) NGOs acknowledge the existence of (potential) water quality problems. 2) NGOs actively help to uncover water quality problems and monitor for them through regular (in situ) water quality testing. 3) NGOs are adequately informed on the necessity of institutionalizing water quality in building capacity of partner organizations. 4) NGOs are willing to significantly steer their capacity building toward assuring safe water at point of use. 5) Provisioning safe water through capacity building is a recurrent and salient topic of discussion in team meetings. 6) NGOs are informed that through a market-based approach most beneficiaries are eventually reached in a sustainable manner 7) NGOs understand and appreciate the merit in upholding a market-based approach. 8) NGOs help in devising payment mechanisms for the market-based distribution of household water filters in collaboration with local microfinancing institutions. 9) NGOs build capacity in local microfinancing institutions, facilitating payment mechanisms for market-based HWTS distribution. 10) NGOs help uncovering means to assure the financial sustainability of the program. 11) NGOs devise means to reach more vulnerable parts of the population. 12) NGOs do not distort the market through e.g. free handouts.	**4) Outcome Challenge: Community Institutions** Community institutions have gained the trust of other boundary partners and contribute constructively to relevant debates and decision-making processes. They have clear goals and plans that are relevant to their context and fully utilize the opportunities produced by HWTS distribution in their community. **Set of progress markers** 1) Community institutions are receptive to and accepting of awareness creation surrounding waterborne diseases. 2) Community organizations understand and appreciate the severity of waterborne diseases in their relevant communities. 3) Community organizations disperse information on waterborne diseases in their relevant communities. 4) Community organizations understand and are transparent about the challenges that exist in their relevant communities surrounding e.g. existing power relations, vandalism of water facilities, sources of conflict, etc. 5) Community organizations are educated adequately on the market-based HWTS distribution scheme. 6) Community organizations understand the inner workings of a market-based HWTS distribution scheme 7) Community organizations accept and endorse the program. 8) Community organizations cooperate with NGOs and hold regular meetings. 9) Community organizations are willing to use workshops and community meetings to create awareness on the distribution of HWTS. 10) Community institutions actively market the HWTS solution in community workshops and -meetings.

13) NGOs prioritize and institutionalize the development of a supply chain within the program. 14) Budget is allocated to supply chain development. 15) NGOs identify outcome payers and uncover their exact preconditions for program outcome financing. 16) Finding outcome payment that assures program continuity is prioritized, for example through carbon credits.	11) Community institutions support women in utilizing the increased time they have acquired because of the HWTS solution in a productive and empowering manner.
Support strategies for NGOs 1) Run workshops on water quality challenges in the area of intervention. 2) Provide tools -software and hardware – to monitor water quality in the area of intervention. 3) Provide capacity building tools that focus on water quality challenges. 4) Set up a knowledge-sharing platform that focuses on market-based HWTS distribution schemes. 5) Hire a professional fundraiser to help identify outcome payers and develop an outcome payment strategy.	**Support strategies for Community Institutions** 1) Run workshops on awareness creation surrounding safe water at schools, town halls, etc. 2) Sensitize influential individuals in the community on HWTS administration such as block leaders. 3) Facilitate labor opportunities for women. 4) Include labor opportunities for women as a precondition for program implementation.
5) Outcome Challenge: Outcome Payers Outcome payers understand the local context and their consequent challenges pertaining to furnishing proof for ambitioned outcomes. They are transparent in their stipulations concerning tasks, responsibilities, and costs, and understand and acknowledge the role of qualitative data in outcome monitoring. **Set of progress markers** 1) Outcome payers seek to be educated on the local context of the HWTS program they fund. 2) Outcome payers appreciate the necessity of understanding the socio-economic inner workings of effectuating outcomes. 3) Outcome payers endorse a qualitative assessment of outcomes where necessary. 4) Outcome payers seek possibilities for furnishing of proof of outcomes through qualitative assessment. 5) Outcome payers seek to be informed on the socio-economic inner workings of effectuating outcomes in an area of intervention. 6) Outcome payers sufficiently understand a local environment. 7) Outcome payers adapt their stipulations according to their understanding of the local environment. 8) Outcome payers facilitate transparent discussion with local NGOs, water utilities, private sector and governmental institutions. 9) Tasks, responsibilities, and costs are identified and communicated to relevant parties. 10) Agreements are made surrounding evidence creation through monitoring.	**6) Outcome Challenge: Private Sector** The private sector understands the local context of development cooperation and the challenges of other program boundary partners. They develop their business plan accordingly and work in synergy with NGOs, government, and water utilities. **Set of progress markers** 1) Private sector actors actively find ways to collaborate with NGOs, government, and water utilities. 2) Private sector actors seek to be educated on their role in the supply chain. 3) Private sector actors actively seek to be educated on their role in the outcome payment financing scheme, e.g. by accepting water utilities or NGOs to pay on consignment basis. 4) Private sector actors understand the necessity of not monopolizing the market for the merit of producing a more effective market-based distribution. 5) Private sector actors actively seek to be informed on their role in providing effective after-sales services by water utilities and/or NGOs. 6) Private sector actors incorporate the provision of adequate after-sales service regularly in team meetings. 7) Private sector actors are transparent in their business endeavors and do not distort the program with these endeavors.

Support strategies for Outcome Payers	Support strategies for the Private Sector
1) Run workshops on relevant local socio-economic factors in the area of intervention. 2) Set up a knowledge-sharing platform pertaining to HWTS outcome monitoring 3) Run workshops on quantitative and qualitative methods.	1) Set up meetings with NGO-, government-, and water utility representatives to share interests, challenges, and mutual expectations. 2) Set up a market-based HWTS distribution knowledge platform. 3) Hire a professional supply chain analyst to provide consultancy on supply chain development. 4) Set up a tool for the private sector to communicate their other business endeavors in an effective manner to the relevant boundary partners.

Organizational practices

1) Continuous prospecting for new ideas and opportunities arising from support strategies.
2) Consultation of key informants in government, civil society, community institutions, etc. in order to unveil best practices.
3) Synergize program effects with higher level stipulations (e.g. that of DGIS, Ministry of Foreign Affairs, etc.)
4) Ask for continuous feedback on program performance from Boundary Partners.
5) Implement suggestions for program change, as made by Boundary Partners.
6) Consult external expert parties on (potential) challenges and how to overcome them, on best practices, and on how to assure program sustainability

Figure 47: HWTS Outcome Monitoring Framework.

For different programs, different aspects of the HWTS Outcome Monitoring Framework will be prioritized. If the financial sustainability of the program is a priority, the outcome challenge pertaining to the boundary partner Outcome Payers can be prioritized. Thinking about the potential uses of data before instigating monitoring is of the essence, for it prevents the potential of gathering of data that has no particular function. For the Malawi HWTS program, monitoring priorities will be heavily steered toward monitoring the progress markers of NGOs and Community Institutions in the Outcome Journal (step 9), as these boundary partners have a salient role in the program. In Ethiopia, this will be steered more toward the progress markers of Water Utilities and Outcome Payers, as the program is less dependent on NGOs and more dependent on the performance of Water Utilities and is already in discussion with the Outcome Payer Believe Green for the attainment of Carbon Credit funding. As the program progresses, however, dissemination into the important institutional community bodies existing in Ethiopia will be more important, emphasizing the importance of boundary partner outcomes of Community Institutions.

This will also be reflected in the Strategy Journal (step 10), prioritizing the support strategies for those boundary partners that are most salient in the program. For the Performance Journal, the monitoring of organizational practices will be more generalized and pertain to monitoring the employed means for the organization to “remain relevant, innovative, sustainable, and connected to its environment” (Earl, Carden, & Smutylo, 2001, p. 76). Employing subsequent monitoring of these parameters, is performed through the Outcome Journal (figure 10; figure 11), Strategy Journal (figure 12), and Performance Journal (figure 13), with evaluation of the program planned in the Evaluation Plan (figure 15). As such, Outcome Mapping as put forward by Earl, Carden, and Smutylo (2001) is specified to a market-based HWTS distribution program and employed by virtue of promoting and monitoring outcomes in boundary partners, i.e. boundary partner outcomes, for the merit of promoting and monitoring outcomes in beneficiaries, i.e. beneficiary outcomes.

7) Conclusion

This research aims to answer the question of how to effectively monitor for outcomes in market-based HWTS programs. It was found that outcomes are as a concept defined differently throughout the development field, producing ambiguity among development practitioners in both their ambitions pertaining to outcomes as well as how to monitor for them and evaluate the means of their achievement. To overcome this ambiguity and produce a more conclusive monitoring framework for HWTS programs, this research provides an account of outcomes as changes effectuated both in a beneficiary population, as well as those changes existing in boundary partners to benefit the program, fulfill its mission, and arrive to its vision. Consequently, to overcome this ambiguity, from this research a different, bilateral appropriation of outcomes can be delineated. The first pertains to its target population, those that are to 'benefit' from the program activities and is defined as 'beneficiary outcomes'. The second pertains to a program's boundary partners, those that work directly with the program, and is defined as 'boundary partner outcomes'.

It was shown that potential outcomes of market-based HWTS programs, beneficiary outcomes as well as boundary partner outcomes, are highly dependent on access to existing infrastructure and on demographic- and socio-economic features of the environment in which the program is implemented. Consequently, quantitative assessment is to customarily be complemented by qualitative assessment. This notion, however, is to be upheld by boundary partners as well throughout a program, for only then a program's mission can be completed and its vision made reality (Earl, Carden, & Smutylo, 2001; Roduner & Schläppi, 2008). When effectively mapping beneficiary outcomes in combination with itemized monitoring of those boundary partner outcomes that are imperative to a program's success, one can sketch an exhaustive account of HWTS program performance that is relevant to all those influenced and/or concerned by it. Such an enhanced and particularized, on HWTS specifically, monitoring tools can aid in expediting the progression to outcome-based monitoring and funding, and more sustainable HWTS programs as a result. Furthermore, this facilitates a high degree of reflection, allowing for Outcome Monitoring to be used as a tool for evaluative thinking, which is an essential part of its application in development (Earl & Carden, 2002).

8) Discussion

Effective and exhaustive monitoring of outcomes was found to necessitate a notion of outcome monitoring that pertains to both beneficiaries as well as boundary partners. Consequently, this research specifies the Outcome Monitoring Framework as presented by Roduner and Schläppi (2008) and Earl, Carden, and Smutylo (2001) to HWTS and appropriates it to mapped outcomes that are ambitioned to be effectuated in the beneficiary population, in line with notions of outcomes as presented by Parsons, Gokey, and Thornton, (2013). It thus conveys a suggestion for elaboration of the Outcome Mapping Framework, upholding a notion of outcome monitoring not only of changes in behaviors, actions, and activities of boundary partners, but also of expediting, facilitating, and reacting upon the changes in behavior, activities, and opportunities produced in a beneficiary population as a result of a development program, in this case an HWTS program.

The research prompts an elaborate narrative on effective outcome monitoring that employs notions of outcome pertaining to both beneficiaries and boundary partners. Effective and itemized monitoring of beneficiary outcomes, however, with progress markers and support strategies, are not provided. This can in part be attributed to the notion of myriad intermediating variables, be it of a socio-economic and/or political nature, prompt the necessity of upholding a substantially qualitative, rather than quantitative, nature of assessment. Moreover, the heavy multi-faceted nature of IDC programs in general and HWTS programs in particular elucidate the challenges pertaining to the effective monitoring of outcomes in general.

This multi-faceted nature and the importance of the socio-economic and political context of a program was exemplified eminently in the research performed in Malawi and Ethiopia. During the first visit to Ethiopia in March, for example, a military coup was in full swing, with the then-ruling administration having called off an emergency situation, trying to retain power by imprisoning or killing any kind of influential individual opposing their rule. Clean water was not a top priority at the time. During the second visit in late June, a new administration was in power and an Ethiopian revolution was in full-swing, led by the already revered new Prime Minister, Abiy Ahmed. Government officials, fearing retaliation by the people, went into hiding, not able to sign any decree related to implementing any kind of IDC program. In addition to this, Ethiopia has been achieving one of the highest economic growth numbers of the African continent for the last 20 years.[28] Such massive numbers of economic growth and such extensive sociopolitical transformation gravely shape any kind of IDC program and the outcomes it is to produce. Such factors have to be taken into account adamantly and can thus differ absolutely in any kind of sociopolitical and -economic environment, as stipulated by Holzapfel (2014). In Finote Selam, between the baseline of November 2016 and the end-line of March 2018, a vast number of factors have influenced the monitored parameters; factors that have to be taken into account when operationalizing a research. This research vouches for upholding a significantly qualitative aspect of inquiry when mapping for and monitoring outcomes. Because of time constraints, however, a truly illuminating assessment of qualitative parameters relevant to the market-based HWTS distribution program in Ethiopia and Malawi, was not realized, calling for further explication.

Furthermore, the fact that this research upholds a forgoing of ambitioning causal relationships between HWTS interventions and outcomes, and refrains from approaching the topic in a purely quantitative manner, does not mean that it invalidates the merit of research that does ambition uncovering such causal relationships and upholding a quantitative approach. Future research can uncover the potential for parameters pertaining to outcomes of HWTS programs, be it market-based or not, to be assessed in a quantitative manner and uncover causal relationships between relevant variables. A salient limitation of this research is that its data is of a self-reported nature. To uncover and utilize the potential for quantitative assessment, one could, instead of relying on self-reported data, for example use health data from clinics and hospitals, to see if an HWTS intervention resulted in less hospitalizations, as is done by for example DHIS2 in Malawi.[29] Furthermore, in Ethiopia, the entire research was performed in a (peri-)urban setting, significantly impeding its representativeness for other Ethiopian demographic categories of people. Consequently, more research can be performed in a rural setting, especially considering that water challenges, with the rural population often having no access to piped water, are even more pressing for this population. in all these situations, however, it is important to uphold a semantically consistent definition of outcomes, approaching it from a perspective of beneficiaries and/or boundary partners, and to employ a monitoring scheme that is consistent with this perspective.

[28] https://tradingeconomics.com/ethiopia/gdp-growth-annual
[29] https://www.dhis2.org/

9) References

Ambrose, K. (2004). Constructing collaborative learning: Outcome Mapping and Its Multiple Uses in the Project Cycle of a SUB Initiative.

Andarge, A. (2017). Monitoring the urban growth of Debre Markos Town (1984-2012), Ethiopia: Using satellite images and GPS. *Journal of Geography and Regional Planning*, *10*(4), 69-76.

Arnold, B., Arana, B., Mäusezahl, D., Hubbard, A., & Colford Jr, J. M. (2009). Evaluation of a pre-existing, 3-year household water treatment and handwashing intervention in rural Guatemala. *International Journal of Epidemiology*, *38*(6), 1651-1661.

Bakewell, O., & Garbutt, A. (2005). The use and abuse of the logical framework approach. Retrieved from dev.usaidlearninglab.org.

Bartram, J., & Cairncross, S. (2010). Hygiene, sanitation, and water: forgotten foundations of health. PLoS medicine, 7(11), e1000367.

Bakker, K. (2008). The ambiguity of community: Debating alternatives to private-sector provision of urban water supply. *Water alternatives*, *1*(2), 236-252.

Bekerie, A. (2003). Iquib and Idir: Socio-Economic Traditions of the Ethiopians. *Tadias (January-March 2004)*, 36.

Cooperrider, D. L., & Srivastva, S. (1987). Appreciative inquiry in organizational life. *Research in organizational change an development*, *1*(1), 129-169.

Dawson, C. (2005). *Introduction to Research Methods, 4th ed.* London, U.K.: Little Brown.

Desai, V., Potter, R.B. (2014). *The companion to development studies* (3rd ed.). New York, N.Y.: Routledge.

Earl, S. & Carden, F. (2002). Learning from complexity: The International Development Research Centre's experience with outcome mapping. *Development in Practice, 12*(3-4), 518-524.

Earl, S., Carden, F., & Smutylo, T. (2001). *Outcome mapping: Building learning and reflection into development programs.* IDRC, Ottawa, ON, CA.

Elfstrand, L., & Florén, C. H. (2010). Management of chronic diarrhea in HIV-infected patients: current treatment options, challenges and future directions. *HIV/AIDS (Auckland, NZ), 2*, 219.

Ellis, H., & Schoenberger, E. (2017). On the Identification of Associations between Five World Health Organization Water, Sanitation and Hygiene Phenotypes and Six Predictors in Low and Middle Income Countries. *PloS one*, *12*(1).

Fforde, A. (2017). Appendix 3 of Option 1—Reconstructivist Development Doctrines—'A Multitude of Tin-Openers': Diversity as the Central Principle of Reinvention. *Reinventing Development* (pp. 183-205). Palgrave Macmillan, Cham.

Freeman, M. C., Strunz, E., Utzinger, J., & Addiss, D. G. (2016). Interventions to improve water, sanitation, and hygiene for preventing soil-transmitted helminth infection. The Cochrane Library.

Fritz, J. (2018). How to talk about nonprofit impacts from inputs to outcomes. *The Balance: Small Business.* Retrieved from www.thebalancesmb.com.

Hasan, M. M., & Gerber, N. (2016). The impacts of piped water on water quality, sanitation, hygiene and health in rural households of north-western Bangladesh-a quasi-experimental analysis. *Discussion Papers on Development Policy, 217.*

Hearn, S. (2011). Introduction to outcome mapping. *International Development Research Centre.* Retrieved from www.outcomemapping.ca.

Holzapfel, S. (2014). The role of indicators in development cooperation: an overview study with a special focus on the use of key and standard indicators.

Intrac (2012). Theory of Change: What's it all about? *Ontrac: 51.* Retrieved from www.intrac.org.

Jacobsgaard, M., & Nørlund, I. (2011). The Impact of Appreciative Inquiry on International Development. *AI Practitioner*, *13*(3).

Kessler, E. H. (Ed.). (2013). *Encyclopedia of management theory*. Sage Publications.

Locatelli, B., & Pedroni, L. (2004). Accounting methods for carbon credits: impacts on the minimum area of forestry projects under the Clean Development Mechanism. Climate Policy, 4(2), 193-204.

MacCarty, N., Ogle, D., Still, D., Bond, T., Roden, C., & Willson, B. (2007). Laboratory comparison of the global-warming potential of six categories of biomass cooking stoves. *Aprovecho Research Center*, *6*.

Mintz, E. D., Reiff, F. M., & Tauxe, R. V. (1995). Safe water treatment and storage in the home: a practical new strategy to prevent waterborne disease. *Jama, 273*(12), 948-953.

Moore, K. A., Lippman, L., & Brown, B. (2004). Indicators of child well-being: The promise for positive youth development. *The Annals of the American Academy of Political and Social Science*, 591(1), 125-145.

Mosse, D. 2003. *The rule of water: Statecraft, ecology, and collective action in South India.* Oxford: Oxford University Press.

Msyamboza, K. P., Hausi, H., Chijuwa, A., Nkukumila, V., Kubwalo, H. W., Im, J., ... & Legros, D. (2016). Feasibility and acceptability of oral cholera vaccine mass vaccination campaign in response to an outbreak and floods in Malawi. *Pan African Medical Journal*, *23*(1).

Murray, A., Pierre-Louis, J., Joseph, F., Sylvain, G., Patrick, M., & Lantagne, D. (2015). Need for certification of household water treatment products: examples from Haiti. *Tropical Medicine & International Health*, *20*(4), 462-470.

Mwanamanga, R. (2015). *Does foreign aid promote growth?* (Unpublished master's thesis) University of Bradford, Bradford, United Kingdom.

OECD (2011). Busan partnership for effective development co-operation: Fourth high level forum on aid effectiveness, Busan, Republic of Korea, 29 November – 1 December 2011. Retrieved from www.oecd.org.

Ojomo, E., Elliott, M., Goodyear, L., Forson, M., & Bartram, J. (2015). Sustainability and scale-up of household water treatment and safe storage practices: enablers and barriers to effective implementation. International journal of hygiene and environmental health, 218(8), 704-713.

Parsons, J., Gokey, C., & Thornton, M. (2013). Indicators of inputs, activities, outputs, outcomes and impacts in security and justice programming. *Vera Institute of Justice*.

Ramesh, A., Blanchet, K., Ensink, J. H., & Roberts, B. (2015). Evidence on the effectiveness of water, sanitation, and hygiene (WASH) interventions on health outcomes in humanitarian crises: a systematic review. *PLoS One*, *10*(9).

Rao, C. R., & Statistiker,, M. (1973). *Linear statistical inference and its applications* (Vol. 2, pp. 263-270). New York: Wiley.

Roduner, D., Schläppi, W., & Egli, W. (2008). Logical Framework Approach and Outcome Mapping, A Constructive Attempt of Synthesis. Rural *Development News, 2*, 1-24.

Rowe, R. (2012). Household water treatment and safe storage in Malawi: A preliminary consultative study. *Government of Malawi: Ministry of Health, Department of Preventive Health Services.* Retrieved from www.300in6.org.

Sharma, M., & Bindal, A. (2014). Public-Private Partnership. *International Journal of Research (IJR)*, *1*(7), 1270-1274.

Shapiro, I. (2006). Extending the framework of inquiry: Theories of change in conflict interventions. *Berghof Research Center for Constructive Conflict Management*, *206*.

Sobsey, M. D., Water, S., & World Health Organization. (2002). *Managing water in the home: accelerated health gains from improved water supply* (No. WHO/SDE/WSH/02.07). Geneva: World Health Organization.

Stein, D., & Valters, C. (2012). *Understanding theory of change in international development.* London, U.K.: The Asia Foundation/The Justice and Security Research Programme, London School of Economics.

UNICEF (2018). Estimates of child cause of death, diarrhea 2018 [Data set]. Retrieved from data.unicef.org.

University of Western Australia (UWA) (2018). *Human Research Ethics.* Retrieved from www.research.edu.au.

Vogel, I., Stephenson, Z. (2012). Appendix 3: Examples of theories of change of Review. The use of 'theory of change' in international development (full report). *Research to Action.* Retrieved from www.researchtoaction.org.

Whitney, D. D., & Trosten-Bloom, A. (2010). *The power of appreciative inquiry: A practical guide to positive change*. Berrett Koehler Publishers.

WHO (2011). National Household Water Treatment and Safe Storage Strategies and Integrated Household Environmental Health Interventions. *WHO/UNICEF International Network on Household Water Treatment and Safe Storage in Collaboration with the Water Institute at UNC, Entebbe, Uganda*.

WHO (2013). Household water treatment and safe storage: Manual for the participant. Retrieved from www.who.int.

WHO (2017). Progress on Drinking Water, Sanitation and Hygiene: Update and SDG Baelines. World Health Organization & UNICEF. Retrieved from www.who.int.

WHO & UNICEF (2007). Rapid assessment of drinking water quality; Summary report. Retrieved from www.who.int.

Wolf, J., Hunter, P. R., Freeman, M. C., Cumming, O., Clasen, T., Bartram, J., ... & Prüss-Ustün, A. (2018). Impact of drinking water, sanitation and handwashing with soap on childhood diarrhoeal disease: updated meta-analysis and meta-regression. *Tropical medicine & international health*, *23*(5), 508 525.

Wright, J., Gundry, S., & Conroy, R. (2004). Household drinking water in developing countries: a systematic review of microbiological contamination between source and point-of-use. *Tropical medicine & international health*, *9*(1), 106-117.

Yami, T. L., Sabatini, D. A., & Busenitz, L. W. (2017). Using business models in designing market-based solutions: the case of fluoride treatment systems. *Journal of Water Sanitation and Hygiene for Development*, washdev2017117.

10) Appendices

1. HWTS administration in Ethiopia - Concepts in the Logical Outcome Assessment Framework

- **Vision**: All Ethiopians have access to safe drinking water at POU.
  - **Indicator**: All Ethiopians have constant access to a water filter.
- **Mission:** Support of Aqua for All for key actors – NGOs, government, HWTS producers, water boards – in the creation of a sustainable business case surrounding the provision and maintenance of HWTS systems.
- **Project Partners**
  - Government bodies – Municipalities
  - Technical HWTS team
    - Producing and maintaining
  - NGOs
    - Funding and setting up of the project
- **Outcome challenges for Project Partners**
  - **Government bodies - Municipalities**
    - Finding financial support by investment fund
    - Supervising production, provision, and maintenance of HWTS systems
    - Adequate facilitation of extensive up-scaling of HWTS provision
    - Assuring adequate usage and maintenance of HWTS systems
  - **Technical HWTS team – Utilities**
    - Organize large-scale production of HWTS systems
    - Collect fees of water HWTS usage
      - Micro financing
    - Assure maintenance of HWTS systems
    - Assure responsible usage of HWTS systems (also on behalf of municipality government bodies)
  - **NGOs**
    - Finding financial support by investment fund
      - Outcome payers
    - Assure synergy between relevant parties
    - Facilitate sustainability in the project
    - Making HWTS systems affordable without distorting the market
- **Project outcomes**
  - Households of different income groups in Ethiopia correctly and consistently use HWTS systems
    - This benefits:
      - Diarrhea and STH prevalence
      - Financial security
      - Social capital
      - CO_2 emission mitigation
      - Plastic usage
      - Gender equality
      - HIV treatment
  - There is an extended sustainable supply chain in Ethiopia for different household filters reaching end users in urban and rural areas
  - Outcome payers enable suppliers and intermediaries to sustain and increase the market for HWTS systems

2. Interview guides

Ethiopia interviews Finote Selam test group:

- Who is benefitting most from use of the filter?
    - In what way?
- How did you come to know about the filter?
- Do you like the filter just as much as you were told you would, including its cost?
    - Why (not)?
    - Are there any negative aspects about the filter?
- What are the main reasons or buying the filter?
- What measures do you take to prevent your family from becoming ill, besides the filter?
- Is the water filter saving you time in any way?
    - In what way?
    - What are you doing with your saved time?
- How has use of the filter changed your social life?

Interviews Finote Selam control group:

- Do you have any information about the availability of household water filters?
- Why did you decide not to purchase a filter?
- Is the water you drink clean from disease?
    - How do you know?
- What measures do you take to prevent diarrhea and waterborne diseases in your family?
- Who takes care of family members when they are ill?
- Is your family ill often?
    - What kind of illness?
    - How is this impacting your lives?

Ethiopia interviews Debre Markos:

- Is the water you drink clean from disease?
    - How do you know?
    - What are the biggest problems related to the water quality here?
        - What could be a solution according to you?
- Do you take any measures to prevent waterborne diseases such as diarrhea or typhoid in your family?
- Is your family ill often?
    - How frequent is this problem?
    - Who is most often affected by diarrhea or any other waterborne disease in your family?
- Do you have any information about the future sales and distribution of water filters in Debre Markos through the water utility?
    - If yes → how did you get this information?
    - What do you think is the best way to get all the people of Debre Markos to know about the availability of filters on sale?
- Distribution and sales of water filters will begin shortly in Debre Markos, to solve the problems of water quality, diarrhea, and other waterborne diseases. Would you be interested in purchasing such a solution?
    - If no → why not?
    - Would you be interested in making use of the installment system?

Malawi interviews

- Is the water you drink clean from any diseases?
    - How do you know?
    - What are the biggest problems related to water quality here?
        - For whom in your family is this the biggest problem?
    - Are there any wells which are bad – which make people sick?
    - How important is this in your community?

    - What do you do to solve it?
    - What are your daily concerns regarding drawing water?
- Is your family ill often?
    - Do you go to the clinic?
    - Who takes care of whom when you are ill?
- Who takes care of the water in your house?
    - How much time is spent on this per day or per week?
    - Do you use the same water for washing, cooking, and drinking?
- Distribution and sales of household water filters will begin shortly this area, to solve the problems of water quality and other waterborne diseases. Would you be interested in purchasing such a solution? The price will be around 10,000 kwacha and you will be able to pay in installments.
    - Why (not)?
- Are you part of any working group in your community?
    - If yes, what kind of working group?
        - What is the role of drinking water in the working group?
- Is your main well broken often?
    - Where do you go when/if the well breaks?