

The individual and the system

A qualitative research combining behavioural theories and system analysis to identify entry-points for interventions for the extension services in Mere-Mieti, Ethiopia



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Abstract

Ethiopia is very vulnerable to the impacts of climate change, especially droughts, because most of Ethiopia's rural inhabitants are involved in subsistence farming, and do not have irrigation systems in place (CIA, 2019; World Bank, 2019; World bank, GFDRR, CIF & ENV, 2011). Droughts in the past have had severe impacts on Ethiopia's natural resources and have caused food shortages (CIA, 2019; USAID, 2016; World Bank, et al., 2011). To increase the agricultural production and mitigate the impacts of climate change, an increase in the implementation of sustainable agricultural adaptation strategies in rural Ethiopia is required (Aggarwal, et al., 2018).

This paper researched the contribution of combining behavioural theories and system analysis in a framework to assess why farmers will or will not implement such adaptation strategies.

This paper therefore applied the Transdisciplinary Conceptual Framework of Lambe, et al. (2020), which includes behavioural theories and system analysis, on a case study in Mere-Mieti: a collective of villages in rural Ethiopia. The paper mapped out the farmers' individual implementation process of adaption strategies. It identified the critical points (points of possible obstacles) in the implementation process and linked elements of behaviour to these points. Then it mapped out what systemic factors influenced the farmers' implementation process. These two mappings were combined to see how the systemic factors influenced specific critical points in the implementation process. This analysis was used to identify entry-points for interventions for the extension services in Mere-Mieti. The extension services are set up by the Ethiopian government to help farmers implement sustainable adaptation strategies that increase farm production and improve the farmers' livelihoods as well as protect Ethiopia's natural resource base.

This paper concluded that the entry-points were strongly influenced by the systemic factors, which in turn influenced the status of the behavioural elements at the critical points for the farmers. The behavioural elements can be seen as tools to zoom in on what issues the systemic factors exactly create at these critical points. Including these elements of the behavioural change theories can contribute to a better understanding of the reasonings of the farmers regarding the implementation of adaptation strategies. However, the paper showed that including the systemic factors in analysing the implementation process of sustainable agricultural adaptation strategies is the backbone for a complete understanding of the farmers' behaviour.

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List of abbreviations

| | |
|---------|---|
| NAP-ETH | National Adaptation Plan Ethiopia |
| BCW | Behaviour Change Wheel (Michie, Van Stralen, & West, 2011) |
| COM-B | Behavioural system of ‘capability, opportunity and motivation’ (Michie, et al., 2011) |
| BDA | Behavioural Design Approach (Datta, & Mullianathan, 2014) |
| TCF | Transdisciplinary Conceptual Framework (Lambe, et al., 2020) |
| DA | Development agent |
| FTC | Farmers Training Centre |
| PSNP | Productive Safety Net Program |

1. Introduction

Issues surrounding climate change dominate the current global policy debates. Scientists and politicians differ about their ideas of how to best address the consequences of climate change. This is partly due to the difference in impacts of climate change across the world. In Ethiopia, the main consequences of climate change are the increase and intensification of droughts and floods (World Bank, 2019). These threats have major consequences for the economic, agricultural and infrastructural sectors (Kotir, 2011; Menghistu, Mersha, & Abraha, 2018; World Bank, GFDRR, CIF, & ENV, 2011). Agricultural and pastoral sectors in developing countries are especially vulnerable to the impacts of climate change, as they are dependent on natural resources (Berrang-Ford, Ford, & Paterson, 2011). It is important for these sectors to anticipate on the impacts of climate change. However, developing countries seem less able than developed countries to implement climate change adaptation strategies at the rates needed to increase their resilience to the consequences of climate change (Berrang-Ford, et al., 2011; Fankhauser, & McDermott, 2014; Jones, Ludi, & Levine, 2010).

Problem statement

Ethiopia is very vulnerable to increasing droughts, because 80% of the population lives in rural areas, and 85% of the population is currently employed in agriculture (CIA, 2019; World Bank, 2019). The agricultural sector is the main driver of the Ethiopian economy (USAID, 2016; World Bank, et al., 2011). Most of Ethiopia's rural inhabitants are involved in subsistence farming (World bank, et al., 2011). These farmers mainly depend on rainfall and usually have no elaborate irrigation systems. Additionally, the options for livelihood diversification are often limited (Federal Democratic Republic of Ethiopia, 2019; UNDP, 2020). Therefore, these smallholder farmers are especially vulnerable to the impacts of climate change (Baya, Gebreegziabher, & Sumago, 2019a; Baya, Nzeadibe, Nwosu, & Uzomah, 2019b; Federal Democratic Republic of Ethiopia, 2019; UNDP, 2020; World Bank, et al., 2011).

Impacts of droughts on food security

Droughts in the past have had severe impacts on Ethiopia's natural resources. They have decreased crop yields, damaged agricultural land, caused overgrazing and caused livestock deaths (CIA, 2019; USAID, 2016; World Bank, et al., 2011). This in turn has led to food shortages; severe droughts can decrease farm production by 90% (World Bank, 2019). Additionally, droughts decrease drinking water availability. Even though Ethiopia has

relatively much access to drinking water in comparison to its neighbouring countries; it has twelve river basins (geographical areas drained by a river), it also has trouble with efficiently storing water and evenly distributing water (World Bank, et al., 2011). It is therefore likely to experience more water shortages in the future (CIA, 2019; World Bank, 2019; World Bank, et al., 2011).

In the last thirty years, Ethiopia has experienced five famines caused by droughts (World Bank, et al., 2011). Yearly approximately 1.5 million Ethiopian are affected by a water-shortages, and during a severe drought this number can rise up to 5 million (World Bank, 2019). During the most recent period of drought, in 2015-2016, the majority of households relied on governmental financial support (71.25%), or turned to family members for financial support (10%) (Mengistu, et al., 2018). However, 30% of the rural households did not have other sources of income to compensate for the loss of farm crops due to the drought (Mengistu, et al., 2018). In a study done by Menghistu, et al. (2018) only 35% of the farmers who participated the study believed they could implement adaptations to cope with the impacts of droughts in the future. In cases of drought and famine, Ethiopia mostly depends on food aid (World Bank, et al., 2011). This dependence is expected to increase when Ethiopia's agricultural productivity does not improve (UNDP, 2020; World Bank, et al., 2011). Moreover, the soil and water shortages can possibly create conflicts over scarce natural resources (UNDP, 2020; World Bank, 2019; World Bank, et al., 2011).

Government's adaptation strategies

To increase the implementation of climate change adaptation strategies, and to increase the country's resilience to climate change impacts, the Ethiopian government launched the National Adaptation Plan (NAP-ETH) in 2017, which falls under the existing national Climate Resilient Green Economy Strategy from 2011 (NAP Global Network, 2017). The NAP-ETH aims to mainstream climate change adaptation strategies and make it part of Ethiopia's general development strategies (Federal Democratic Republic of Ethiopia, 2019). They aim to improve Ethiopia's food security, natural resources base and resilience to climate change by setting up extension offices that offer assistance with implementing sustainable adaptation strategies aimed at increasing farm production and improving livelihoods (Federal Democratic Republic of Ethiopia, 2019; NAP Global Network, 2017). These extension offices have three or four development agents (DAs), who give advice on their expertise areas (crops, livestock and natural resources) (Federal Democratic Republic of Ethiopia, 2019; NAP Global Network, 2017). They encourage the use of drought-resistant and early maturing crop

varieties, improve access to and knowledge of better weather forecasting systems and introduce improved agricultural technologies (small-scale irrigation), as well as promote non-farming livelihood diversification (Federal Democratic Republic of Ethiopia, 2019; World Bank, et al., 2011).

The small-scale farmers traditionally have had their own strategies to cope with the impacts of droughts and they are autonomous in their decisions about implementing new climate change adaptations (Asrat, & Simane, 2018; Ayal, Abshare, Desta, & Leal Filho, 2017). Farmers only implement adaptations when they have the confidence that these will help them improve their livelihoods, and this is very dependent on the local context (Asrat, & Simane, 2018; Ayal, Abshare, Desta, & Leal Filho, 2017). Unfortunately, research up until today has indicated that the government hasn't incorporated the local context enough in designing agricultural interventions (Asrat, & Simane, 2018; Ayal, et al., 2017; Berger, et al., 2017; Menghistu, et al., 2018). Several studies recommend the government to focus on incorporating the local context when developing adaptation strategies or facilitating the scaling up of local strategies that are already present (Baya, et al., 2019b; Gebru, Van Steenberg, & Hagos, 2016; Menghistu, et al., 2018). The assistance provided by the government does have the potential to reduce vulnerability to droughts, but only if it is designed to suit the local context (Ayal, et al., 2017; Berger, et al., 2017).

Development relevance: Selection of adaptation strategies

To increase the agricultural production and mitigate the impacts of climate change, an increase in the implementation of sustainable agricultural adaptation practices in rural Ethiopia is required (Aggarwal, et al., 2018). This is easier said than done, as smallholder farmers individually decide whether or not they implement adaptation strategies on their farms (Berger, et al., 2017; Gorddard, Colloff, Wise, Ware, & Dunlop, 2016; Mersha, & Van Laerhoven 2018; Moser, & Ekstrom, 2010). Several studies have researched the most commonly used adaptation strategies. These included crop storage, saving up money, implementing natural resource management mechanisms, changing planting and managing date of crops, using fertilizers and livelihood diversification amongst which migration, but also praying and asking for gods interventions is a commonly used and highly appreciated strategy (Baya et al., 2019b; Berhe, et al., 2017; Onoja, Abraha, Girma, & Achike, 2019). One way for the government to gain insight into the local context of farmers, is by focusing on why these strategies are more commonly implemented than others. Smallholders are for example influenced by their believe in their own capabilities of implementing the adaptation

strategies, by the mental and physical abilities they have, by society's norms and values, by the environmental opportunities they have, by other actors and by contextual processes of the system which they are part of (Ajzen, 1991; Bandura, 1977; Cialdini, Kallgren, & Reno 1991; McLeod, Hine, Please, & Driver, 2015; Michie, Van Stralen, & West 2011; Levin, 1998; Slovic, Finucane, Peters, & MacGregor, 2004). Decisions of farmers regarding the implementation of climate change adaptation strategies, are decisions about whether they will change their behaviour, which are influenced by the broader context in which the farmers live (Blackstock, Ingram, Burton, Brown, & Slee, 2010; Levin, 1998, Lambe, et al., 2020). Focussing on what influences the decisions of farmers to implement adaptation strategies and in what way the system in which they live influences this implementation process, can help to provide insight into what issues can inhibit farmers from implementing an adaptation strategy.

Academic relevance: Knowledge gap in previous research

The majority of the studies on climate change adaptation strategies in Ethiopia have come up with a list of factors that influence the choice of an adaptation strategy. These factors include gender and age of head of household, household size, education level, level of available finances, farm size, participation in cooperatives, livestock ownership and production, access to weather and temperature information, access to natural resources, access to agricultural extension services and the environmental context (Asrat, & Simane, 2018; Ayal, et al., 2017; Berhe, et al., 2017; Deressa, Hassan, & Ringler, 2011; Gebrehiwot, & Van der Veen, 2013; Gebru, Ichoku, & Phil-Eze, 2018; Onoja, et al., 2019). However, a lot of these studies do not extensively zoom in on the underlying reasonings of the farmers to explain why they chose certain adaptation strategies. Even though, in the last few years, more research has included elements of behavioural science in explaining farmers adaptation behaviour, these studies often only focusses on separate influences on behaviour, such as attitudes, economic incentives, the social context, cultural roles and/or indigenous knowledge, but not on the behavioural change process as a whole (Bagagnan, Ouedraogo, Fonta, Sowe, & Wallis, 2019; Barnes Truelove, Carrico, & Thabrew, 2015; Dang, Li, Nuberg, & Bruwer, 2014; Lambe, et al., 2020; Momvandi, Omidi Najafabadi, Hosseini, & Lashgarara, 2018; Yazdanpanah, Feyzabad, Forouzani, Mohammadzadeh, & Burton, 2015).

Additionally, different stakeholders are influenced differently by the same interventions, based on their different positions in the system (Notenbaert, Pfeifer, Silvestri, & Herrero, 2017). A focus on power-relations and systemic factors related to the intervention, is

therefore also important when designing climate change adaptation interventions. System analysis aims to assess the connections and influences between all actors and processes related to the implementation process (Lambe, et al., 2020). System analysis sees individuals as behaving in patterns based on their direct surroundings, thus their local context (Levin, 1998). Identifying how these patterns are influenced, will provide more insight into how the local context influences the reasons of why farmers will not implement certain adaptation strategies.

Thus, combining theories about behavioural change processes with system analysis, can help to identify obstacles for the implementation of adaptation strategies. This knowledge can consequently be used to finetune interventions aimed at increasing the implementation of adaptation strategies.

In general, this research is about how societies can adapt to climate change, a pressing global issue due to the increasing problems caused by climate change. Additionally, it links to the food security literature, which focusses on how agricultural productivity can be increased to sustain or improve the livelihoods of rural inhabitants (Baya, et al., 2019a; Baya, et al., 2019b). And lastly, it relates to improving a design framework for development interventions, as it helps to identify obstacles in the implementation process of adaptation strategies, which can be used as entry-points for interventions. This paper will combine the use of behavioural theories and system analysis to identify entry-points for interventions aimed at increase the implementation of adaptation strategies in a case study in Northern Ethiopia.

This paper will first present the theoretical literature review and theoretical framework. In this part, the behavioural change theories and the system analysis approach that will be used in the theoretical framework are discussed. Following the theoretical framework, the paper will present the research questions. The paper continues with the method section of the research. It then discusses the relevant regional and national context, before zooming in on a case study in Mere-Mieti, a collection of villages in the north of Ethiopia. The case study is used to assess how the framework can explain the farmers' implementation process of adaptation strategies. This understanding is then used to identify entry-points for the governmental extension services (aimed at increasing the implementation of sustainable agricultural practices) in Mere-Mieti. The paper concludes with a discussion, reference list and appendixes.

2. Theoretical literature review and theoretical framework

Behaviour and behavioural change theories

The central focus of this section will be on how theories about behaviour originating from the socio-psychological science field can improve the design of development interventions aimed at behavioural change. Behaviour is defined as “the internally coordinated responses (actions or inactions) of [humans] (individuals or groups) to internal and/or external stimuli” (Levitis, Lidicker, & Freund, 2009, pp. 103). The first part of this chapter will describe three different categories of behavioural theories and concludes with the Behaviour Change Wheel (BCW) of Michie et al. (2011) which incorporates the three categories of behavioural theories and links them to elements of development interventions. The second part of this chapter describes the Behavioural Design Approach (BDA) by Datta and Mullianathan (2014). The last part of this chapter concludes with the Transdisciplinary Conceptual Framework (TCF) by Lambe, et al. (2020), which is a combination of the BDA of Datta and Mullianathan (2014) and the BCW of Michie et al. (2011). This framework will form the basis of the theoretical framework that will be used in the case study.

Rational theories

Most early behavioural theories assume that individuals think rationally. Individual choices are made by evaluation the costs and benefits from all available options and choosing the one that has the most benefits, and the lowest costs (Ajzen, 1991). These theories assume that people’s choices are always based on the maximization of personal benefits, and therefore are egocentric at its core (McLeod, et al., 2015). The cost-benefit analyses are based on the probability of the expected outcomes of behaviour and the values individuals give these expected outcomes (Ajzen, 1991).

Rational theories give us insights into conscious cognitive processes, but do not take the unconscious cognitive processes into account. More often than not, behaviour is not rational. It is influenced by external factors and internal processes that inhibit the optimal rationalization of the choice made (Datta, & Mullianathan, 2014). Rational theories, for example, do not include the influence of the social and cultural context on the evaluation of behavioural options. Therefore, these rational theories only explain a part of human behaviour (Richburg-Hayes, Anzelone, Dechausay, & Landers, 2017).

Normative theories

Normative theories do acknowledge the influence of social values and norms in the creation of behavioural intentions (McLeod, et al., 2015). Individuals' attitudes and behaviours are influenced by the social and cultural environments in which they live (Blackstock, et al., 2010). These socio-cultural subgroups have their own value-systems, which determine what is seen as "good" agricultural practices and what entails a "good" farmer (Blackstock, et al., 2010). Farmers are more inclined to implement climate change adaptation strategies when this gives them social capital, such as peer-approval and social status. Therefore, adaptation strategies need to fit the social and cultural conceptions of "good" practices (Blackstock, et al., 2010). It is also important to realize that scientific concepts of "good" agricultural practices do not necessarily correspond with these social and cultural concepts of "good" practices (McLeod, et al., 2015). Social norms are not the only factors that influence behaviour, but they have a strong influence on the creation of behavioural intent.

Affect theories

The previous theories have mostly focused on the cognitive rationalization of behaviour, modified by external social influences. However, they have not accounted for the influence of emotions and automatic cognitive processes on behaviour. Affect is the either positive or negative intuitive feeling one gets when evaluating decision options (Slovic, et al., 2004). There are two systems with which people make decisions; the analytic system, which is based on rationality and is conscious, and the experiential system, which is based on affect, emotion and is intuitive/unconscious (Slovic, et al., 2004). Trust is for example such an influential subconscious feeling that creates feelings of affect and influences the way in which information is evaluated (Blackstock, et al., 2010). Affect and emotions are therefore important subconscious influencers of behaviour (Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008).

Behaviour Change Wheel (BCW)

The Behaviour Change Wheel of Michie, et al. (2011) incorporates all of the key elements of rational, normative and affect theories in the behavioural system of 'capability, opportunity and motivation' (COM-B), see Figure 3.2 (Michie, et al., 2011, p.4).

Capability includes both physical capability (physical power, skills, ability) and psychological capability (knowledge and understanding) of executing the behaviour (Michie,

et al., 2011).

Opportunity is related to external factors, and refers to physical opportunity (having tools available) and social opportunity (facilitating socio-cultural norms and values).

Opportunity thus incorporates the normative theories about behaviour (Michie, et al., 2011).

Lastly, motivation refers to the decision-making part of behaviour. It includes both reflective motivation (conscious brain processes, including imagining consequences of behaviour, making decisions, weighing costs and benefits) and automatic motivation (unconscious brain processes, including habits and emotions) (Michie, et al., 2011). The element of reflective motivation relates mostly to the rational theories of behaviour (or analytic decision systems) and the element of automatic motivation relates mostly to the affect theories of behaviour (or experiential decisions systems) (Michie, et al., 2011).

The two elements of capability (psychological and physical) and the two elements of opportunity (physical and social) both influence the two elements of motivations, or two decision systems, see Figure 3.1 (Michie, et al., 2011, p.4). Capability, opportunity and motivation have an influence on practiced behaviour, but practiced behaviour also has an influence on the three elements (Michie, et al., 2011).

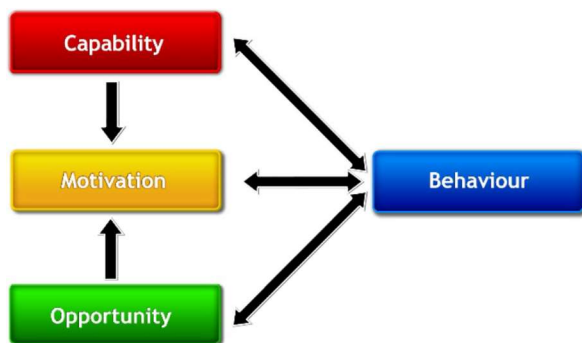


Figure 3.1. Capability, opportunity and motivation elements of behaviour (COM-B).

Reprinted from “The behaviour change wheel: A new method for characterising and designing behaviour change interventions”, by S. Michie, M.M. van Stralen, & R. West, 2011, *Implementation Science*, 6(1), 4.

Behavioural Design Approach (BDA)

While Michie et al.’s (2011) model does incorporate ‘unconscious mental processes’ in the element of automatic motivation, they do not zoom in on the various ways in which mental processes can influence behaviour. Datta and Mullianathan (2014) do this elaborately as a part of their Behavioural Design Approach. They argue that the relationship between behavioural intention and practiced behaviour is not as strong as the rational behavioural theories, and also

the BCW, argues it to be. Datta and Mullianathan (2014) start their reasoning by stating that resources are scarce; an assumption shared in both economic and environmental studies. Consequently, they argue that mental resources are scarce too (Datta & Mullianathan, 2014). They distinguish between four common scarcities of mental resources: a scarcity of self-control, a scarcity of attention, a scarcity of cognitive abilities and a scarcity of understanding (Datta & Mullianathan, 2014). These scarcities can influence the creation of behavioural intent, but can also influence the transition of behavioural intent towards practiced behaviour (Datta & Mullianathan, 2014). This implies that intent can already be present with farmers, but something else is inhibiting them from practicing the intended behaviour (Datta, & Mullianathan, 2014). This is where this approach differs from that of Michie, et al. (2011), as they assume that behavioural intent is a good predictor for practiced behaviour.

Mental models

For example, a lack of understanding can stem from different mental models adhered by the farmers and the designers of the intervention (Datta & Mullianathan, 2014). We all have mental models about how the world works (Datta & Mullianathan, 2014). These are our realities, our truths, and they can differ per person (Datta, & Mullianathan, 2014). For example, the realities between a non-religious and a religious individual can differ significantly. However, these mental models can also refer to what 'evidence' is trusted by a person; something that is scientifically proven, is not automatically believed by everybody, as the concept of 'human caused climate change' proves. Different mental models between farmers and the employees of the extension office (development agents) can influence the farmers' understanding of the information given. Mental models are thus very much related to the knowledge base of someone (Datta, & Mullianathan, 2014). Mental models are not so much unconscious mental processes, but more implicit reasonings; ways in which we understand the world works. These mental models can create a scarcity of attention; when someone thinks information is not useful for them, they are less likely to pay attention to this information (Datta, & Mullianathan, 2014).

Critique

One of the main issues with the behavioural theories in the context of development interventions in agricultural contexts is that they don't include the broader socio-economic-ecological context (Lambe, et al., 2020). It does not incorporate the motivations and

influences of other actors at play which creates power-relations and inequality issues about access and resources (Lambe, et al., 2020). Furthermore, they do not acknowledge the rigid influence of religion on social norms. This while social cohesion and religion are very important in the Ethiopian society. Without taking all these other factors in account, the commonly used behavioural theories in agricultural studies can only explain so much of the farmers' behaviour. Moreover, the theories focus on explaining and changing behaviour in one point in time (Lambe, et al., 2020). They do not acknowledge the influence of the sequencing interventions on the behavioural change process, and the importance of behavioural patterns in time (Lambe, et al., 2020). Additionally, the theories are focused on individuals or individual households. To scale up interventions, the theories should be more generalizable (Lambe, et al., 2020). Lastly, farmers' own knowledge about behaviour should be included more (Baya, et al., 2019b; Gebru, Van Steenberg, & Hagos, 2016; Menghistu, et al., 2018). These behavioural change theories are mostly designed in a Western world. Since mental models differ in different areas of the world, the farmers should be more than just passive recipients of knowledge. Co-creation should be a highlighted component of a behavioural change theory in the context of agricultural adaptation interventions (Winschiers-Theophilus, Chivuno-Kuria, Kapuire, Bidwell, & Blake, 2010).

Transdisciplinary Conceptual Framework (TCF)

Lambe, et al. (2020) combined the Behavioural Design Approach of Datta and Mullianathan (2014) and the Behaviour Change Wheel of Michie, et al. (2011), while incorporating the influence of the socio-ecological context by using the complex adaptive systems analysis. The TCF therefore also acknowledges the influence of structural processes and power-relations between actors on the behaviour of farmers (Lambe, et al., 2020). It incorporates the differences in behaviour and motivations for different actors and groups together so that interventions can be based on categorizations of farmers, instead of on individual households (Lambe, et al., 2020). Furthermore, it acknowledges the (indirect) influence of other actors on the behaviour of the farmers. Lastly, it emphasizes that behavioural change processes are complex and often entail changing multiple behaviours at multiple points in time. It is therefore very much focused on the importance of the timing and sequencing the interventions in assisting behavioural change (Lambe, et al., 2020).

Complex adaptive system

Behaviour and decision-making processes do not happen in isolation, but are imbedded in these complex adaptive systems of actors and processes (Lambe, et al, 2020; Levin, 1998). Like a flock of birds, you adjust behaviour to direct surroundings, and these direct surroundings adjust behaviour consequently. This creates a system in which patterns of behaviour arise (Levin, 1998). Actors interact in unstructured ways and patterns and feedback loops created by these interactions can change other parts of the system (Levin, 1998). Identifying opportunities for changing these patterns and feedback loops is the intention of behavioural change interventions. This requires an understanding of the forming of current behaviour in the system. How is this behaviour related to its surroundings? Alterations in the patterns of the complex system contribute to the shift of one stable state of the system to another (Levin, 1998). This shift is what sustainable adaptation intervention try to achieve; a shift from unsustainable behaviour to sustainable behaviour, see Figure 3.2 (Lambe, et al., 2020, p. 3).

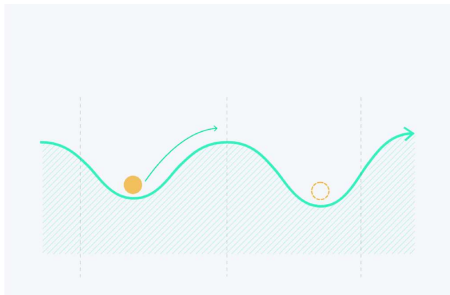


Figure 3.2. Behaviour change as a transition from one state of the complex adaptive system to another. Reprinted from “Embracing complexity: A transdisciplinary conceptual framework for understanding behavior change in the context of development-focused interventions” by F. Lambe, et al., 2020, *World Development*, 126, 3.

Stages

The TCF has six stages. This paper will focus on two of these stages. The first relevant stage for this paper consists of an experience-based problem diagnosis done via user journey mapping (Lambe, et al., 2020). In this stage the recipients of the intervention identify the key behavioural bottlenecks in different stages of the complex behaviour change, see Figure 3.3 (Lambe, et al., 2020, p. 7). Journey mapping identifies which elements of behaviour can potentially inhibit behaviour change (Lambe, et al., 2020). It is therefore based on the COM-B model of Michie, et al. (2011). Journey mapping thus identifies the points in the behavioural change process, during which participants might require extra assistance (Lambe, et al.,

2020). The behavioural change process has three phases: the before, the during and the after phase. The before phase consists of preconditions for behavioural change, the during phase is where behaviour is actively changed and the after phase is where the behavioural change has become a habit. In the during phase the actor's expectations constructed in the before phase need to be met, for the motivation of changing behaviour to be sustained (Lambe, et al., 2020).

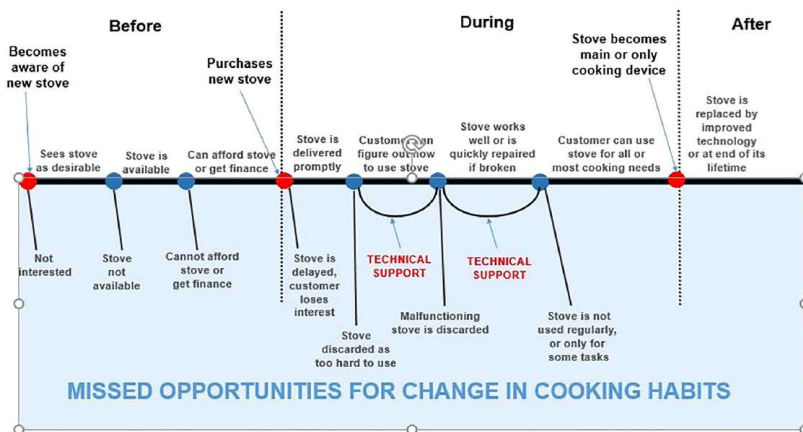


Figure 3.3. Example of a journey map. The red and blue dots symbolize key behavioural decision moments, in which the process of behavioural change can be disturbed. Reprinted from “Embracing complexity: A transdisciplinary conceptual framework for understanding behavior change in the context of development-focused interventions” by F. Lambe, et al., 2020, *World Development*, 126, 7.

The second stage relevant for this paper consists of a system mapping method (Lambe, et al., 2020). This stage is focused on all actors and processes in the complex system related to the intervention (Lambe, et al., 2020). The mapping is focused on the broader context, on the complex adaptive system itself and on all possible (social, economic, ecological, environmental and institutional) influences these actors and processes on the targeted behaviour (Lambe, et al., 2020). The system mapping method thus contributes to identifying possible bottlenecks in the behavioural change process due to the influence of the system on the behaviour of the participants (Lambe, et al., 2020).

Both the outcomes of the stages are used to distinguishing different entry-points for interventions (Lambe, et al., 2020). The two mappings also contribute to determining the most efficient sequencing of development interventions, see Figure 3.4 (Lambe, et al., 2020, p. 4-5). The focus of both stages lies on co-creation, which includes all actors (in)directly related to the intervention in the defining of the problem and consequently the design of the

intervention (Lambe, et al., 2020).

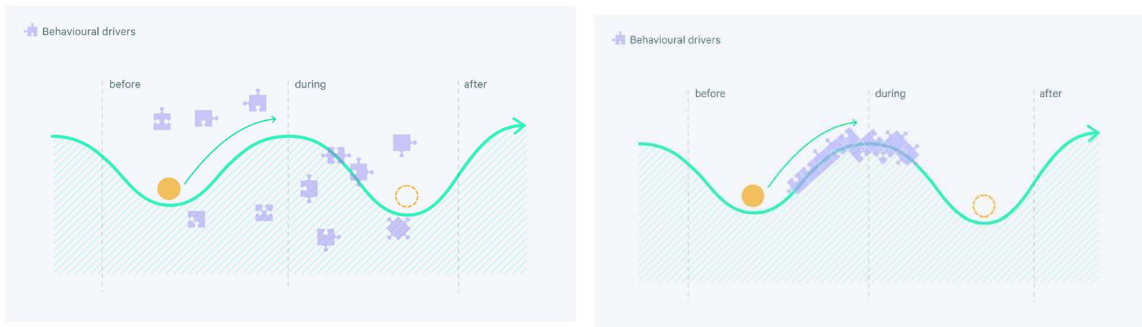


Figure 3.4. Sequencing of interventions without taking journey mapping and system mapping into account, versus sequencing of interventions with taking journey mapping and system mapping into account. Reprinted from “Embracing complexity: A transdisciplinary conceptual framework for understanding behavior change in the context of development-focused interventions” by F. Lambe, et al., 2020, *World Development*, 126, 4-5.

Theoretical Framework

The theoretical framework used in this paper is based on the Transdisciplinary Conceptual Framework from Lambe, et al. (2020), see Figure 3.5 (Lambe, et al., 2020). This framework incorporates the three behavioural elements of the Behavioural Change Wheel, with the six corresponding sub-elements. It entails a journey mapping where critical behavioural points before and during the implementation process of an adaptation strategy are identified. These critical points focus on the users’ experience with the new adaptation strategy, starting from being aware of a possible strategy, to the decision to implement a strategy and to the new strategy turning into the ‘new normal’. For each critical point, the different elements of behaviour that require extra assistance are identified. Next, the external influences from actors and processes are assessed with a system mapping. The actors include for example the government, the organization behind the intervention, the beneficiaries of the intervention, local community leaders and religious leaders and indirectly related actors, such as the actors related to the crop-market (Lambe, et al., 2020). The processes entail both formal rules and laws, as well as informal rules and traditional/cultural/social norms and values (Lambe, et al., 2020). These actors and process have an influence on the behavioural elements of farmers. These actors and processes can either be facilitating in the fulfilment of these elements, or they can inhibit the fulfilment of these elements. Additionally, the actors and processes also have a direct influence on the critical points as identified in the journey mapping.

Combining the journey mapping and the system mapping will give an overview of all critical points in the implementation process, as well as the influences of the broader system on these critical points. These critical points can be used as entry-points for interventions.

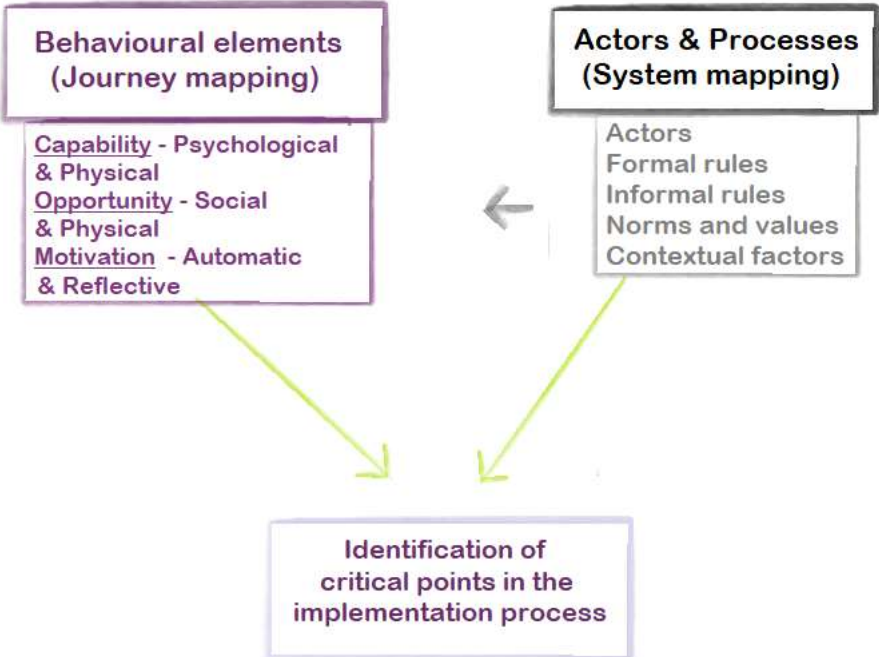


Figure. 3.5. Theoretical framework used for this research, based on the TCF of Lambe, et al. (2020).

3. Research questions

As described in the introduction, this paper will research to what extent behavioural change theories combined with system analysis can contribute to the understanding of Ethiopian farmers' implementation of process of adaptation strategies. It consequently looks into to how this understanding can contribute to the identification of entry-points for interventions for the extension services in Mere-Mieti.

The main research question is:

How does the Transdisciplinary Conceptual Framework (TCF) of Lambe, et al. (2020) * contribute to the identification of entry-points for interventions for the extension services** in Mere-Mieti, Ethiopia?

The sub-questions are:

What are the critical points in the farmers' implementation process of adaptation strategies*** in Mere-Mieti?

What are the systemic factors influencing the farmers' implementation process of adaptation strategies*** in Mere-Mieti?

* A framework on the design of development interventions, based on behavioural change theories and system analysis

** The extension services are part of the National Adaptation Plan launched by the Ethiopian government. The NAP-ETH aims to mainstream climate change adaptation strategies and make it part of Ethiopia's general development strategies. The extension services are part of the extension offices that are set up in each Kebele, the lowest administrative unit in Ethiopia. In each extension office there are three to four development agents that assist in providing extension services to improve the implementation of sustainable agricultural strategies (Federal Democratic Republic of Ethiopia, 2019; NAP Global Network, 2017).

*** In practice, not much difference is made between interventions aimed at mitigating the consequences of climate change and general agricultural strategies aimed at improving livelihoods (Birner, et al., 2009). Therefore, this paper will use the concept 'adaptation strategies' which entails both climate change adaptation strategies (natural resource management) and strategies aimed at improving the agricultural productivity. Even though these strategies might not always be directly related to mitigating climate change: their common goal is improving the sustainability of livelihoods.

4. Method

This chapter will introduce the method used for this research and elaborate on the research instruments used. The research was supposed to take place from the tenth of February until the sixteenth of May over a period of fourteen weeks. The research was originally designed to take place in two research areas: the villages of Mere-Mieti and Ilkim, located in the proximity of Mekelle, in the district of Tigray. However, due to the corona-virus pandemic, the researcher was forced to return home after six weeks of field research and only qualitative research had been done in the village of Mere-Mieti during that time. Therefore, the research design and method were revised afterwards. The research was done in collaboration with the University of Mekelle. Doctor Kebede Manjur was the local supervisor for this research.

Design

Due to the corona-pandemic the research methods used to collect the data in Mere-Mieti were designed on the basis of the old research questions. After coming back to the Netherlands, the research questions were altered slightly. The data was afterwards used as much as it could, as it was very much related to the current research questions. However, in the six weeks the researcher was in the field, only qualitative research methods were used. Unfortunately, the research design was thus altered from a mixed method design to ensure data triangulation, to a qualitative research method. However, qualitative research is still very valuable in unravelling the story behind the factors that have already been established to influence the farmers adaptation behaviour in previous studies.

Research instruments

In the first section of this paper a theoretical framework was established. In the second section, this theoretical framework will be used on a case study to identify entry-points for interventions for the extension services in Mere-Mieti. This will be done by identifying critical points in the farmers' implementation process of adaptation strategies, and by identifying how systemic factors influence this implementation process. The case study will be based on the data collected in the first six weeks of the field-research. The goal of this analysis is theoretical refinement: "the elaboration or modification of pre-existing theory using new empirical material" (Hennink, Hutter, & Bailey, 2010, p. 260) The new empirical data is used to identify entry-points for interventions for the extension services in Mere-Mieti, and by doing so this paper also examines the contribution of the Transdisciplinary Framework in identify these entry-points for interventions.

Case study

Study area

The case study focusses on smallholder farmers in Mere-Mieti, a collective of three villages in the east of the Tigray district in Ethiopia. The collective consists of the village Mere-Mieti itself, the village of Ilkim and the village of Mikeyah. The data collection was done in Mere-Mieti the village. To avoid confusion, Mere-Mieti the village will hereby further be referenced as ‘Mere-Mieti (v)’. The total population of the collective of Mere-Mieti is 9631. The total areas of Mere-Mieti is 3611 hectares, of which 2083,25 is arable land and 303,75 hectares are irrigated. 1527,75 is non-arable land.

The study area was selected on the basis of its proximity to Mekelle (where the host organisation was located), its vulnerability to the impacts of climate change and its experience with an extension office. The study area was therefore not randomly selected, but purposively selected on the basis of their characteristics. The study area was suggested by the host university’s contact person: Kebede Manjur Gebru. Mere-Mieti (v) has access to electricity, it has several coffee houses and is located next to the main road. See Figure 4.1 for a picture of the main road that crosses through Mere-Mieti (v), and Figure 4.2 for an impression of Mere-Mieti (v). The village is located in the middle-highland areas.



Figure 4.1. The main road that crosses through Mere-Mieti (v).



Figure 4.2 Impression of Mere-Mieti (v)

Explorative Key Informant Interviews

The Key Informant Interviews (KIIs) were conducted with three development agents (DAs), who work in the local agricultural extension office in Mere-Mieti (v). These extension offices are located in every Kebele, the lowest administrative unit in Ethiopia. The purpose of these interviews was to gain more insight into how the extension services worked and how many farmers used the services. At the beginning of the KIIs, some background information of the participants was collected: name, place of origin, education level and job. See **Appendix A** for the interview guide used in these interviews.

Participants KIIs

In each Kebele there are three development agents. These are specialized in Crops, Livestock and Natural Resources and provide extension services (services aimed at increasing livelihoods, increasing farm productivity and improve natural resources) to smallholder farmers. Sometimes a fourth development agent is also present. This DA is specialized in Corporations and is usually assigned to multiple Kebeles. The participants for the KIIs were selected with the help of the translator, Amsalu Mengistu (from the Department of Rural and Agricultural Extension at the Mekelle University) and a local facilitator; the head of the extension office of Mere-Mieti. Therefore, the selection strategy of the participants was purposive; the DAs were selected on the basis of their expert knowledge about the extension services. All interviews were conducted in Mere-Mieti (v). See **Appendix B** for an overview

of the participants of the KIIs. Two of the interviews were held outside, and one inside, to suit the convenience of the participants.

Semi-structured In-depth Interviews

The semi-structured in-depth interviews were conducted to gather more in-depth information about the reasoning of farmers regarding the implementation of sustainable adaptation strategies. Why do they, or do they not, implement certain adaptation strategies? What factors influenced their decision? Fourteen interviews have been conducted. At the beginning of the in-depth interviews, some background information of the participants was collected: their name, age, place of origin, household composition, education level and source of livelihood. See **Appendix A** for the interview guide used in these interviews.

Participants Semi-structured In-depth Interviews

The participants were contacted via two members of the extension office, as we needed their approval to interview people in Mere-Mieti's community. The DAs randomly approached farmers that were living around the main road or passing by the main road. Additionally, some of the participants were found via the snowballing method where interviewed participants were asked if they knew others who might want to participate. To ensure the participants' privacy and voluntary participation, the snowballing method was used by letting potential participants contact us, instead of us contacting them. The participants were selected on the basis of their primary income source (being smallholder farmers) and thus, the selection strategy for the participants was purposive. All interviews were conducted in Mere-Mieti (v), but the ten participants lived in Mere-Mieti (v) and four in Ilkim. The four participants from Ilkim had travelled to Mere-Mieti (v) to go to church. The interviews took between thirty minutes to one and a half hours. One interview with a farmer from Ilkim was stopped before it was completed, because the participant was required at church. The male participants were between 25 and 62 years old. Most of them were between 40 and 50 years old. The female participants were between 35 and 50 years old. The education level differed from 'no education' to 'grade 7', with most participants having 'no education' (four participants) or up to 4 years of education (eight participants). See **Appendix B** for a more complete overview of the characteristics of the participants. Thirteen of the interviews were held outside, where other people could pass by and therefore the participants might have been more careful or conscious about what they said. However, the interviews were held outside to suit the convenience of the participants, who were partly passing by. One interview was held

at the extension office, in a room where only the translator, researcher and participant were present.

Informed consent

A short paragraph was written about how the interview worked, how much time it would approximately take and with whom the data and possible recording would be shared. See **Appendix A**.

This paragraph was translated by Amsalu, the translator, in the participants' native language: Tigrinya. In this paragraph participants are asked if they give consent to being interviewed and for the interview to be recorded. However, after the first few semi-structured interviews, the translator told the researcher that the recordings made the participants uncomfortable. The researcher therefore decided to no longer ask for recordings to make sure the participants felt comfortable to say what they wanted during the interview. From that moment onwards the researcher fully focused on taking notes during the interviews as a way to keep track of what was being said.

Translation

The translation was done by Amsalu Mengistu, a native Tigrayan speaker. He was briefed beforehand about the purpose of the interviews, as this enabled him to focus on potentially interesting topics during the interview. In translation it is inevitable that some information is lost. Especially when the translation only happens during the interview, and is not based on a recording of the complete interview, as was the case for most of this research. Having a translator present however, also had its benefits, as the translator was known with the local context (he was originally from the rural area in Tigray) and had a better understanding of underlying messages of the participants. He could provide additional information about the subjects discussed.

Compensation

Due to the financial constraints of the researcher, the participants were not given any compensation for their time. This consideration was quite difficult, as the researcher felt like she took valuable time away from the participants. However, after consulting with local researchers, who assured that not giving compensation was acceptable, she decided to move forward with it. The head of the extension office however did require compensation for his time. This was done afterwards, based on the recommendation of her translator.

Operationalization of theoretical framework

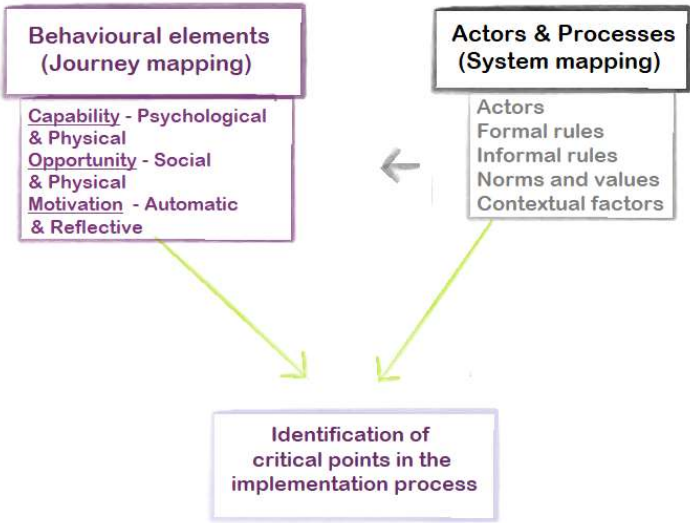


Figure 4.3. Theoretical framework used for this research, based on the TCF of Lambe, et al. (2020).

For the operationalizations of the concepts used in the theoretical framework, see Table 4.1.

Table 4.1

| <i>Operationalization of concepts used in theoretical framework</i> | |
|---|---|
| Concept | Operationalization |
| Critical point | Barriers in each phase that can stop the implementation of adaptation strategies (Lambe, et al., 2020). |
| Behavioural elements | Elements of behaviour that are relevant for a behavioural change process, in this case the implementation process of adaptation strategies (Michie, et al., 2011). |
| Capability | Includes both physical capability (physical power, skills, ability) and psychological capability (knowledge and understanding) of executing the behaviour (Michie, et al., 2011). |
| Opportunity | Is related to external factors, and refers to physical opportunity (having tools available) and social opportunity (facilitating socio-cultural norms and values, and in this case also religious norms and values) (Michie, et al., 2011). |
| Motivation | Refers to cognitive processes, both conscious (reflective motivation), such as imagining consequences of behaviour, making decisions, |

| | |
|-----------|---|
| | weighing costs and benefits and unconscious (automatic motivation), such as habits and emotions (Michie, et al., 2011). |
| Actors | Actors directly and indirectly related to the intervention: the government, the organization behind the intervention, the beneficiaries of the intervention, local community leaders and religious leaders and indirectly related actors (Lambe, et al., 2020). |
| Processes | Formal rules, laws, policies, and institutions, as well as informal rules and traditional/cultural/social norms and values and contextual factors such as ethnic conflicts (Lambe, et al., 2020). |

Analysis of KIIs and semi-structured in-depth interviews

During the KIIs and the semi-structured in-depth interviews the researcher made notes as well as recordings but only if the participants agreed to this in advance. Afterwards, all the interviews were transcribed. When recordings were made, these were used as the basis of the transcripts, otherwise the notes made during the interviews were used as the basis for the transcript. The researcher herself did the transcriptions (due to financial constraints) and therefore was only able to transcribe the translated English parts of the interviews. Therefore, the transcription is based on the words of the translator, rather than the participant, and thus the quotes used in the result section are interpreted both by the translator and consequently by the researcher. This reduced the number of exact quotes that could be used in the research to explain the research findings. Content coding was done on the transcriptions by the use of NVivo; a coding program. The code-book used during the analysis was both inductively formed on the basis of the data found and deductively formed on the basis of the operationalization of the theoretical framework. This double method is recommended by Hennink, Hutter and Bailey (2010). Subgroups of participants were formed to compare results within and between groups. These subgroups were both deductively (based on the theoretical literature) and inductively (based on trends in the data) formed. During the whole analysing process memo-writing was applied to ensure the transparency of the analyzations, again as recommended by Hennink, et al. (2010). See **Appendix C** for the NVivo code-book, and an explanation of codes used.

Result section

In the results sections of this paper, no personal details other than village of origin and gender will be mentioned. The farmers and development agents' names will be replaced by fictional names. The village of origin is either Ilkim or Mere-Mieti (v), and thus the latter will be shortened to Mere-Mieti in the quote references. The result section will be written in with a developmental argument: it argues how the process of implementation of adaptation strategies develops in Mere-Mieti and what obstacles can slow this development or inhibit this development.

Limitations

Possible conflicts of interest

The host organization had expressed its expectation to receive suggestions for new implementation strategies as a result of the research. However, this research was focused on detecting points for improvement in current governmental extension services. Creating new strategies was not in the capabilities of the researcher. After communicating about the expectations of the research, both the host organization and the researcher were on the same page. Furthermore, since Mekelle University is funded by the government (Mekelle University, n.d.), they could potentially have specific views on how to portray the extension services. However, in the researcher's experience no such views were present.

Positionality as a researcher

As a researcher and an outsider, the researcher did not have an emic/insider's perception of the context. She will never have the same understanding of the context as the smallholders who lived their whole lives in Tigray have. Additionally, there were cultural differences present, because the researcher grew up in the Netherlands and not Ethiopia. Furthermore, the researcher is a woman, and in Ethiopia there is still a lot of gender inequality, but she hasn't noticed any unwillingness to participate because of her gender. It could be that the answers given to her would have been different if she were a man, but there was no indication to suspect this.

Research design change

Because the research design was changed afterwards and the data used was not originally collected with the current theoretical framework in mind, some of the required data was not present in this research. For example, the case study analysis did not collect data on market access, -information and -actors. However, these actors and process would have been relevant

in context of the farmers, because increasing farm productivity should go hand in hand with access to markets interested in the products of farmers. Because when farmers produce more, but they cannot sell their crops, they will not achieve an improvement of their livelihoods. Thus ideally, this kind of information should have been included.

Co-creation

The journey mapping and system mapping methods are meant to be done with the input of farmers themselves. Unfortunately, since the analysis happened afterwards when the researcher returned to the Netherlands, this was not possible. The involvement of farmers themselves would have improved the reliability of the analysis. Since the corona pandemic also caused restrictions in Ethiopia, the translator who worked with the researcher was not able to return to the research site and could not provide help in that aspect either.

Time-frame

Moreover, the field-research period of this research was limited to six weeks, of which three days were spend in Mere-Mieti doing interviews. It was therefore difficult to create an insider perspective on the implementation behaviour of smallholder farmers in Mere-Mieti.

5. Case study – National and Regional Context

This chapter will provide some background information on the national and regional context relevant to the research questions. This chapter helps to put the findings in Mere-Mieti, described in the next two chapters, into perspective and it helps to link those findings to trends on regional or national level.

General information

The Federal Democratic Republic of Ethiopia is located in the horn of Africa on the East coast, as can be seen in Figure 5.1 (Google Maps, 2020). It consists of nine districts, one of them being Tigray, the district in which Mere-Mieti is located. Tigray lies in the north of Ethiopia as can be seen in Figure 5.2 (BBC News, 2005). In Tigray the majority of the population lives in rural areas (Ethiopia Data Portal, 2019). Ethiopia is a very poor country: about 65% of the population earns less than 2 dollars a day (USAID, 2016). It has therefore introduced the Productive Safety Net Program (PSNP), where households in need can receive aid in return for their participation in public works (IFPRI, & EDRI, 2013).



Figure 5.1. Geographical location of Ethiopia in Africa. Adapted from “Africa” by Google Maps, 2020, February 18. Retrieved from <https://www.google.nl/maps/@9.0516713,38.5101246,3z>



Figure 5.2. Districts of Ethiopia. Reprinted from “Ethiopia seeks unity government” by BBC New, 2005, May 20. Retrieved from <http://news.bbc.co.uk/2/hi/africa/4567199.stm>

Environment and climate change

Ethiopia has a tropic monsoon climate, but due to its environmental variability, there is much climatic variability; it has humid hot, arid hot and cool areas (CIA, 2019; Berhanu, Seleshi, & Melesse, 2014; UNDP, 2020). Most inhabitants therefore live in the cooler areas of Ethiopia (see Figure 5.3 and Figure 5.4) (World Bank, 2019, p.4; World Bank, et al., 2011, p.4). Tigray is one of these areas with relatively lower temperatures and more inhabitants, but even within the geographic areas of relatively high and low temperatures, there is a high interannual variability of rainfall and temperature. Due to this variability it is difficult to identify which trends exactly are due to climate change. This in turn hinders the prediction of climate change trends for the coming years (UNDP, 2020; World Bank, 2020; World Bank, et al., 2011).

However, the two most significant hazards in Ethiopia due to climate change, currently and in the future, are estimated to be droughts and floods, while other, less prominent hazards include landslides, earthquakes and volcano eruptions (CIA, 2019; UNDP, 2020; World Bank, 2019; World Bank, et al., 2011). Tigray, is most likely to be affected by droughts, rather than floods, see Figure 5.5 (World Bank, 2019, p.5). In Tigray more than 400.000 inhabitants a year are expected to be exposed to water scarcity (World Bank, 2020; World Bank, 2019).

Furthermore, from 1960 onwards, the average temperature in Ethiopia has increased with 1.3°C per decade (UNDP, 2020; World Bank, et al., 2011). Especially in the months July, August and September it got hotter (McSweeney, New, & Lizcano, 2012). In the coming years the temperature is expected to rise even more (McSweeney, et al., 2012; USAID, 2016; World Bank, 2019; World Bank, et al., 2011).

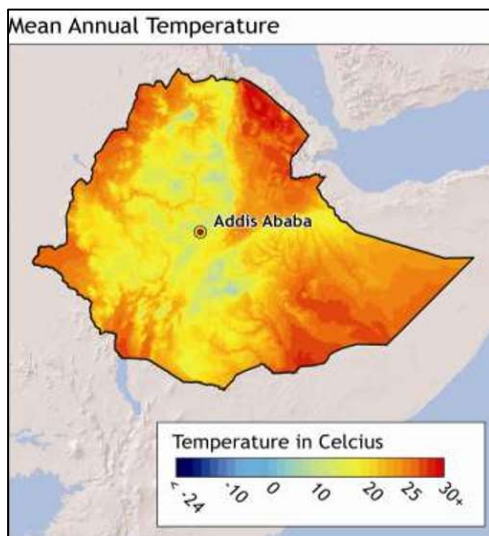


Figure 5.3. Mean annual temperature of Ethiopia. Adapted from “Vulnerability, Risk Reduction, and Adaptation to Climate Change – Ethiopia” by World Bank, Global Facility for Disaster Reduction and Recovery (GFDRR), Climate Investment Fund (CIF), & ENV, 2011, p.4. Retrieved from https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdr climate change country profile for ETH.pdf

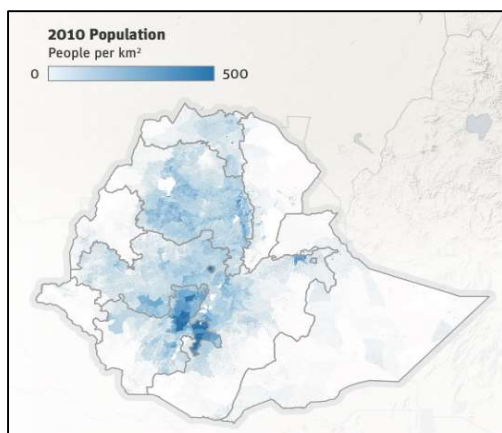


Figure 5.4. Population density of Ethiopia. Reprinted from “Disaster Risk Profile – Ethiopia” by World Bank, 2019, p.4. Retrieved from https://www.gfdr.org/sites/default/files/publication/ethiopia_low.pdf

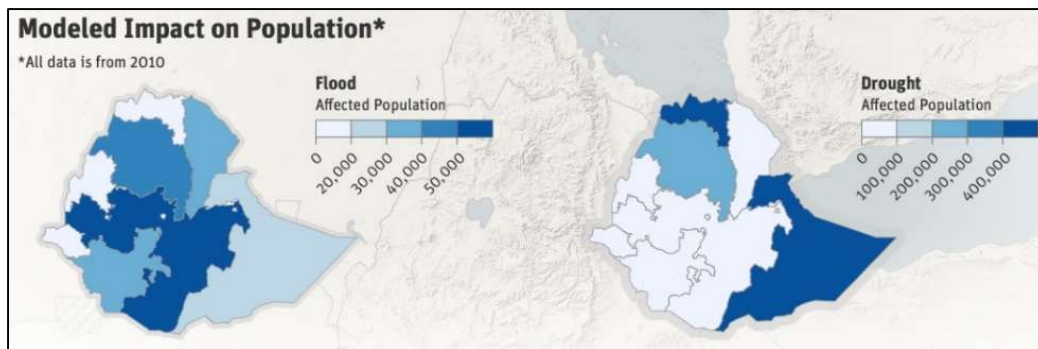


Figure 5.5. Impacts of droughts and floods on population per district in Ethiopia. Reprinted from “Disaster Risk Profile – Ethiopia” by World Bank, 2019, p.5. Retrieved from https://www.gfdrr.org/sites/default/files/publication/ethiopia_low.pdf

Rainfall

While onset of rainfall and rainfall intensity varies across Ethiopia, in most places the rain season stretches from June to September. This rain season is called the Kiremt and 50 to 80 percent of the rainfall in Ethiopia happens during this season. Ethiopia’s agriculture is very dependent on the Kiremt, and the droughts affecting Ethiopia’s agriculture, usually occur during the Kiremt (Federal Democratic Republic of Ethiopia, 2019; UNDP, 2020; USAID, 2016).

Agriculture

Climate change impacts on natural resources include land degradation, soil erosion, deforestation, desertification, water shortages, water- and air pollution and loss of biodiversity (CIA, 2019; Federal Democratic Republic of Ethiopia, 2019; UNDP, 2020; World Bank, 2019; World Bank, et al., 2011). These impacts thus negatively affect the agricultural sector in Ethiopia. This while the majority (85%) of the Ethiopian population is employed in agriculture (World Bank, et al., 2011). Most people employed in agriculture are involved in subsistence farming and depend mainly on rainfall instead of modern irrigation techniques. Figure 5.6 (World Bank, et al., 2011, p.9) shows this division of rainfall-based agricultural lands and irrigated agricultural lands.

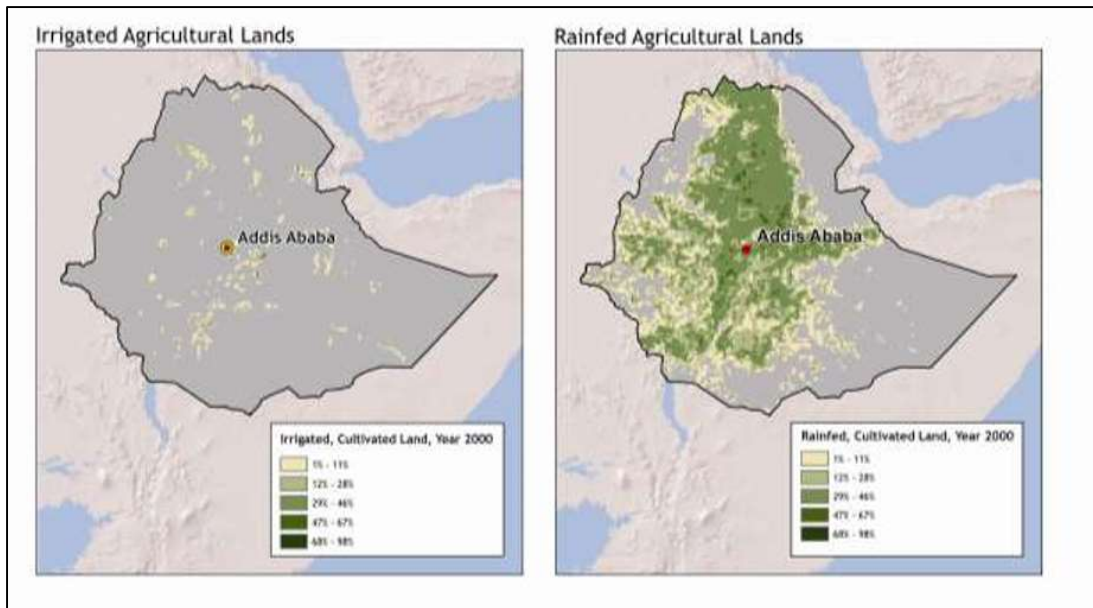


Figure 5.6. Irrigated agricultural lands versus rain-fed agricultural lands in Ethiopia. Reprinted from “Vulnerability, Risk Reduction, and Adaptation to Climate Change – Ethiopia” by World Bank, Global Facility for Disaster Reduction and Recovery (GFDRR), Climate Investment Fund (CIF), & ENV, 2011, p.9. Retrieved from https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdr climate change country profile for ETH.pdf

6. Case study – Extension office

In the next two chapters the case study in Mere-Mieti is described. These descriptions are based on the data collected in the six weeks of the field-research. In this first chapter, a description of the current extension services is given. In the next chapter, the theoretical framework will be applied. That chapter will be separated into a journey mapping section where the critical points in the farmers implementation process are identified, and the system mapping section, where the systemic influences on the farmers implementation process are identified.

Extension office

Joanna, one of the development agents, explained that the collective of Mere-Mieti has one extension office, which was set up in 2001. The extension office is located in Mere-Mieti (v) and provides services aimed at improving the livelihoods of the inhabitants of all three villages. *Michael*, another development agent, gave information about the use of land in Mere-Mieti. The extension office has contributed to the creation of 1345,50 hectares of soil- and water-conservation sites. Additionally, it has labelled 359 hectares as forest conservation sites to promote the growth of trees and 45 hectares as grazing grounds for livestock to stop the free-grazing of livestock. *Joanna* explained that free-grazing damages forest conservation sites and agricultural land. All three development agents, *Joanna, Michael & Sarah*, stated that the focus of the extension office is placed on increasing agricultural production and conserving natural resources to increase the livelihoods of the farmers. See Figure 6.1 for a picture of the extension office in Mere-Mieti (v).



Figure 6.1. The exterior of the extension office in Mere-Mieti (v).

Extension services

One of the extension services concerns crop management, which consists of improved methods to prepare land, to extend land, to protect crops and in general to increase crop production [*Joanna*]. It includes the use of fertilizer and new improved seed varieties. *Sarah* explained the livestock management services, which consist of improving livestock production (for example by livestock fattening), managing livestock, and increasing the use of new varieties of livestock (hybrid cows or poultry production). She continued with describing the third service of the extension office, namely forest conservation. The office helps with protecting the forest and training farmers in tree planting methods. The purpose of the forest conservation sites is to support the growth of trees, or as one of the farmers described it: "... to keep the balance" [*Mattias*, male, Mere-Mieti]. The fourth service of the extension office is identifying the communal areas for soil- and water conservation and recommending techniques to use on these areas, as explained by both *Joanna* and *Michael*. The office also helps with the implementation of water conservation methods on individual farms. Fifthly, the extension office provides help with credit and saving issues. These services are shortly mentioned by *Joanna*, but more elaborately described by several of the farmers themselves [*Matthias*, *John*, & *Lily*]. The office trains farmers on how to save money and grain and it promotes saving as a value and strategy in the community. The office also provides credit, which *John* described can be given out in kind (for example a goat or a sheep) or in money. Lastly, *Joanna* explained that the extension office provides weather information. The DAs themselves are not the ones doing the predictions, but they pass on the weather information they get from the district office to the farmers.

Extension services - Farmers Training Centre (FTC)

The extension office is also used as a training centre (called the Farmers Training Centre or FTC) for farmers: it provides training sessions about adaptation strategies, as explained by *Sarah* and *Joanna*, and two of the farmers [*Gabriel* and *Julia*]. The extension agents give instructions to the farmers and the farmers implement the adaptation strategies themselves. Assistance from the DAs during the implementation phase is available. *Gabriel* and *David* explained that the farmers give feedback back to the office about their experiences with the implementation of the adaptation strategies: "With the [development agents], we share our experiences. They teach us, and we report our experiences back to them." [*David*, male, Mere-Mieti]

Usage rate of extension services

Michael stated that he was fifty percent satisfied with the implementation rate of the adaptation strategies in Mere-Mieti:

“Soil and water management and forestry works good; farmers see the results and are satisfied as well. They have direct results. But sometimes strategies do not have direct results and these strategies are less often implemented. I am 50/50 satisfied.” [*Michael*, male, DA].

Directly seeing the results thus seems to stimulate the farmers to implement the strategies. More than half of the farmers agreed with the efficiency of the soil- and water management strategies. They were both positive about these conservation sites as well as implementing irrigation methods on their own farm [*Matthias, John, David, Aaron, Jeremiah, Anna, Lily, & Rebekah*].

The farmers differ in the speed of implementing new adaptations strategies. Some farmers are quick to implement new strategies. These farmers are labelled the ‘adopters’ by *Joanna* and *Sarah*. The majority of the farmers follows the adopters, either fast (early majority) or sometime later (late majority). However, a small group, estimated between 2-20% of the farmers, lags behind and refuses to implement any kind of new strategy [*Joanna & Sarah*]. *Joanna* explained these farmers want to follow tradition and hold on to traditional practices. They refuse any advice from anyone, not only from the development agents [*Joanna*].

7. Case study – Applying the theoretical framework

In this chapter, the theoretical framework will be applied. The chapter starts with a journey mapping section where the critical points in the farmers implementation process are identified, and then moves on to the system mapping section, where the systemic influences on the farmers implementation process are identified. These two steps, the journey mapping and the system mapping, will be combined to identify the entry-points for interventions for the extension services in Mere-Mietti. This will be done in the discussion, in which the broader regional and national context also will be incorporated.

The journey mapping section is guided per critical point of the implementation process. Each point begins with an argumentation of why this point is important in the farmers' implementation process. Subsequently, it links the behavioural elements that need extra assistance to the critical point. It then moves on to describe the status of the critical point in Mere-Mietti. Each critical point section concludes with a table, in which the behavioural elements relevant at the critical point are summed up and a short overview of the status of the critical point in Mere-Mietti is given. The journey mapping section ends with an overview of all the identified critical points.

7.1 Journey mapping

Critical point 1: Availability of climate change- and weather information– before phase

The first critical point regards the availability of information about the impacts of climate change on the livelihoods of the farmers and the availability of weather information for the farmers.

Before farmers will start to consider any kind of adaptation strategy, they need to identify climate change as a realistic threat to their livelihoods and see the urgency to adopt adaptation strategies (Rogers, 1975). Additionally, not only long-term climatic changes, but also short-term weather changes determine how farmers' livelihoods are affected. Therefore, it is important to have weather information available for farmers to adapt their choice of adaptation strategies too. One farmer, for example, said: "Every year the farmers decide what seeds they will use, based on weather predictions. They change the seeds every year." [Aaron, male, Mere-Mietti]. To correctly estimate the most efficient strategy, information about weather predictions should be available to the farmers.

The awareness of the threat of climate change relates to having the knowledge

(psychological capability) about these threats and the imagining the consequences of climate change on their personal livelihoods (reflective motivation). Having a realistic conception of a threat will influence the cost-benefit analysis of the farmer (reflective motivation) of implementing an adaptation strategy. A farmer will be more motivated to implement a strategy if they think this will protect their households from misfortune (Rogers, 1975). The first critical point in the before phase of implementation, is therefore ‘the availability of climate change- and weather information’, see Table 7.1.

In Mere-Mieti, all farmers mentioned either increasing droughts, increasing water shortages, or increasing rainfall variability as changes in climate. Furthermore, climate change caused an increase in human-, livestock- and crop diseases, according to thirteen of the farmers. However, the other impacts of climate change were mentioned less often. Eight of the farmers also mentioned an increase in temperature [*John, David, Aaron, Anna, Lily, Julia, Nathan, Benjamin*], and eight farmers mentioned an increase in air pollution [*John, Aaron, Gabriel, Anna, Julia, Rebekah, Tobias, Rafael*]. *John* explained that he thought this pollution came from the machines used in industrial projects surrounding Mere-Mieti. *Joanna*, one of the DAs, however, said that this ‘air pollution’ was also caused by dust coming from the Danakil Depression due to the increased temperatures there.

The decrease in rainfall was especially harming for the livelihoods of the farmers according to both *Matthias* and *Gabriel*. However, *Gabriel* added that the livelihoods of the community are better than they were before. Thus, even though the changes in climate are harmful for the farmers, their livelihoods have improved compared to the past. Regarding the cause of climate change, the farmers were not sure what made these changes happening. *Jeremiah* stated he did not know the cause for the increase in human diseases he described, and *Matthias* said the cause for yield variation and crop failure “could be nature, but this is a guess”. Three of the farmers referred to God as the explanation for climate change [*Matthias, David, Lily*]. As *David* put it: “God is the most influential, God caused all the changes in the weather and climate...” [*David, male, Mere-Mieti*]. The farmers thus seemed aware of the changes in climate and how these changes can affect their livelihoods, but many farmers did not give an explanation of why these changes are happening.

When asked where farmers got their information about the impacts of climate change from, the DAs were mentioned by seven farmers as the first source of information. Six other farmers said they first relied on their own experience and social network, and then on the information of the DAs.

Lastly, the development agents rely on the Tigray district office to spread information

about short-term weather changes/weather forecasts [Joanna]. *Matthias* stated that the farmers have to depend on the extension office for weather information, because they cannot predict the weather themselves. *Rafael* also explains that he trusts the weather information from the DAs, because this information has proved to be correct in the past. *Nathan*, however, explained that he depends both on the extension services, but also on this own social network for weather information.

Table 7.1.

| <i>Before phase – Critical point 1</i> | | |
|---|---|--|
| Critical point | Behavioural elements | Status Mere-Mieti |
| Availability of climate change- and weather information | <ul style="list-style-type: none"> ○ Psychological capability ○ Reflective motivation | <ul style="list-style-type: none"> ○ Farmers have awareness about climate change and how it affects/ will affect livelihoods ○ No knowledge of origin of climate change ○ Farmers get their climate change and weather partly from the DAs and partly from their own experiences and social network |

Critical point 2: Awareness of extension services – before phase

Next, based on the climate change and weather information the farmers have, they can select an adaptation strategy. However, this requires availability of information about the adaptation strategies. The farmers need to be aware of the different possible adaptation strategies and understand how they work, before they can make their choice. In the case of Mere-Mieti this means that the extension office and all the services they offer, should be known to the farmers.

The awareness of the adaptation strategies thus relates to knowledge about the extension services (psychological capability). The second critical point in the before phase therefore is ‘awareness of adaptation strategies’, see Table 7.2.

In Mere-Mieti, all farmers were able to sum up some of the extension services the office provided, but none of the farmers listed all the possible adaptation strategies the office provides services for. See Figure 6.1 for an overview of the most commonly mentioned services. Furthermore, the knowledge about the available services for adaptation strategies

differed slightly for farmers from Ilkim and Mere-Mieti (v). Farmers from Ilkim seemed less aware of the credit and saving options than farmers in Mere-Mieti (v), as only *Matthias, John,* and *Lily*, all living in Mere-Mieti (v) mentioned the services. Overall, the farmers seemed aware of the extension office and the services they provide, but some farmers might be more aware of certain services than others.

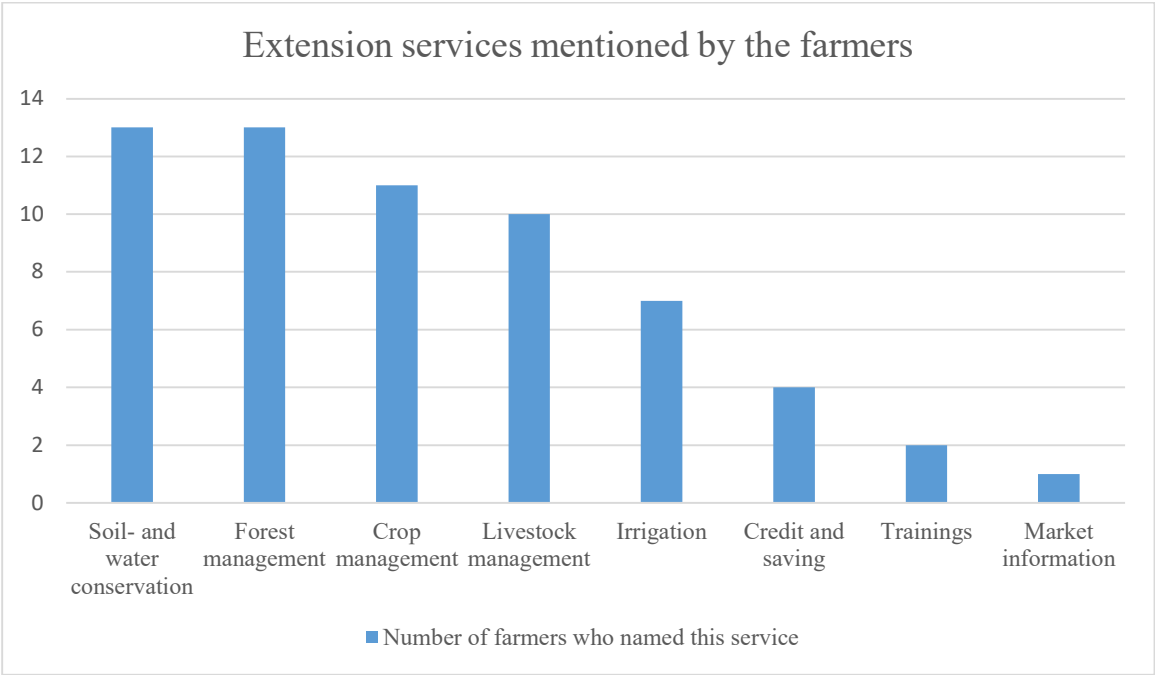


Figure 7.1 Extension services mentioned by the farmers.

Table 7.2

Before phase - Critical point 2

| Critical point | Behavioural elements | Status Mere-Mieti |
|---|----------------------------|---|
| Awareness of services for adaptation strategies | ○ Psychological capability | ○ Awareness about the existence of the extension services, but possibly not about all services ○ Possible less awareness in Ilkim than in Mere-Mieti (v) |

Critical point 3: Accessibility of the extension services – before phase

Even when farmers are aware of the existence of the extension services, they can only benefit from these services if the services are accessible for them. Access to the extension services is important because these services provide farmers with the knowledge (psychological

capability) and skills (physical capability) required to implement adaptation strategies. Even when farmers know about the existence of adaptation strategies, they still need to feel confident about having the knowledge and skills required to implement the strategy (Ajzen, 1991). Furthermore, accessibility of the extension services is related to having the time (physical opportunity) to come to the office. Therefore, the third critical point in the before phase is ‘accessibility of the extension services’, see Table 7.3.

In Mere-Mieti both farmers from Mere-Mieti (v) and farmers from Ilkim, were welcome to use the extension services [*Joanna, John, Matthias*]. However, *Joanna*, one of the development agents, said:

There is no difference in services for Mere-Mieti and Ilkim. They can all use it. But in application some might be laggards. There is a good follow up in Mere-Mieti, because it is surrounding the office, we can help them day and night. In Ilkim there is less application - it is not surrounding, but further away. [*Joanna, female, DA*]

Giving assistance in Ilkim is thus more difficult for the DAs, according to *Joanna*.

Furthermore, both men and women are welcome to come to the trainings at the extension office [*John*]. However, *Matthias* commented that men usually are more involved in implementing the new adaptation strategies. This has to do with the social expectations of women being responsible for running the household. This topic will be further discussed under the header of ‘gender norms’ in the system mapping section.

Thus, everybody is welcome at the extension office, but the implementation rate of the adaptation strategies taught at the extension office is lower for some groups (farmers from Ilkim vs. Mere-Mieti (v) and females vs. males).

Table 7.3

| <i>Before phase - Critical point 3</i> | | |
|--|---|---|
| Critical point | Behavioural elements | Status Mere-Mieti |
| No accessibility of extension services | <ul style="list-style-type: none"> ○ Psychological capability ○ Physical capability ○ Physical opportunity | <ul style="list-style-type: none"> ○ Extension services are less accessible for farmers from Ilkim (placed further away from the extension office) than from Mere-Mieti (v) ○ Extension services are accessible for both men and women, but the |

implementation of adaptation strategies taught at the centre is lower for women

Critical point 4: Interest in adaptation strategies – before phase

An obvious requirement before farmers will implement adaptation strategies, is that they have the motivation to implement these strategies. There should be a ‘need’ for the farmers to implement a strategy (Rogers, 1975).

The farmers’ perception of a need for adaptation strategies depends on the knowledge farmers have (psychological capability), and the explicit (reflective motivation) and implicit (automatic motivation) reasoning used by the farmers. The fourth critical point in the before phase therefore is ‘interest adaptation strategies’, see Table 7.4.

In Mere-Mietti, two farmers mentioned that livelihood diversification as a trader or construction worker is a very beneficial strategy to improve your livelihood, as this increases the sources of income [John, David]. With multiple sources of income, there is less need to invest in the productivity of one particular sources of income. This corresponds with the advice given by one of the DAs. He said that more focus should be on livelihood diversification strategies, instead of irrigation methods to sustain and increase the livelihoods of the farmers [Michael].

Besides the amount of livelihood income sources, the farmers’ perception of need is also influenced by whom they see as responsible for improving their livelihoods. For example, one farmer said: “Climate change is a natural happening, you should pray to nature and nature is God.” [Lily, female, Mere-Mietti]. The development agents additionally mentioned that religion can inhibit farmers from doing anything: “The farmers use religiousness in times of trouble to do nothing. They believe that God won't harm humans. Therefore, it is not in their hands.” [Joanna, female, DA]. Thus, for some farmers, their motivation to implement adaptation strategies is reduced due to their trust in God’s interference.

Table 7.4

Before phase - Critical point 4

| Critical point | Behavioural elements | Status Mere-Mietti |
|----------------|----------------------|--------------------|
|----------------|----------------------|--------------------|

| | | |
|--------------------------------|---|---|
| Need for adaptation strategies | <ul style="list-style-type: none"> ○ Psychological capability ○ Automatic motivation ○ Reflective motivation | <ul style="list-style-type: none"> ○ Not all farmers have a need for the farm-based adaptation strategies due to livelihood diversifications ○ Some farmers do not see the need for adaptation strategies because they see God as responsible for their livelihoods |
|--------------------------------|---|---|

Critical point 5: Efficiency and suitability of adaptation strategies – before phase

Another important step towards implementation is the efficiency of the available adaptation strategies in the local context of the farmers (Baya, et al., 2019b; Gebru, Van Steenberg, & Hagos, 2016; Menghistu, et al., 2018). According to Lambe et al. (2020) positive expectations about changing behaviour help with starting the behavioural change process. Thus, the adaptation strategies need to raise positive expectations about their efficiency in the local context before farmers are likely to implement them. Additionally, a farmer needs to see the potential of a strategy on their own farm, before they will implement it. A farmer’s potential is based on their resources to implement strategies, on the suitability of the strategies that are available, and on the knowledge of the farmers about what makes strategies suitable for them. The farmers, thus have to evaluate a strategy as efficient and suitable, which is related to their mental models about what makes adaptation strategies efficient and suitable (Datta, & Mullianathan, 2014).

The evaluation of efficiency and suitability, therefore, is based on almost all parts of behaviour: having knowledge (psychological capability) and skills (physical capability) to implement a strategy, having suitable land (physical opportunity) to implement a strategy on and on the automatic and reflective motivation of the farmers; the implicit and explicit reasoning about what makes strategies suitable. The fifth critical point in the before phase is therefore ‘Efficiency and suitability of adaptation strategies’, see Table 7.5.

In Mere-Mieti, having ‘direct experience’ with the efficiency and suitability of the strategies, appeared to be the basis for the farmers’ trust in the usefulness of the adaptation strategies. The farmers explained they started to trust the services of the extension office, when they ‘saw’ or heard from others who had ‘direct experiences’, that these services worked [*Rafael, John, David, Aaron, Gabriel, Jeremiah, Anna, Julia, Tobias, & Rafael*]. When the DAs first got to Mere-Mieti, their information was mistrusted because they based their advice on scientific evidence, but did not have farms themselves, so the farmers argued

that therefore they couldn't know about the efficiency or suitability of the adaptation strategies [Joanna].

Moreover, farmers own ideas of what makes strategies efficient and suitable differ as well. Eight of the farmers were positive about the irrigation methods used in the community [Matthias, John, David, Aaron, Jeremiah, Anna, Lily, & Rebekah]. Rebekah stated that "Irrigation expansion is important for development; it helps with everything." [Rebekah, female, Mere-Mietti]. John said: "Crop failure happens as well, but only on the rain-fed landscapes. But with a water pump, or irrigation you can prevent it from happening." [John, male, Mere-Mietti]. While he is positive about irrigation, John, as well as four other farmers, did argue that the government should help them with gaining more access to water, by implementing ground water pumps [Matthias, John, David, Aaron & Anna]. David explained that he saw the potential for irrigation for the farmers, but mentioned the community needed the help of the government to fulfil this potential:

I like the irrigation practices the most. With the help of the government we can be like *forengi* farmers.... irrigation is very important for farmers. It will give you more income in a relatively short time - in about 3 to 4 months. It changes livelihoods for the better." [David, male, Mere-Mietti]

In contrast to these previous statements, Nathan, another farmer, was not positive about irrigation at all: "Irrigation is not efficient because the water is reducing that you need for irrigation" [Nathan, male, Ilkim]. Michael, one of the DAs, seemed to agree with this statement, as he mentioned: "For irrigation, the interest has gone up in the years, but unfortunately there is less water now, so we must focus on other strategies as well." [Michael, male, DA]. These two different assumptions about the efficiency of irrigation: 'irrigation is useful because it helps with providing water', and 'irrigation is getting more ineffective because you need water for irrigation', have a different influence on the farmers' expectations about the benefits of implementing irrigation systems. The different expectations of the efficiency of irrigation methods thus influence the choice of implementing these methods.

And even when a strategy is deemed efficient, it does not mean it is always suitable for the situation of the farmers. Rebekah, who was positive about the irrigation services, for example, said: "Poultry production and cattle fattening, these are the [extension services] I personally use, I have no potential for other services. I have rain-fed land and no capital for irrigation." [Rebekah, female, Mere-Mietti]. And Benjamin stated: "... I have no knowledge about irrigation. I cannot implement this because my land is not enough and I am not able to

rent land” [Benjamin, male, Ilkim]. Benjamin therefore focused more on his sewing business. These two farmers thus focused on other, more suitable, adaptation strategies.

Table 7.5

| <i>Before phase - Critical point 5</i> | | |
|---|--|--|
| Critical point | Behavioural elements | Status Mere-Mieti |
| Efficiency and suitability of adaptation strategies | <ul style="list-style-type: none"> ○ Psychological capability ○ Physical capability ○ Physical opportunity ○ Automatic motivation ○ Reflective motivation | <ul style="list-style-type: none"> ○ Having ‘direct experience’ with the efficiency and suitability of the strategies, appeared to be the basis for the farmers’ trust in the usefulness of the adaptation strategies ○ Farmers have different perceptions about what efficient and suitable strategies are ○ Farmers do not always see suitability of efficient strategies for their personal situations |

Critical point 6: Availability and accessibility of tools and/or (natural) resources – during phase

When farmers have decided they want to implement a strategy, they need to have access to the tools and (natural) resources required for this strategy. This requires the availability of resources to buy the tools, the availability of tools to buy, and the availability of natural resources required for the adaptation strategy.

The presences of tools and resources relates to the physical opportunity of the farmers. The accessibility of tools and resources is related to both the physical and social opportunity (having time and money to buy tools and there being facilitating social norms) of the farmers. Therefore, the sixth critical point is ‘no availability and accessibility of tools and/or (natural) resources’, see Table 7.6.

In Mere-Mieti, two of the DAs and the majority of the farmers mentioned the decreasing availability of water in Mere-Mieti [Sarah, Michael, Matthias, John, David, Aaron, Gabriel, Anna, Julia, Nathan, Tobias, & Benjamin]. As explained above, the farmers urged the government to help them with the implementation of groundwater pumps. Matthias

explained that the community lacks the financial resources to implement the ground water pumps themselves. *Anna* said: “The government or we as a collective should expand irrigation. This will change our livelihoods for the better. The government should introduce it, work on it and then the community can expand it.” [*Anna*, female, Mere-Mieti]. Additionally, *Benjamin* complained about the availability of new machines to use on the farmland. The government does introduce new machines, but usually only one, as an example, which is either not used - is there just for show, or is damaged quickly [*Benjamin*].

Thus, farmers struggle with gaining access to the required natural resources, and financial restraints inhibit them from creating this access themselves. Additionally, lack of availability of machinery to use on farmland is also mentioned as inhibiting farmers from implementing more efficient adaptation strategies.

Additionally, in terms of financial resources, there is a difference between the genders; male led households earn more than female led households [*Aaron*]. *Aaron* explained: “...males earn more than females, because females lack labour and they often rent out the land. Males however can improve their income from their land due to the trainings from the expert agencies.” [*Aaron*, male, Mere-Mieti]. This corresponds with the comments of two development agents that females are more dependent on financial aid than males [*Sarah*, & *Michael*].

When farmers are able to buy the required tools and enough (natural) resources are available to start the implementation of the adaptation strategy, they move into the ‘during phase’ of implementation process.

Table 7.6

| <i>Before phase – Critical point 6</i> | | |
|---|--|--|
| Critical point | Behavioural elements | Status Mere-Mieti |
| Availability, and accessibility of tools and/or (natural) resources | <ul style="list-style-type: none"> ○ Physical opportunity ○ Social opportunity | <ul style="list-style-type: none"> ○ Lack of water inhibits the use of irrigation systems ○ Lack of financial resources inhibits the creation of access to water ○ Not enough machinery available in Mere-Mieti |

-
- Female head of households have fewer financial resources than male head of households
-

Critical point 7: Continued availability and accessibility of (technical) assistance – during phase

The availability and accessibility of assistance in the during phase will help farmers to continue the implementation. When a farmer encounters a problem with the implementation of their strategy, they need access and availability of advice about how to tackle this problem. When this is not available, chances are that the farmer wrongly implements, or stops with the implementation (Lambe, et al., 2020).

The elements of behaviour addressed with assistance are knowledge (psychological capability) and skills (physical capability) needed to keep continuing implementation. ‘Continued availability and accessibility of (technical) assistance’ is thus the seventh critical point, see Table 7.7.

Julia explained the support given by the development agents as follows: “...they give training, they follow-up and supervise the implementation. You get assistance when implementing what you learned in the trainings.” [*Julia*, female, Mere-Mieti]. This continued dialogue between the DAs and the farmers during the implementation phase was also mentioned by *David* and *Gabriel*. *Benjamin* also argued for the availability of technical advice thorough the implementation process. He explained that:

Technical advice of the [development agents] is very effective, any advice, if it is not technical is not useful, because you have to know how the strategies technically work to implement them in the right way. For example, with fertilizer, if you do not know you need to yield timely, then the crops are negatively affected and the strategy doesn’t work. [*Benjamin*, male, Ilkim]

A lack of assistance during the implementation phase, can thus decrease the efficiency of the adaptation strategy. As mentioned before, continued assistance for farmers from Ilkim is less available than for framers from Mere-Mieti (v).

Table 7.7

During phase - Critical point 7

| Critical point | Behavioural elements | Status Mere-Mieti |
|-----------------------|-----------------------------|--------------------------|
|-----------------------|-----------------------------|--------------------------|

| | | |
|--|---|---|
| Continued availability and accessibility of (technical) assistance | <ul style="list-style-type: none"> ○ Psychological capability ○ Physical capability | <ul style="list-style-type: none"> ○ Farmers in Mere-Mietti argued the importance of continued assistance ○ Continued assistance for farmers from Ilkim is less available than for framers from Mere-Mietti (v) |
|--|---|---|

Critical point 8: Continued availability and accessibility of the required tools and/or (natural) resources – during phase

Having the required tools and (natural) resources is essential for the habituation of the behaviour (Lambe, et al., 2020). For example, continued water availability is required for irrigation to work. Additionally, the fulfilments of expectations about the efficiency of the implementation are very important in the motivation to continue the implementation (Lambe, et al., 2020). Having the needed tools and (natural) resources of course determines the experienced efficiency of the adaptation strategy. Furthermore, sometimes purchased tools break during the implementation phase. Having the required financial resources or physical resources to replace or repair the tool is needed to continue with the implementation.

The availability of required resources is part of the physical opportunity of behaviour (there being resources available to use), and also relates to knowledge (thus psychological capability) about how to use these resources and the skills to do so in the correct way (thus physical capability). This makes it critical point eight: ‘continued availability and accessibility of the required tools and/or (natural) resources’, see Table 7.8.

In Mere-Mietti water scarcity makes it difficult to continue or intensify irrigation practices, as mentioned before [Matthias, John, David, Aaron, Gabriel, Anna, Julia, Nathan, Tobias, Benjamin, Sarah, & Michael]. The declining efficiency of irrigation because of water shortages could contribute to disengagement of the farmers with irrigation methods (Lambe, et al., 2020). Another important resource in Mere-Mietti is fertilizer. Fertilizer is quite commonly used amongst the farmers according to both the farmers and the DAs [David, Aaron, Gabriel, Jeremiah, Nathan, & Joanna]. However, Benjamin mentioned that farmers in Ilkim had a shortage of fertilizer in the recent past, as there was a delay in the supply of fertilizer to farmers in Ilkim. He said this had happened because some of the farmers did not know how to use fertilizer, and thus used too much [Benjamin]. DA Joanna correspondingly

said the farmers needed more information on how to use the fertilizer. However, she also remarked that the shortage of fertilizer was due to a misestimation of future demand on the supply side [Joanna].

Table 7.8

| <i>During phase - Critical point 8</i> | | |
|---|---|--|
| Critical point | Behavioural elements | Status Mere-Mieti |
| Continued availability and accessibility of the required tools and/or (natural) resources | <ul style="list-style-type: none"> ○ Psychological capability ○ Physical capability ○ Physical opportunity | <ul style="list-style-type: none"> ○ Lack of water can inhibit continued irrigation practices ○ Lack of fertilizer due to misuse and a lack of fertilizer on the supply-side |

Habituation of the adaptation practice – after phase

Habituation of the adaptation practice happens when using an adaptation strategy becomes the new normal for a farmer: the new default modus (Lambe, et al., 2020). This happened for example with irrigation methods for some of the farmers. DA Sarah describes it as a normal practice in society. However, as Michael said, still half of the adaptation strategies are not yet ‘normal’ for the farmers.

An overview of all critical points

See Table 7.9 for an overview of the critical points. Due to the fact that the farmers were not actively involved in the journey mapping (since they were interviewed for the purpose of different research questions), these points are indications of the actual critical points in the implementation process of the farmers in Mere-Mieti.

Table 7.9

| <i>Overview of all critical points</i> |
|--|
| Before phase |
| 1. Availability of climate change- and weather information |
| 2. Awareness of extension services |
| 3. Accessibility of the extension services |
| 4. Interest in adaptation strategies |

5. Efficiency and suitability of adaptation strategies

6. Availability and accessibility of tools and/or (natural) resources

During phase

7. Continued availability and accessibility of (technical) assistance

8. Continued availability and accessibility of the required tools and/or (natural) resources

7.2 System mapping

In this section the systemic factors that influence the implementation process of adaptation strategies are identified. Each section concludes with a table that gives an overview of the influences of the described actors or processes.

The section starts with discussing the influential actors in Mere-Mieti. These are the development agents, the religious men, the social networks of the farmers and the media (radio and telephone). It then moves on to describe the influential processes. Firstly, the formal rules and regulations are described, after which the impact of the social norms and values are explained and lastly the ethnic conflict in Ethiopia is highlighted. After that the paper moves on to the discussion, in which the journey mapping and system mapping sections are linked together to identify entry-points for interventions for the extension services in Mere-Mieti. The broader regional and national context will also be included in that section.

Development Agents (actors)

Firstly, there are several actors from whom farmers get information about adaptation strategies. The development agents are of course one of these, but anyone in the farmers social network can function as an information source as well, including farmers from outside the villages. However, most of the farmers state that, besides from their own experience and social networks, they rely on the extension office for information about adaptation strategies. The acceptance of information from the extension office and development agents, however, requires trust.

Joanna explained that in Mere-Mieti, the development agents initially struggled to gain the farmers' trust. The DAs at the Farmers Training Centre tried to show that their extension services were beneficial for the farmers. However, the farmers initially were hesitant to implement new strategies. The farmers didn't trust information coming from the development agents because the development agents didn't practice the methods themselves [*Joanna*]. She gave an example:

One time we advised chemicals for wood control - but the farmers reacted with 'How do you know', 'You didn't practice it, you have no farmland', and 'What is our guarantee?' So, we gave them a guarantee contract. If the trees burn down, we would cover the costs, just as the costs of the loss of expected products. However, this was very dangerous- so we showed them how to use it, we did it together the first time to

be sure it was done good. The second time we trusted the farmers to do it themselves.”

[*Joanna*, female, DA]

Joanna meant that giving out a guarantee contract, could be dangerous for the extension office, because the office would be held responsible for the failure of a strategy. Even when this failure is caused by the wrong implementation of the strategy. However, with this guarantee contract, the DAs did gain the trust of the farmers. Another way the development agents gained trust, was by working together with the religious men and the local leaders. *Sarah* explained that these men were already trusted by the farmers: “Most farmers trust the religious men more than the [development agents], so we have second term trust.” [*Sarah*]. *Joanna* elaborated on how the extension office works together with the religious men to spread information about the extension services:

... Biggest gathering of people are found at church. A religious man preaching is very effective. We [development agents] tell the religious men what we want to promote and the religious men include it in their preach. The [development agents] don't talk directly to the framers. In my experience one got two options. Before years we were struggling to make farmers use fertilizers. Therefore, we use the religious men, but they needed to practice the services themselves as well to be believed.

[*Joanna*, female, DA]

Unlike the development agents, the local community leaders and religious men did have farmlands on which they could implement the strategies to show the effectiveness of them to the farmers [*John*]. When the farmers were convinced of the benefits of a strategy, they started to implement them one by one [*Joanna*]. *Joanna* concluded: “But now the farmer should come to our office. They know and trust us now. No more need of preaching. Farmers know about things. If they need anything they will come to the office.” The experienced effectiveness of the strategies contributed to a gradual level of trust gained by the development agents. Currently, the farmers seem to trust the development agents, as they are cited as one of the main sources of information about climate change and adaptation strategies. *Nathan* and *Aaron* additionally explained that they trust the DAs because they specially trained to help the farmers; they have had education to help them.

Trust in the development agents thus influences the farmers’ acceptance of information coming from the extension office. It thus relates indirectly to the knowledge base of the farmers: their ‘psychological capability’. Trusting also relates to feelings of affect.

Trust influences the automatic/experiential evaluation system of farmers and this system determines whether or not information feels trustworthy and is accepted. This automatic evaluation relates to the automatic motivation of farmers. See Table 7.10 for an overview of the influence of ‘(trust in) the development agents’.

Table 7.10

(Trust in) development agents - actors

Influences

- Acceptance of information coming from the extension office, thus indirectly on the knowledge base of the farmers: ‘psychological capability’
- On the ‘automatic motivation’ of the farmers

Religion and religious men (actors and processes)

Religion is mentioned as a very important value in the Mere-Mieti society by thirteen of the farmers, as well as by all of the DAs. One farmer said:

Religious men are the most influential regarding the promotion of adaptation strategies, in comparison to social network and the local community leader. They tell us to pray and work hard. Praying helps in defending your problems. When problems are detained, you get better livelihoods. [*Nathan*, male, Ilkim]

In one way, religion might inhibit the implementation of adaptation strategies, as some farmers feel like God will help them and therefore no additional measurements are needed [*Joanna*]. *Joanna* explained that these farmers trust that God won’t harm them. On the other hand, the DAs work together with the religious men, as explained above, and in this way, religion helps to spread the development agents’ message across more people. The religious men also functioned as model farmers, by implementing the new adaptation strategies on their farms to show their effectiveness [*John*]. As one farmer said: “Farmers do as the religious men preach” [*David*, male, Mere-Mieti]. However, not all farmers are such loyal followers of the advice of the religious men on adaptation strategies. Two of the farmers interviewed said that religion had no influence on the adaptation strategies they used [*Jeremiah, & Benjamin*]: “The religious men have no role in climate change, only in spiritual matters, not in any economic, political or environmental issues.” [*Jeremiah*, male, Mere-Mieti].

As the religious men are very important in society, it is relevant to know which values they promote. In this case the religious men preached values to farmers such as ‘be a hard

worker’, ‘protect the forest’, ‘save grain’, ‘pray to avoid diseases’, and ‘love each other and work together’ [John, Aaron, Anna, Julia, Nathan, & Rafael]. Aaron also added that the religious men actively take farmers to plant trees and tell them to avoid cutting trees. Religion and the religious men thus influence the adaptation strategies that are valued as ‘good’ practices in society. They influence social norms and values and consequently the ‘social opportunity’ (behavioural element) of implementing an adaptation strategy. See Table 7.11 for an overview of the influences of religion and the religious men.

Table 7.11

| <i>Religion and religious men – actors and processes</i> |
|--|
| Influences |
| <ul style="list-style-type: none"> ○ Can inhibit motivation to implement adaptation strategies (‘motivation’) ○ Spreads awareness of extension services (which adds to the farmers knowledge base: ‘psychological capability’) ○ Functions as model farmers to show efficiency (which increases knowledge of efficiency: ‘psychological capability’ and also can create more ‘motivation’ to implement) ○ Can create more ‘social opportunity’ in society for implementing adaptation strategies |

Media and social network (actors)

Aside from the development agents and religious men, farmers in Mere-Mietti get their information from the media (a radio program on agricultural practices and telephone line on crop management) [Julia, & Joanna]. However, not a lot of farmers have access to these media according to Benjamin. Matthias for example, commented that he only has access to these media via his social network. Matthias also said that social media is less trustworthy than the development agents or his social network, because: “...you are not physically in touch or in control with the spreaders of the information. Social media is not local context specific and the advice of the extension services is.” [Matthias, male, Mere-Mietti].

Interestingly the youngest farmer interviewed was the only one who relied firstly on social media for information about adaptation strategies. This can indicate a generational difference in using the media. However, this must be interpreted with care, as he was the only young farmer interviewed.

Additionally, farmers rely on their social network for information about adaptation

strategies [Matthias, John, David, Aaron, Gabriel, Jeremiah, Anna, Julia, Rebekah, Nathan, Tobias, Rafael, Benjamin]. Farmers trust and learn from each other’s experiences. This means that not only the information given by the development agents will influence the farmers choice of adaptation strategy, but also the opinion about the strategies in their social networks, and the information coming from the media influences their choice. For, example, common social practices can influence the choice of adaptation strategy in the before phase (Cialdini, et al., 1991). See Table 7.12 for an overview of the influences of the media and the farmers’ social networks.

Table 7.12

| <i>Media and social network – actors</i> |
|--|
| Influence |
| <ul style="list-style-type: none"> ○ Spread awareness of extension services (which adds to the farmers knowledge base: ‘psychological capability’) ○ Influence what is seen as efficient and suitable (which increases knowledge of efficiency: ‘psychological capability’ and also can create more ‘motivation’ to implement) |

Formal rules and regulations (processes)

There are several official rules about forest conservation sites and soil- and water conservation sites. Inhabitants of the villages are required to participate in soil and water conservation works for forty days a year [Matthias, Nathan, & Rafael]. This influences the adaptation strategies available to farmers. When you invest time in the soil- and water conservation areas, you have less time to work on your own land [Matthias].

There is also an area in Mere-Mietti (v) where multiple individual plots are irrigated. These plots were distributed amongst the community members in the past. *Rebekah* described the distribution process of the plot. The plots went to the elders, both male and female, in the community firstly and the number of hectares per household was based on the number of household members. *Rebekah* explained why she didn’t get an irrigation plot: “I wasn’t old enough to get one. Also, when the land was distributed, I was in a refugee camp.” (*Rebekah*, female, Mere-Mietti). Lacking such a plot sets these farmers one step back compared with their counterparts. Farmers who do not have a plot have the possibility of renting one [Rebekah]. This is possible when the owner of the plot is not interested in working on the plot themselves, but rather chooses rent as an income source. However, of course a farmer has to

have enough resources to be able to rent such a plot.

Furthermore, most farmers explained that there are no formal rules about what adaptation strategies a farmer is allowed to implement on their land [*Matthias, John, David, Aaron, Gabriel, Jeremiah, Lily, Julia, Nathan, & Benjamin*] *David* stated: “No approval is needed for no one to implement on their own grounds.” *Benjamin* specifically mentioned that nobody should interfere with a farmers choice of adaptation: “A farmer should work with what he got. He will learn as he goes. Nobody should select an adaptation strategy for him, they shouldn't be selected for him by means of rules” [*Benjamin, male, Ilkim*]. *Matthias* did clarify that ‘having the official ownership of land’ is not an issue in their society, as they have a certificate with the map of our farmland in geographic coordinates. According to *Matthias* everybody with land, was in ownership of the certificate.

Having no rules facilitates the implementation of adaptation strategies, but can also prove problematic when farmers need the same natural resources for their implementations. As there are no formal rules about the use of water on private plots [*Matthias, Jeremiah*], conflict of interests in natural resources could arise. However, *Matthias* explained that you shouldn't take too much water; that is in the farmers ‘culture’ not to do that.

Formal rules about soil- and water conservation sites, the distribution of plots on the communal irrigation site and rules about the use of natural resources, influence the resources a farmer has. This relates to the ‘physical opportunity’ of the farmer. Do the farmers’ resources allow the implementation of an adaptation strategy? When farmers have less time to invest in their farms due to their work on the soil and water conservation sites, they might generate less income, and are less able to purchase the required tools. On the other hand, investing in the soil and water conservation sites is beneficial for the general level of natural resources. Furthermore, having a communal irrigation plot helps with generating more resources and thus enables farmers to further invest in their land or in other livelihood diversification strategies. See Table 7.13 for an overview an overview of the influences of formal rules and regulations.

Table 7.13

Formal rules and regulations – processes

Influences

- On the resources in possession or in availability of the farmers (time, land, financial capital, and/or water), thus the ‘physical opportunity’ of the farmers
-

Social norms: gender (processes)

Different gender norms were acknowledged by several farmers during the interviews. Both genders have the same land-ownership rights, and all extension services are available to men and women [*Matthias, & Anna*]. There are also no formal or informal rules about whether the gender of the head of household determines which strategies can be implemented [*Matthias, John, & Jeremiah*]. Additionally, both men and women are required to work on the soil- and conservation sites and in forest conservation [*Matthias, John, Jeremiah, Anna*]

However, according to *Matthias* and *Anna*, men put in more time on these sites because women have other duties, such as reading for the children, nursing and running the household. One of the women interviewed, when asked about the formal rules in the community regarding adaptation strategies, indeed said: “I don't know, I stay in home much.” [*Julia, female, Mere-Mieti*]. *Anna* explained that female heads of households do not only have less time to work on the soil- and water conservation sites and in tree management, they also have less time to invest in adopting adaptation strategies on their own farms. This results in male and female heads of households using different adaptation strategies according to several of the farmers. Men tend to participate more in implementing new adaptation strategies, such as gaining access to extra underground water for irrigation, row planting in crops, using fertilizer and using new and improved seeds [*Matthias, John, & Jeremiah*]. According to *Anna*, this results in male led households being more resilient to climate change, as they can spend more time to implementing and maintaining adaptation strategies. Women usually participate more in poultry production, as this enables women to manage the chicken and still be close to home [*John & Michael*] Women also rely more on the PSNP aid program of the government, according to two of the DAs [*Sarah, & Michael*]. Additionally, as already mentioned in critical point six; *Aaron* explained that female head of households generally have less financial resources than male head of households, which, according to him, was caused by the fact that females lack labour power and rent out their lands more.

Furthermore, two out of the four women interviewed did not receive any level of education, while for men this number was two out of ten. Women thus seem to not only lack income, but education as well.

Gender roles therefore are very much related to the social opportunity of implementing adaptation strategies, as well as the physical opportunity, as women have less opportunity to gather the required resources for implementation. See Table 7.14 for an overview of the influences of gender norms in Mere-Mieti.

Table 7.14

Social norms: gender – processes

Influence

- Perceived suitability of adaptation strategies for male head of households vs. female head of households, relating to their ‘social opportunity’
- ‘Physical opportunity’ of implementing adaptation strategies for male head of households vs. female head of households (time, financial capital)

Social norms: social responsibility (processes)

The farmers expressed that they feel like everybody in the community has the responsibility to participate on the community soil and -water conservation sites and follow the rules regarding forest management [*David, Aaron, Rafael, & Joanna*]. These rules are originally formal governmental rules but have become informal as well; they have become norms in society [*Joanna*]. The farmers help with implementing and upholding these rules [*Joanna*]. *Matthias* gave this example:

You cannot just cut trees. There are formal guards and society also guards these forests. If somebody sees someone else cutting a tree, they contact the local community leader, who present the case to court and the tree cutter can be punished. [*Matthias, male, Mere-Mieti*]

Another farmer explained the severity of cutting wood on the forest conservation sites: “Everyone sees cutting trees as bad as killing men or eating meat while fasting.” [*Rafael, male, Mere-Mieti*]. This indicates that cutting wood is seen as extremely bad in society, equal to either committing murder or acting irreligiously. However, not everybody upholds these rules, as sometimes wood gets stolen during the night [*Joanna*].

Such social norms thus influence the social opportunity of farmers by creating expectations of how farmers should act. Not only is a farmer formally obliged to participate in the conservation sites, but they will also loose social status if they do not participate on the sites. And, again, on the other hand, these social norms stimulate the conservation of natural resources, which increases the ‘physical opportunity’ of implementing strategies that require water and fertile soil. See Table 7.15 for an overview of the influences of social responsibility as a norm in Mere-Mieti.

Table 7.15

Influence

- ‘Social opportunity’ of the farmers (expectations of where farmers should direct their efforts towards)
 - ‘Physical opportunity’ of the farmers (increasing natural resources, decreasing time to invest in individual adaptation strategies)
-

Social values: saving and working hard (processes)

Saving is seen as a good adaptation strategy by the farmers [Matthias, Aaron, & Anna]. It is mentioned as a value in society by the farmers, and promoted by the religious men and development agents [Matthias, Aaron, Gabriel, Anna, & Julia]. However, social norms can contrast the actualisation of saving in practice. DA Michael explained this:

The government and the religious men try to reduce expenditure, but people actually spend more on weddings and funeral ceremonies. This is because people feel like the community will blame them and say they are selfish if you reduce the amount spend on these family events. ... people always bring gifts and feel the social obligation to bring a good gift. [Michael, male, DA]

Aaron agreed with this and said: “People find it difficult to spend less on that, because they might be seen as bad family members.” [Aaron, male, Mere-Mieti]. Additionally, he thinks that some farmers are not even trying to save money and invest in adaptation strategies. He said:

Laziness influences our decisions for adaptation strategies. Some farmers say 'we haven't much' to hide laziness. They do not tell plainly, but hide the amount of capital they have. Telling the exact amount of capital hinders getting aid they think. They are not trustworthy. [Aaron, male, Mere-Mieti]

These farmers thus value aid more than working hard and saving up.

The value of saving money and grain can stimulate the implementation of adaptation strategies, whereas other societal values, such as elaborately celebrating ceremonies, can decrease the ability of farmers to save up financial resources to invest in the implementation of adaptation strategies. These values thus relate to the social norms and values facilitating or inhibiting implementation behaviour: it relates to the social opportunity of farmers. This consequently, influences the physical opportunity of farmers (financial resources). See Table

7.16 for an overview of the influences of saving as a value in society.

Table 7.16

Social values: saving and working hard – processes

Influence

- ‘Social opportunity’ of the farmers (where financial resources should be invested in)
- ‘Physical opportunity’ of the farmers (financial resources)

Social values: self-experience (processes)

As mentioned above, the famers’ distrust of the development agents’ messages roots in the fact that development agents do not have direct experience with farming. This while farmers themselves, their social network, and the religious men and local leaders do have this experience. *John* commented: “I trust self-experience and social network the most because we farmers have direct experience, something social media and the extension services haven't.” [*John*, male, Mere-Mieti]. Thus, the mental model of: ‘experience proves efficiency’, influences when information is trusted and how information about new adaptation strategies is perceived. See Table 7.17 for an overview of the influences of self-experiences as a value in Mere-Mieti.

Table 7.17

Value in society: self-experience – processes

Influence

- What makes information trustworthy (knowledge base: ‘psychological capability’)
- How the efficiency and suitability of adaptation strategies is evaluated (‘motivation’ to use these strategies)

Ethnic conflicts in Ethiopia – (processes)

The ethnic conflicts in Ethiopia indirectly also influence the livelihoods of the farmers in Mere-Mieti. One farmer said: “Peace is the most effective, then all other strategies can be implemented.” [*Julia*, female, Mere-Mieti]. Before the ethnical conflicts in Ethiopia, for example, some men in Mere-Mieti migrated as a way of improving the livelihoods of their households. They did so to the southern region of Tigray and to the Amharic region. However, with the current ethnic conflicts this is no longer an option [*Matthias*].

The ethnic conflicts in Ethiopia thus influence what an efficient and suitable adaptation strategy is for the farmers, see Table 7.18.

Table 7.18

| <i>Ethnic conflicts – processes</i> | |
|-------------------------------------|---|
| Influence | |
| ○ | Evaluation of efficiency and suitability of adaptation strategies (‘motivation’ – the reasoning for not implementing certain adaptation strategies) |

An overview of the identified systemic influences

See Table 7.19 for an overview of the identified systemic influences. Due to the short period of the (field-)research, and the fact that the farmers were not actively involved in the system mapping, these will not include all of systemic influences affecting the implementation process of the farmers in Mere-Mieti.

Table 7.19

| <i>Overview of all system influences</i> | |
|--|--|
| Category | Influence |
| Actors | (Trust in) development agents |
| Actors and processes | Religion and religious men |
| Actors | Media and social network |
| Processes | Formal rules and regulations |
| Processes | Social norms: gender |
| Processes | Social norms: social responsibility |
| Processes | Social values: saving and working hard |
| Processes | Social values: self-experience |
| Processes | Ethnic conflicts |

8. Discussion

As described in the introduction, this paper aims to identify entry-points for interventions for the extension services in Mere-Mieti. It has applied the theoretical framework based on Lambe, et al. (2020)'s Transdisciplinary Conceptual Framework, which included behavioural theories and system analysis, on a case study in Mere-Mieti. Firstly, eight critical points in the farmers' behaviour change process of implementing adaptation strategies have been mapped out and the status in Mere-Mieti has been identified for all critical points. Subsequently, the systemic factors influencing this process have been identified as well. Next, the status of the critical points in Mere-Mieti will be linked to both the broader national and regional context and to the systemic factors previously discussed, to identify the entry-points of interventions in Mere-Mieti. This chapter will end with a conclusion on the entry-points identified with the framework, as well as a conclusion on the contributions of the Transdisciplinary Conceptual Framework on identifying these entry-points. Lastly, the academic- and development implications and recommendations will be discussed.

Entry point for interventions

Even though the livelihoods of the farmers in Mere-Mieti have improved, the head of the DAs office is still only satisfied with the implementation rate of fifty percent of the extension services. The identification of entry-points for interventions can possibly help to increase this percentage. Additionally, the speed of implementation might also be addressed via these entry-points: new interventions might help increase the implementation speed of farmers who are categorized by the DAs as the 'late majority'.

Critical point 1: availability of climate and weather information

In Mere-Mieti, the farmers were aware about climate change, its impacts and how these impacts can affect their livelihoods, but they did not know what the origin of climate change was. Additionally, farmers got their information both from the extension office and from their own and social network's experiences.

Context and systemic factors

Firstly, the unknown cause of climate changes actually corresponds with the scientific knowledge about the impacts of climate change in Ethiopia. Rain variability is present, but it is hard to tell if climate change is the exact cause of this, or if rain variability is just part of the climate of Ethiopia (UNDP, 2020; World Bank, 2020; World Bank, et al., 2011). Therefore, the farmers' lack of knowledge about the origins of climate change is no indication that the

extension office is lacking in providing information about climate change. This first observation is thus not necessarily an entry-point for an intervention.

Secondly, the system analysis showed that trust in the development agents influences the farmers' acceptance of information coming from the extension office. Distrust in the DAs has inhibited the acceptance of climate change and weather information coming from the extension office in the past. Nowadays, the DAs are no longer distrusted, because the farmers have experienced that the information coming from the DAs is truthful. Another entry-point thus would be using this reliance on 'experience' to convey information about climate change and weather predictions. Adjusting the way in which a message is brought to the local ways of thinking can help to increase the trust of the farmers in the information provided.

Critical point 2: awareness of the available services for adaptation strategies

In Mere-Mieti, the farmers were generally aware of some of the extension services, but might not have been aware of all services. Additionally, farmers in Ilkim seemed less aware of the credit and saving services of the extension office than the farmers in Mere-Mieti (v).

Both observations need to be interpreted with care. Firstly, the farmers might have been aware of the services, but they simply might not have mentioned all of them in the interviews. This could be because the question posed in the interview asked which extension services were available in the area, however, it did not specifically state to list *all* available services.

Additionally, the interpretation about the farmers from Ilkim is based on four interviews with these farmers, while ten farmers from Mere-Mieti (v) were interviewed. Since no farmer from Mere-Mieti (v) mentioned all of the services in their interview, it is possible that other farmers from Ilkim would have mentioned the credit- and saving services.

Context and systemic factors

Since this critical point also concerns the awareness of the farmers about a certain topic related to the extension office, the trust in the DAs information is again relevant for the acceptance of the information by the farmers. Distrust can influence the awareness of the available services for adaptation strategies, because if farmers do not trust the extension agents, they might not come to trainings and learn about the different services for adaptation strategies. Thus, distrust can result in a scarcity of attention for the extension services. This scarcity of attention means that farmers only focus on information that confirms their ideas and do not give attention to information that goes against their assumptions (Datta, & Mullianathan, 2014).

Assuming that the information is indeed available, but the farmers are not interested in the information or do not trust the information, working together with trusted individuals in society might be a solution. The DAs in Mere-Mieti indeed started working together with the religious men, who are very respected and trusted figures in the society. If the religious men preach the use of the extension services in church, this information reaches a lot of the farmers at once, and this information is more easily trusted than when it would have come from the DAs. An entry-point for an intervention would thus be to identify and include the trusted individuals in society, from the beginning on, in the design phase of a new strategy. Co-creation with these trusted individuals can help with the trust of the farmers in the new strategy. Another entry-point would be to include the use of ‘experience’ as a way to create trust in new strategies. For example, the trusted individuals can, by functioning as model farmers, show other farmers how a strategy is used. This way the other farmers can ‘experience’ the new strategy.

However, assuming that a ‘scarcity of attention’ inhibits the uptake of information, is assuming that all information is easily accessible, but that some farmers are not interested in the information. However, this might not always be the case. Lacking knowledge about the extension services or in fact, about climate change in general, is often more than just a shortage knowledge (‘having psychological capability’) on the farmers’ part. It is often also a shortage of available and accessible information in the system surrounding the farmers (‘having access to gaining psychological capability’). The next critical point will discuss this point more in depth. However, in any case, mapping out all the available information sources (including information coming from the media and the farmers’ own social networks) and mapping out to whom they are available is another entry-point. These mappings provide an overview, that can be used to design interventions to increase the availability of information sources. It might also be useful to map out information sources that provide contradicting information and to assess how these sources are valued in society. Co-creating with these different sources of information might create a better understanding of information that is valued relevant the local context. Co-creating with local actors can also increase the chance that the information is provided in correspondence with the local way of thinking: that it is complementary to the existing local knowledge bases and mental models.

Critical point 3: Accessibility of the extension services

In Mere-Mieti, the extension services were less accessible for farmers living far away (Ilkim) from the extension office. Additionally, the extension services were accessible for both men

and women, but the implementation of adaptation strategies taught at the Farmers Training Centre is lower for women.

Context and systemic factors

Ilkim is an hour walk away from the extension office, and therefore it is more difficult for the DAs to provide on-farm assistance with the implementation of adaptation strategies. The distance between Ilkim and the extension office can thus complicate the use of the extension service for farmers from Ilkim. An entry-point for this critical point thus would be, to include issues of inequalities in accessibility of the extension office, into the design of future interventions.

Additionally, female heads of households have less time to invest in implementing adaptation strategies on their own farms, due to the time the household tasks require. Female head of households thus might also have less time to go to the office and learn about which adaptation strategies are present and thus will be less aware of these services. Another entry-point would thus be, including gender inequalities about the accessibility of the extension office into the interventions. This might mean creating interventions especially aimed at farmers from Ilkim or female head of households.

Critical point 4: Interest in adaptation strategies

In Mere-Mieti, some farmers did not have an interest in farm-based adaptation strategies due to livelihood diversifications options, because having multiple sources for income reduces the need for on-farm adaptation strategies. Additionally, other farmers did not see the need for adaptation strategies because they see God as responsible for their livelihoods.

Context and systemic factors

Some of the livelihood diversification options used and positively valued by the farmers, such as working in construction or being a trader, are not focused on increasing farm productivity. This can indicate a discrepancy between the government's aims for the extension services and the actual used services by the farmers. The government's aim with the extension services is to improve livelihoods, protect natural resources and reduce food insecurity by means of increasing farm productivity (Federal Democratic Republic of Ethiopia, 2019). However, livelihood diversifications, such as becoming traders or construction workers, are mostly aimed at improving livelihoods and do not necessarily protect natural resources or decrease food insecurity. Some of the farmers opted for livelihood diversification, because their preferred adaptation strategy: irrigation, decreased in efficiency because of water shortages.

The farmers indicate that groundwater pumps are necessary and that they need the governments help to implement these pumps. Thus, including continued dialogue with the farmers and government officials (DAs and higher-up) about the farmers' needs, wishes and insights, is another entry-point for new interventions. Using co-creation might help to establish how the extension services could combine the needs of the farmers with the aims of the government.

Furthermore, the religious men can provide an entry-point for interventions as well at this critical point. They might help motivate farmers who trust that God is responsible for improving their livelihoods. The way in which the religious men preach the need of the adaptation strategies, has proved to influence the way the farmers see the need for adaptations strategies in the past as well.

Critical point 5: Efficiency and suitability of adaptation strategies

In Mere-Mieti, having 'direct experience' with the efficiency and suitability of the strategies, appeared to be the basis for the farmers' trust in the usefulness of the adaptation strategies. However, the farmers had different perceptions about what efficient and suitable strategies are, and whether the strategies were suitable for their own personal situation.

Context and systemic factors

All lot of different factors influence the perceived efficiency and suitability of the adaptation strategies. The development agents influence this by the kind of information they give about the efficiency and suitability of strategies. The religious men influence these perceptions by being the first to implement the adaptation strategies on their farms, which enables farmers to see the efficiency of the strategies in real-life. The information coming from the media and the opinions of the farmers' social network also contribute to the perception of efficiency and suitability of the strategies. Additionally, formal rules about land ownership can influence the range of suitable adaptation strategies for the farmers, as they can only implement strategies on land that is formally theirs. For example, ownership rights can create inequalities as these certificates can make it more difficult to gain land (has to go through the administrative route) and also the power-relations existing in the society could have influence the distribution of the certificates when they were first handed out. Furthermore, social norms about gender roles limit the time women can spend on their lands. This in turn, decreases the range of adaptations strategies these women can implement. Lastly, suitable strategies also depend on the contextual factors, such as the level of ethnic conflict in Ethiopia. For example, currently, migration is no longer a suitable adaptation strategy for the farmers. Any one of these

systemic factors can function as an entry-point for an intervention, and because of that in general for this critical point system mapping is very important. This critical point shows that the evaluation of the efficiency and suitability of an adaptation strategy for the farmers' personal situation is depended on their own capabilities, opportunities and motivation, but even more so on systemic factors of the broader context surrounding the farmers. For this critical point, the entry-point is thus to look at the actors and processes active in the system in which the farmers live.

Critical point 6: Availability and accessibility of tools and/or (natural) resources

In Mere-Mieti, the farmers and DAs have stated that there is a lack of natural resources, most prominently a lack of water, which complicates the use of irrigation systems. The farmers also argued that there is a lack of financial resources in the community to create groundwater pumps/access to water. Furthermore, there are not enough machines/tools available in Mere-Mieti. This issue relates to the government's financial capital directed at the extension services. Additionally, female head of households have fewer financial resources than male head of households.

Context and systemic factors

The lack of water corresponds with the main findings of impacts of climate change in Ethiopia. Droughts are the most common consequence of climate change in the Tigray region (World Bank, 2020; World Bank, 2019). There are no formal rules and regulations about the use of natural resources. However, the soil and water shortages can possibly create conflicts over scarce natural resources (UNDP, 2020; World Bank, 2019; World Bank, et al., 2011). This could be an entry-point for an intervention: how should scarce natural resources be divided across the community, so that everybody can equally benefit?

Furthermore, existing formal rules and regulations, and also social norms, about participation on the soil- and water conservation sites influence the time farmers can spend on their own farms. These thus influence 'time' as a resource of the farmers. However, these rules about soil- and water conservation consequently also contribute to the restoring of natural resources. Dialogue with the farmers about the balance of caring for natural resources and investing in their own farms is another entry-point.

Additionally, to combat the issue of lacking financial capital in the community, the DAs and the religious men started to promote the value of saving. However, other social values in society, such as expectations about expenditures on gifts for friends and family, can inhibit the farmers' ability to save up. This inhibits investment in adaptation strategies, and

thus is another entry-point for interventions.

Moreover, financial capital in general is more available to male led households than female led households, and as mentioned before female head of households rely more on government aid by means of the PSNP. However, this aid can be conditional by requiring the beneficiaries to participate in public works in order to receive the aid (IFPRI, & EDRI, 2013). This means they have even less time to invest in their own land or other sources of income. Again, this provides an entry-point for interventions by focussing on how to improve the access to financial resources for female head of households.

Critical point 7 (during): Continued availability and accessibility of (technical) assistance

In Mere-Mieti, farmers argue the importance of continued assistance during the implementation of adaptation strategies. Again, this assistance was less available for farmers from Ilkim than for framers from Mere-Mieti (v).

Context and systemic factors

This assistance is available at the extension office, so again the same issues regarding unequal access to the extension office are present in this critical point. These inequalities can be used as entry-points for interventions. For example, by focussing interventions that make the extension office more accessible to farmers from Ilkim, or by focussing interventions on facilitating on-farm assistance of the DAs in Ilkim.

Critical point 8 (during): Continued availability and accessibility of the required tools and/or (natural) resources

In Mere-Mieti, during the implementation, the same issues with the availability of tools, and (natural) resources exists as in the before phase. Additionally, in the past there has also been a lack of fertilizer due to misuse of fertilizer by the farmers (using too much) and due to a miscalculation of the amount of fertilizer needed on the supply-side.

Context and systemic factors

The misuse of fertilizer could be connected to the mental models of the farmers about the use of fertilizer, but also to a misestimation on the development agents' side regarding the needed supply of fertilizer. Both can be addressed by having more dialogue with the farmers, which is thus again an entry-point for interventions. There is some dialogue going on in Mere-Mieti, as the farmers give feedback about their experiences to the DAs. However, intensifying this and actively involving the farmers in the design of the interventions for the extension services

might help the understanding of the DAs of why the farmers used more fertilizer than necessary, for example. It can help with the earlier identification of different mental models used by the farmers and the DAs.

Conclusion on the entry-points

Firstly, because of a lack of data due to the changed research design the system mapping specifically, but also the journey mapping, were not as elaborate as they might have been if the data collection was done with the current theoretical framework in mind. Especially information about the market actors and processes was lacking. Also, the data only allowed for a limited focus on (power-)relations between actors.

However, with the data that was available several possible entry-points for interventions were identified based on the journey mapping and system mapping methods. The proposed entry-points and suggestions on how these entry-points can be used, are interpretations from one researcher who was in the field for a short period of time. These are just ideas on how to use the data and the framework. The real solutions need to be created in co-creation with the farmers themselves and should be tested to establish their usefulness.

The entry-points were strongly influenced by systemic factors, which in turn influenced the status of the behavioural elements at the critical points for the farmers. The influence of the systemic factors was especially present for the accessibility and availability of knowledge and resources. For example, they were influenced by the formal rules and regulations (which can create inequalities in owning resources), informal rules (directing where people should invest their time in), social norms (gender inequalities that cause a lack of time and financial resources for women), social values (saving financial resources versus complying with social values), mental models of efficiency and suitability (linked to the value of ‘experience’) and last but not least, climate change, which causes a lack of water needed for certain adaptation strategies. These issues are not easily resolved, but involving the farmers more in the design of the intervention could help with directing the available resources more efficiently. This because the farmers can indicate whether or not the interventions are useful in their personal/local context, so that the few financial resources that are available to the farmers and the extension office can be invested in interventions that suit the farmers’ reality.

Additionally, the entry-points often referred back to including more co-creation into the design of new interventions. All the different actors had different influences on the

implementation process of the farmers. Focussing on the different relationships and influences of these actors can help to understand the farmers implementation process more. Furthermore, including different voices in the design process can help to identify contradicting assumptions and mental models and to create a better understanding of the local ways of thinking: the farmers knowledge bases, insights and suggestions. Cooperating with the related actors in society can also help with creating trust in the effectiveness and suitability of the extension services and with aligning these services even more with the needs of the farmers, as well as the governments aims.

General conclusion on the use of the framework in identifying entry-points for interventions for the extension services in Mere-Mieti

The framework laid out a timeline of the implementation process while acknowledging different systemic factors that influenced this timeline. It created a step by step playbook of critical points that need to be overcome for behavioural change to happen. This facilitates the identification of the most efficient sequencing of the extension services (Lambe, et al., 2020). The framework acknowledged that behavioural change processes are complex and often entail changing multiple behaviours at multiple points in time (Lambe, et al., 2020).

The systemic factors are at the core of the issues at the critical points during the implementation process. The behavioural elements can be seen as tools to zoom in on what issues the systemic factors exactly create at these critical points. Including these elements of the behavioural change theories can contribute to a better understanding of the reasonings of the farmers regarding the implementation of adaptation strategies. But, only analysing the implementation of adaptation strategies from a behavioural perspective will not create a full picture of everything that influences the implementation process. This paper showed that including the systemic factors in analysing the implementation process of adaptation strategies is the backbone for a complete understanding of the farmers' behaviour.

Conclusion behavioural elements

The framework identified the specific elements of behaviour that are inhibiting behaviour change at the critical points, which facilitates the design of the appropriate interventions that address the core problems at these points. The two motivation elements of behaviour, both automatic and reflective (especially concerning 'trust', 'mental models' and 'cost-benefit analyses), help to understand the reasonings behind why farmers will or won't implement certain strategies. Additionally, the normative behavioural theories, concerning social norms

and values actually related to a large part of the systemic factors in Mere-Mieti. Social norms and cost-benefit analyses are known in the development intervention literature to influence the behaviour of participants; however, theories of affect, regarding trust and automatic decision systems are much less incorporated in the design process of development interventions.

Conclusion system analysis

All critical points are influenced by systemic factors, which can be both inhibiting of facilitating the behavioural change process of farmers. The framework showed that including the systemic factors in analysing the implementation process of adaptation strategies is essential for a complete understanding of the farmers' behaviour. Thus, this means shifting the focus of interventions to the influences of the broader context on the farmers' implementation process, instead of trying to find solutions within the scale of the farmers' households.

Implications and recommendations

Development implications and recommendations

All the mentioned entry-points are implications for the extension services in Mere-Mieti, but also for development interventions aimed at increasing the implementation of adaptation strategies in general. Especially important is maintaining dialogue with the farmers about their ideas on the extension services. It is important that these interventions are being designed in co-creation with the farmers themselves, on the basis of demand (needs of the farmers), instead of supply (recommendations of the district office), as recommended by Lambe et al. (2020). Additionally, a focus on the automatic and reflective motivation of the farmers, increases the understanding of the mental models of the farmers, and this can help to identify miscommunications about for example the correct use of fertilizer, earlier in the process. Furthermore, the importance of the systemic factors needs to be acknowledged and highlighted when designing interventions aimed at stimulating the implementation of adaptation strategies. In many cases, interventions should broaden their scope outside of the capabilities of the household, to include systemic factors in their target aim. In these cases, journey and system mapping can provide a handle to do so.

Academic implications and recommendations

Compared to the explanatory factors found with previous studies about climate change adaptation in Ethiopia, as mentioned in the introduction, the framework contributes a more elaborate explanation of why these factors influence the implementation of adaptation strategies. Yet, the quantitative methods are very useful in checking the assumptions made in the framework to see if these are true for the majority of the targeted beneficiaries of the interventions. The framework should thus be combined with these quantitative methods.

Improving the design of interventions suits the current trend of stricter evaluations of development programs (White, & Raitzer, 2017). Currently, multiple methods are used for designing sustainable adaptation interventions (Garnett, Sayer, & Du Toit, 2007). However, a lot of factors need to be taken into account when designing an intervention. Thus, basing intervention designs on an appropriate framework is recommended. Research into the best suited framework for interventions aimed at implementing adaptation strategies in rural areas in Ethiopia should be done more elaborately. For example, even though the behaviour elements of the COM-B framework facilitated insights into the adaptation behaviour of farmers, it would be interesting to see what other concepts could be used as the tools to zoom in on the influences of the systemic factors at the critical points during the implementation process. For example, the concepts of household capitals of the Sustainable Livelihoods Approach (SLA) bear some resemblances to the behavioural elements (Serrat, 2017). Would a combination of these elements and the capitals provide even more insight in to the abilities of a household? Additionally, the systemic factors of actors and processes, might benefit from being complemented by the concepts of ‘structures’ and ‘the vulnerability context’ of the SLA (Serrat, 2017). This can create a more specifically directed focus on the different influences of the system, and thus create a more complete picture of the system.

For interventions to be more efficient and suitable in the local context, future studies should focus on mapping out all the directly and indirectly involved actors and processes. Especially more focus should be given to the different motives of the actors involved in the intervention and how these can create inequality issues for other actors. As was seen with the development agents, the trust relationship between the agents and the farmers was of major importance in the efficient workings of the extension services. However, the farmers were also clear about including their own experiences, and depending on their social network for information. This combination of new information combining with local knowledge is already recommend by several other studies as well (Baya, et al., 2019b; Gebru, Van Steenberg, & Hagos, 2016; Menghistu, et al., 2018).

Improving intervention designs will contribute to a better efficiency of these interventions. More efficient interventions will help with combatting the negative consequences of climate change and help with increasing food production to combat food insecurity: two of the main issues with which Ethiopia is currently struggling (Federal Democratic Republic of Ethiopia, 2019; NAP Global Network, 2017). However, the findings are not generalizable as this paper used a case study. Therefore, aside from researching the best framework for the design of adaptation interventions, future research should also look into the contributions of this particular framework to development interventions in other places and sectors.

Furthermore, since mental models differ in different parts of the world, the farmers should be involved more in the framework analysis to make sure the framework fits the farmers reality. In future research, the journey- and system mapping should be done in collaboration with the farmers, to gain more realistic insight about their automatic and reflective motivation.

Lastly, even though the TCF focusses very much on co-creation, it does not describe what co-creation would look like. For example, the way in which community members participate is often already a social norm in the local communities (Winschiers-Theophilus, et al., 2010). This form of participation, however, might be different from Western versions (Winschiers-Theophilus, et al., 2010). So therefore, the outsiders involved in designing the intervention should be led by the suggestions of the possible beneficiaries of the intervention about what participation should look like (Winschiers-Theophilus, et al., 2010). This is something that needs to be researched more thoroughly. Apart from co-creation with the beneficiaries of the interventions, this should also involve the local researchers. They are much more familiar with the context and have more chance of creating a realistic insider perspective.

9. References

- Aggarwal, P.K., Jarvis, A., Campbell, B.M., Zougmore, R. B., Khatri-Chhetri, A., Vermeulen, S. J., ..., Yen, B. T. (2018). The climate-smart village approach: Framework of an integrative strategy for scaling up adaptation options in agriculture. *Ecology and Society*, 23(1), 1–15. <https://doi.org/10.5751/es-09844-230114>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-t](https://doi.org/10.1016/0749-5978(91)90020-t)
- Asrat, P., & Simane, B. (2018). Farmers' perception of climate change and adaptation strategies in the Dabus watershed, North-West Ethiopia. *Ecological Processes*, 7(7), 1-13. <https://doi.org/10.1186/s13717-018-0118-8>
- Ayal, D.Y., Abshare, M.W., Desta, S., & Leal Filho, W. (2017). Pastoralists and farmers coping and adaptation strategies to climate variability and their perceived success in Ethiopia. In W. Leal Filho, S. Belay, J. Kalangu, W. Menas, P. Munishi, & K. Musiyiwa (Eds.), *Climate Change Adaptation in Africa: Fostering Resilience and Capacity to Adapt* (pp. 457–473). https://doi.org/10.1007/978-3-319-49520-0_28
- Bagagnan, A., Ouedraogo, I., Fonta, W.M., Sowe, M., & Wallis, A. (2019). Can Protection Motivation Theory explain farmers' adaptation to climate change decision making in The Gambia? *Climate*, 7(13), 1–14. <https://doi.org/10.3390/cli7010013>
- Barnes Truelove, H., Carrico, A.R., & Thabrew, L. (2015). A socio-psychological model for analyzing climate change adaptation: A case study of Sri Lankan paddy farmers. *Global Environmental Change*, 31, 85–97. <https://doi.org/10.1016/j.gloenvcha.2014.12.010>
- Baya, B.B., Gebreegziabher, K.T., & Sumago, A.G. (2019a). Local farmers' level of perceptions and awareness's on climate change in Amaro ward, Ethiopia, *Global Journal of Earth and Environmental Science*, 4(5), 101-109. <https://integrityresjournals.org/journal/GJEES/article-full-text-pdf/8D8832E04>
- Baya, B.B., Nzeadibe, T.C., Nwosu, E.O., & Uzomah, N.L. (2019b). Climate change, food insecurity and household adaptation mechanisms in Amaro Ward, Southern Region of Ethiopia. *Journal of Agricultural Extension and Rural Development*, 11(5), 106–113. <https://doi.org/10.5897/jaerd2019.1042>

BBC News. (2005, May 20). BBC News: Ethiopia seeks unity government. Retrieved December 16, 2019, from <http://news.bbc.co.uk/2/hi/africa/4567199.stm>

Berger, T., Troost, C., Wossen, T., Latynskiy, E., Tesfaye, K., & Gbegbelegbe, S. (2017). Can smallholder farmers adapt to climate variability, and how effective are policy interventions?: Agent-based simulation results for Ethiopia. *Agricultural Economics*, 48(6), 693–706. <https://doi.org/10.1111/agec.12367>

Berhanu, B., Seleshi, Y., & Melesse, A.M. (2014). Surface water and groundwater resources of Ethiopia: Potentials and challenges of water resources development. In A. M. Melesse, W. Abtew, & S. G. Setegn (Eds.), *Nile River Basin: Hydrology, Climate and Water Use* (pp. 97–117). https://doi.org/10.1007/978-3-319-02720-3_6

Berhe, M., Hoag, D., Tesfay, G., Tadesse, T., Oniki, S., Kagatsume, M., & Keske, C.M.H. (2017). The effects of adaptation to climate change on income of households in rural Ethiopia. *Pastoralism: Research, Policy and Practice*, 7(1), 1–15. <https://doi.org/10.1186/s13570-017-0084-2>

Berrang-Ford, L., Ford, J.D., & Paterson, J. (2011). Are we adapting to climate change? *Global Environmental Change*, 21(1), 25–33. <https://doi.org/10.1016/j.gloenvcha.2010.09.012> (adaptation deficit)

Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., ..., Cohen, M. (2009). From best practice to best fit: A framework for designing and analyzing pluralistic agricultural advisory services worldwide. *The Journal of Agricultural Education and Extension*, 15(4), 341–355. <https://doi.org/10.1080/13892240903309595>

Blackstock, K.L., Ingram, J., Burton, R., Brown, K.M., & Slee, B. (2010). Understanding and influencing behaviour change by farmers to improve water quality. *Science of the Total Environment*, 408(23), 5631–5638. <https://doi.org/10.1016/j.scitotenv.2009.04.029>

Central Intelligence Agency (CIA). (2019, December 3). The World Factbook - Africa: Ethiopia. Retrieved December 9, 2019, from <https://www.cia.gov/library/publications/the-world-factbook/geos/et.html>

Cialdini, R.B., Kallgren, C.A., & Reno, R.R. (1991). A Focus Theory of Normative Conduct: A theoretical refinement and reevaluation of the role of norms in human behavior. *Advances*

- in *Experimental Social Psychology*, 24(C), 201–234. [https://doi.org/10.1016/s0065-2601\(08\)60330-5](https://doi.org/10.1016/s0065-2601(08)60330-5)
- Datta, S., & Mullainathan, S. (2014). Behavioral Design: A new approach to development policy. *Review of Income and Wealth*, 60(1), 7–35. <https://doi.org/10.1111/roiw.12093>
- Dang, H.L., Li, E., Nuberg, I., & Bruwer, J. (2014). Understanding farmers' adaptation intention to climate change: A structural equation modelling study in the Mekong Delta, Vietnam. *Environmental Science & Policy*, 41, 11–22. <https://doi.org/10.1016/j.envsci.2014.04.002>
- Deressa, T.T., Hassan, R.M., and Ringler, C. (2011). Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia, *Journal of Agricultural Science*, 149(1), 23–31. <https://doi.org/10.1017/S0021859610000687>
- Ethiopia Data Portal. (2019). *Tigray - Ethiopia | Data and Statistics*. Retrieved November 28, 2019, from <http://ethiopia.opendataforafrica.org/apps/atlas/Tigray>
- Fankhauser, S., & McDermott, T.K.J. (2014). Understanding the adaptation deficit: Why are poor countries more vulnerable to climate events than rich countries? *Global Environmental Change*, 27, 9–18. <https://doi.org/10.1016/j.gloenvcha.2014.04.014>
- Federal Democratic Republic of Ethiopia. (2019). *Ethiopia's climate resilient green economy: National adaptation plan*. Retrieved from <https://www4.unfccc.int/sites/NAPC/Documents/Parties/NAP-ETH%20FINAL%20VERSION%20%20Mar%202019.pdf>
- Garnett, S.T., Sayer, J., & Du Toit, J. (2007). Improving the effectiveness of interventions to balance conservation and development: A conceptual framework. *Ecology and Society*, 12(1), 2. Retrieved from <http://www.ecologyandsociety.org/vol12/iss1/art2/>
- Gebrehiwot, T., & Van der Veen, A. (2013). Farm level adaptation to climate change: The case of farmer's in the Ethiopian Highlands. *Environmental Management*, 52(1), 29–44. <https://doi.org/10.1007/s00267-013-0039-3>

- Gebru, G., Ichoku, H., & Phil-Eze, P. (2018). Determinants of livelihood diversification strategies in Eastern Tigray Region of Ethiopia, *Journal of Agriculture & Food Security*, 7(62), 1-9. <https://doi.org/10.1186/s40066-018-0214-0>
- Gebru, K., Steenbergen, F, van, & Hagos, E. (2016). *Reading the rain: Postcard from the Raya in Tigray, Ethiopia*. Retrieved March 13, 2020, from <https://wle.cgiar.org/thrive/2016/02/16/reading-rain>
- Gerrard, M., Gibbons, F.X., Houlihan, A.E., Stock, M.L., & Pomery, E.A. (2008). A dual-process approach to health risk decision making: The prototype willingness model. *Developmental Review*, 28(1), 29–61. <https://doi.org/10.1016/j.dr.2007.10.001>
- Gorddard, R., Colloff, M.J., Wise, R.M., Ware, D., & Dunlop, M. (2016). Values, rules and knowledge: Adaptation as change in the decision context. *Environmental Science & Policy*, 57, 60–69. <https://doi.org/10.1016/j.envsci.2015.12.004>
- Google Maps. (2020). *Africa*. Retrieved February 18, 2020, from <https://www.google.nl/maps/@9.0516713,38.5101246,3z>
- Hennink, M., Hutter, I., & Bailey, A. (2010). *Qualitative Research Methods* (1st ed). SAGE Publications Ltd. ISBN-13: 978-1412922265
- International Food Policy Research Institute (IFPRI), & Ethiopian Development Research Institute (EDRI). (2013). *The impact of research on the Productive Safety Net Programme (PSNP)*. Retrieved from http://essp.ifpri.info/files/2011/04/Outcome-Note_5_PSNP_v1-0.pdf
- Jones, L., Ludi, E., & Levine, S. (2010, December). *Background Note - Towards a characterisation of adaptive capacity: A framework for analysing adaptive capacity at the local level*. Overseas Development Institute. Retrieved from <https://oxfamlibrary.openrepository.com/bitstream/handle/10546/595168/bn-local-adaptive-capacity-011210.en.pdf?sequence=1>
- Kotir, J.H. (2011). Climate change and variability in Sub-Saharan Africa: A review of current and future trends and impacts on agriculture and food security, *Environment, Development and Sustainability*, 13, 587–605. <https://doi.org/10.1007/s10668-010-9278-0>

- Lambe, F., Ran, Y., Jürisoo, M., Holmlid, S., Muhoza, C., Johnson, O., & Osborne, M. (2020). Embracing complexity: A transdisciplinary conceptual framework for understanding behavior change in the context of development-focused interventions. *World Development*, *126*, 104703. <https://doi.org/10.1016/j.worlddev.2019.104703>
- Levin, S.A. (1998). Ecosystems and the Biosphere as Complex Adaptive Systems. *Ecosystems*, *1*(5), 431–436. <https://doi.org/10.1007/s100219900037>
- Levitis, D.A., Lidicker, W.Z., & Freund, G. (2009). Behavioural biologists do not agree on what constitutes behaviour. *Animal Behaviour*, *78*(1), 103–110. <https://doi.org/10.1016/j.anbehav.2009.03.018>
- McLeod, L.J., Hine, D.W., Please, P.M., & Driver, A.B. (2015). Applying behavioral theories to invasive animal management: Towards an integrated framework. *Journal of Environmental Management*, *161*, 63–71. <https://doi.org/10.1016/j.jenvman.2015.06.048>
- McSweeney, C., New, M., & Lizcano, G. (2012). *UNDP Climate Change Country Profiles - Ethiopia*. Retrieved from https://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Ethiopia/Ethiopia.hires.report.pdf
- Mekelle University (n.d.). *About MU*. Retrieved February 27, 2020, from <http://www.mu.edu.et/index.php/about-mu/overview/about-mu>
- Menghistu, H.T., Mersha, T.T., & Abraha, A.Z. (2018). Farmers' perception of drought and its socioeconomic impact: The case of Tigray and Afar regions of Ethiopia. *Journal of Applied Animal Research*, *46*(1), 1023–1031. <https://doi.org/10.1080/09712119.2018.1450752>
- Mersha, A.A., & Van Laerhoven, F. (2018). The interplay between planned and autonomous adaptation in response to climate change: Insights from rural Ethiopia. *World Development*, *107*, 87–97. <https://doi.org/10.1016/j.worlddev.2018.03.001>
- Michie, S., van Stralen, M.M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, *6*(1), 42. <https://doi.org/10.1186/1748-5908-6-42>

Momvandi, A., Omidi Najafabadi, M., Hosseini, J., & Lashgarara, F. (2018a). The identification of factors affecting the use of pressurized irrigation systems by farmers in Iran. *Water*, *10*(11), 1532. <https://doi.org/10.3390/w10111532>

Moser, S.C., & Ekstrom, J.A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences*, *107*(51), 22026–22031. <https://doi.org/10.1073/pnas.1007887107>

NAP Global Network. (2017, September 24). Ethiopia launches National Adaptation Plan document – NAP Global Network. Retrieved February 19, 2020, from <http://napglobalnetwork.org/2017/09/ethiopia-launches-national-adaptation-plan-document/>

Notenbaert, A., Pfeifer, C., Silvestri, S., & Herrero, M. (2017). Targeting, out-scaling and prioritising climate-smart interventions in agricultural systems: Lessons from applying a generic framework to the livestock sector in sub-Saharan Africa. *Agricultural Systems*, *151*, 153–162. <https://doi.org/10.1016/j.agsy.2016.05.017>

Onoja, A.O., Abraha, A.Z., Girma, A., & Achike, A.I. (2019). Climate-Smart Agricultural Practices (CSA) adoption by crop farmers in semi-arid regions of West and East Africa: Evidence from Nigeria and Ethiopia. In P. Castro, A. Azul, W. Leal Filho, & U. Azeiteiro (Eds.), *Climate change-resilient agriculture and agroforestry* (pp. 89–113). https://doi.org/10.1007/978-3-319-75004-0_6

Richburg-Hayes, L., Anzelone, C., Dechausay, N., & Landers, P. (2017). *Nudging change in human services: Final report of the Behavioral Interventions to Advance Self-sufficiency (BIAS) project* (OPRE Report 2017-23). Retrieved from https://www.mdrc.org/sites/default/files/2017_MDRC_BIAS_Final_Report_FR.pdf

Rogers, R.W. (1975). A Protection Motivation Theory of fear appeals and attitude change. *Journal of Psychology*, *91*, 93-114. Retrieved from <https://search-proquest-com.proxy.library.uu.nl/docview/1290659540?accountid=14772>

Serrat, O. (2017). The Sustainable Livelihoods Approach. *Knowledge Solutions*, 21–26. https://doi.org/10.1007/978-981-10-0983-9_5

Slovic, P., Finucane, M.L., Peters, E., & MacGregor, D.G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis*, 24(2), 311–322. <https://doi.org/10.1111/j.0272-4332.2004.00433.x>

United Nations Development Program (UNDP). (2020). Ethiopia National Programme of Action (NAPA) | UNDP Climate Change Adaptation. Retrieved January 9, 2020, from <https://www.adaptation-undp.org/projects/ethiopia-national-programme-action-napa>

United States Agency for International Development (USAID). (2016). Climate risk profile: Ethiopia. Retrieved December 15, 2019, from <https://www.climatelinks.org/resources/climate-change-risk-profile-ethiopia>

White, H., & Raitzer, D.A. (2017). *Impact evaluation of development interventions: A practical guide*. Retrieved from <https://www.adb.org/sites/default/files/institutional-document/390086/guide-impact-evaluation-development-interventions.pdf>

Winschiers-Theophilus, H., Chivuno-Kuria, S., Kapuire, G.K., Bidwell, N.J., & Blake, E. (2010). Being participated: A community approach. *ACM International Conference Proceeding Series, 2010*, 1–10. <https://doi.org/10.1145/1900441.1900443>

World Bank, Global Facility for Disaster Reduction and Recovery (GFDRR), Climate Investment Fund (CIF), & ENV. (2011). *Vulnerability, risk reduction, and adaptation to climate change - Ethiopia*. Retrieved from https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdrr_climate_change_country_profile_for_ETH.pdf

World Bank. (2019). *Disaster risk profile - Ethiopia*. Retrieved January 9, 2020, from https://www.gfdrr.org/sites/default/files/publication/ethiopia_low.pdf

World Bank. (2020). *Ethiopia - Climate data projections*. Retrieved January 9, 2020, from <https://climateknowledgeportal.worldbank.org/country/ethiopia/climate-data-projections>

Yazdanpanah, M., Feyzabad, F.R., Forouzani, M., Mohammadzadeh, S., & Burton, R.J.F. (2015). Predicting farmers' water conservation goals and behavior in Iran: A test of social

cognitive theory. *Land use Policy*, 47, 401-407.

<https://doi.org/10.1016/j.landusepol.2015.04.022>

Appendices

Appendix A: Interview guides

These interview guides were based on the ‘Values, Rules and Knowledge decision context’ by Gorddard, Colloff, Wise, Ware, and Dunlop (2016). They were thus structured according to the concepts of the decision context. The introduction and informed consent sections are the same for both the Key Informant Interviews and the Semi-Structured In-Depth Interviews.

Introduction and informed consent

Thank you for participating in this interview. My name is Sanne Zwagemaker and this is the translator Amsalu. I am a master-student from The Netherlands who studies International Development and this interview is part of my research for my study. I do research in Tigray focusing on adaptations of farmers to climate change. I want to know how farmers in Tigray adapt to climate change impacts and, mainly, *why* you chose these adaptation strategies. I am especially interested in what knowledge you trust and value relevant, what values you incorporate into your decision and how the local rules of the community and the official governmental rules influenced this decision.

Participation in the interview today is voluntary, if you, at any moment, feel like you do not want to be a part of this interview anymore, you are free to tell us so and leave. The content of what we discuss today will be treated anonymously in the further process, meaning that no one, but the individuals present today, will know who said what. If you consent to this, the interview will be recorded and after that, it will be written down, so I can re-read the interview. Your name and any other personal information that reveals your identity, will be replaced by codes or be left out of the written version of the interview. The recoding and written document of the interview will be secured so that only I can access these.

The information discussed today will be used for my thesis. The thesis will be publicly available in English. Some quotes might be directly in the thesis, but without any information that might reveal the identity for the quotes-giver.

I want to assure you that there are no right or wrong answers, I am interested in your opinion on things, so please feel free to say anything you think is relevant.

I will take notes during the interview to remember what we talked about, if you agree with this? But just to be sure I don't miss anything; I would like to ask your permission to record this interview? I am the only one who will listen to the recording. Do you agree to us recording the interview?

The interview will last approximately 60 minutes. Do you have any questions before we start?

Key Informant Interview Guide

Background information

- Can tell me a bit about yourself?
 - Name
 - Place of origin
 - Education level
 - Job

Introductory questions

- 1) How big is this area/Ilkim/Mere-Mieti?
 - Km²
 - Inhabitants
 - Households
- 2) What are the impacts of climate change in Ilkim/Mere-Mieti?
 - Characteristics (droughts, water shortage, pollution, crop failure, livestock deaths, crop and livestock diseases, soil degradation)
 - Intensity of phenomenon
 - How would farmers see climate change?
 - How are the livelihoods of farmers affected?

2. Transition question(s)

I've asked about climate change and increasing droughts, but would now like to continue with adaptation strategies to the impacts of these phenomena.

- 1) What kind of governmental extension services are there in this area?
 - Accessibility (for whom)

- Gender
- How many households use extension services?
- What skills are needed
- Examples
- Efficiency/relevance in local context/useful in your opinion – Which ones, why, in which way (increasing livelihoods, sustaining livelihoods)

3. Key questions

I'd know like to continue to discuss from where farmers gain knowledge about climate change impacts and adaptation strategies.

Topic: Knowledge: - What role do bodies of knowledge play a smallholder's selection process of adaptation strategies?

- 1) Where do farmers get knowledge about climate change impacts and adaptation strategies?
 - Local community leader
 - School
 - Family
 - Social network
 - Cooperatives
 - Social media?
 - Government/Development agents
 - External actors – NGO
 - Ranking
 - Difference in education level/income/gender

- 2) What kind of knowledge do farmers get from these sources?
 - Information/facts
 - Skills
 - Experience/opinions

- 3) Where does the source get this information from?
 - Experience

- Earlier mentioned sources
- 4) Could you rank the accessibility and availability of the abovementioned sources?
- Why
 - For whom (education level, income, distance, gender)
 - For whom not
 - What would farmers think

Topic: Values: - What role do societal values play in a smallholder's selection process of adaptation strategies?

- 1) How much do the ideas, beliefs and recommendations of others in the community influence a farmer's selection of adaptation strategies?
 - Whose is especially influential
- 2) What societal values do farmers take into consideration when selecting an adaptation strategy?
 - Values of community (collectivism, innovation, responsibility to others, responsibility to nature, community participation)
 - Ideas, beliefs and recommendations of others
 - Faith

Topic: Rules in practice & form: - What role do rules-in-use and rules-in-form play in a smallholder's selection process of adaptation strategies?

- 1) Are there official legislations, laws, regulations in society that determine who is able to implement adaptation strategies?
 - Which laws
 - Who implements these?
 - Which strategies
 - When
 - Who is able– why gender, resources, ownership?
- 2) Are there informal practices, norms, habits in society that determine who is able to implement adaptation strategies?
 - Which practices

- Who implements/checks these
 - Which strategies
 - When
 - Who is able– why gender, resources, ownership?
 - Originated in community or government practices
- 3) Whose approval is needed for a farmer to be allowed to implement adaptation strategies?
- After consulting with others/getting approval
 - Gender
 - Ownership

Topic: Experienced effectiveness: - To what extent are the implemented adaptation strategies experienced as effective?

- 1) What are effective adaptation strategies according to the farmers?
 - Why (increasing livelihoods, sustaining livelihoods)
 - How do they know (experience, trust)
- 2) Which adaptation strategies would they recommend to others?
- 3) What are ineffective adaptation strategies according to the farmers?
 - Why (increasing livelihoods, sustaining livelihoods)
 - How do they know (experience, trust)
- 4) What do you think are efficient strategies?
- 5) Are you satisfied with the implementation rate of these efficient strategies?

4. Closing question(s)

We are heading towards the end of this interview. The purpose of this interview was to get new insights in why farmers chose certain adaptation strategies.

- 1) Do you have anything else to add (things that I haven't touched upon, but should have)?

Thank you very much for taking the time to do this interview!

Semi-structured In-depth Interview Guide

Introduction and informed consent section

Background information

- Can tell me a bit about yourself?
 - Name
 - Age
 - Place of origin
 - Household composition
 - Education level
 - Source(s) of livelihood

1. Opening questions

- 1) What is climate change in your opinion?
 - impacts, characteristics, intensity of phenomenon
- 2) What do you think are the consequences of climate change on your lives?
 - Droughts
 - Illnesses
 - Water shortage/pollution
 - Crop failure
 - Livestock deaths
 - Soil degradation

2. Transition question(s)

We've talked about climate change and its impacts, but we would now like to continue to discuss about adaptation strategies for improving your livelihoods in the face of these impacts.

- 1) What are traditional ways of dealing with climate change/droughts in Ilkim/Mere-Mieti? Practices that have been done for generations?
 - Examples
 - Efficiency
 - Relevance in local context/useful in your opinion

- 2) What kind of governmental extension services are there in this area?
 - Examples
 - Efficiency
 - Relevance in local context/useful in your opinion

- 3) Which adaptations strategies do you use to cope with changes in weather and climate?
 - Why do you use these?

3. Key questions

Topic: Knowledge: - What role do bodies of knowledge play a smallholder's selection process of an adaptation strategy?

- 5) Where do you get information about climate change impacts and possible adaptation strategies?
 - Local community leader
 - School
 - Family
 - Social network
 - Social media
 - Government/Development agents
 - External actors

- 6) What kind of information do you get from these sources?
 - Knowledge
 - Skills
 - Experience

- 7) What is a trustworthy source for information about climate change impacts?
 - Why
 - Local community leader
 - School
 - Family
 - Social network

- Cooperatives
- Social media
- Government/Development agents
- External actors - NGO

8) Could you rank the trustworthiness of the abovementioned sources?

9) Could you rank the accessibility and availability of the abovementioned sources?

- Why
- For whom
- For whom not

Topic: Values: - What role do values play in a smallholder's selection process of an adaptation strategy?

3) How much does the opinion or recommendations of others in the community influence your decision about an adaptation strategy?

- Whose opinion especially?

4) What values did you take into consideration when selecting an adaptation strategy?

- Values of community (collectivism, innovation, responsibility to others, responsibility to nature)
- Opinions others
- Faith

Topic: Rules in practice & form: - What role do rules-in-use and rules-in-form play in a smallholder's selection process of an adaptation strategy?

1) Who is able to implement adaptation strategies in your society?

- Why
- Influence government
- Influence community norms
- Gender

2) When can you implement adaptation strategies?

- Why

- After consulting with others, for example?
 - Influence government
 - Influence community norms
- 3) Which adaptation strategies are accepted in your community?
- Why
 - Whose approval
 - Influence government
 - Influence community norms

Topic: Perceived effectiveness: - To what extent are the implemented adaptation strategies experienced as effective?

- 6) What are effective adaptation strategies?
- Why
 - How do you know
 - Own experience
- 7) Which adaptation strategies would you recommend to others?
- 8) What are ineffective adaptation strategies?
- Why
 - How do you know
 - Own experience

4. Closing questions

We are heading towards the end of this interview. The purpose of this interview was to get new insights in why you chose certain adaptation strategies.

- 2) Do you have anything else to add (things that I haven't touched upon, but should have)?

Thank you very much for taking the time to do this interview!

Appendix B: Characteristics of interview participants

Characteristics of Key Informant Interview participants

The names from the participants of the Key Informant Interviews as well as from the participants of the Semi-Structured In-Depth Interviews are changed to fictional code-names. The researcher felt that because the participants were all Christian orthodox, Biblical names seemed appropriate. See Table B1 for an overview of the characteristics of the Key Informant Interview participants.

Table B1

| <i>Characteristics of participants of Key Informant Interviews</i> | | | |
|--|---------------|-----------------------------|--------------------------------|
| Code name | Gender | Region of origin | Education level |
| <i>Joanna</i> | Female | Tigray region | Diploma (Vocational education) |
| <i>Sarah</i> | Female | Tigray, close to Mere-Mieti | Diploma (Vocational education) |
| <i>Michael</i> | Male | Tigray region | Diploma (Vocational education) |

Characteristics of Semi-Structured In-Depth Interview participants

See Table B2 for an overview of the characteristics of the Semi-Structured In-Depth Interview participants.

Table B2

| <i>Characteristics of participants of Semi-Structured In-Depth Interviews</i> | | | | | | |
|---|---------------|-----------------------------------|------------------------|--------------------------------|--------------------------|---------------------------------|
| Code name | Gender | Village of origin | Education level | Source(s) of livelihood | Head of household | Composition of household |
| <i>Matthias</i> | Male | Mere-Mieti | Grade 4* | Farming | Yes | - |
| <i>John</i> | Male | Moved to Mere-Mieti when he was 5 | Grade 7 | Farming | Yes | 1 male, 4 female |
| <i>David</i> | Male | Mere-Mieti | Grade 2 | Farming | Yes | 6 male, 3 female |
| <i>Aaron</i> | Male | Mere-Mieti | Grade 6 | Farming | Yes | 3 male, 4 female |
| <i>Gabriel</i> | Male | Mere-Mieti | Grade 4 | Farming | Yes | 4 male, 2 female |

| | | | | | | |
|---------------------|--------|------------|--------------|---------------------|-----|------------------|
| <i>Jeremiah</i> | Male | Mere-Mieti | Grade 3 | Farming | Yes | 5 male, 3 female |
| <i>Anna</i> | Female | Mere-Mieti | No education | Farming | Yes | 1 female, 5 male |
| <i>Lily</i> | Female | Mere-Mieti | Grade 2 | Farming and trading | Yes | 2 female, 1 male |
| <i>Julia</i> | Female | Mere-Mieti | No education | Farming | No | 2 female, 2 male |
| <i>Rebekah</i> | Female | Mere-Mieti | Grade 3 | Farming | No | 3 female, 2 male |
| <i>Nathan</i> | Male | Ilkim | Grade 2 | Farming | Yes | 4 male, 2 female |
| <i>Tobias</i> ** | Male | Ilkim | No education | Farming | Yes | 4 male, 2 female |
| <i>Raphael</i> | Male | Ilkim | No education | Farming and trading | Yes | 2 male, 4 female |
| <i>Benjamin</i> | Male | Ilkim | Grade 4 | Farming and sewing | Yes | 1 male, 1 female |

Note: * all grades under 8 are in primary school ** was interrupted before completed

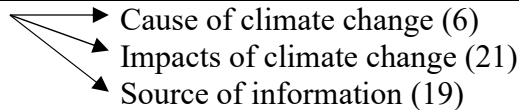
Appendix C: NVivo code-book

See Table C1 for the NVivo code-book used during the analysis of the interviews. See Table C2 for the definitions and examples of the codes.

Table C1

NVivo code tree as used in the analysis of the interviews

Implementation process (102)

Availability of climate and weather information (37) 

Awareness of extension services (49)

Accessibility of extension office (4)

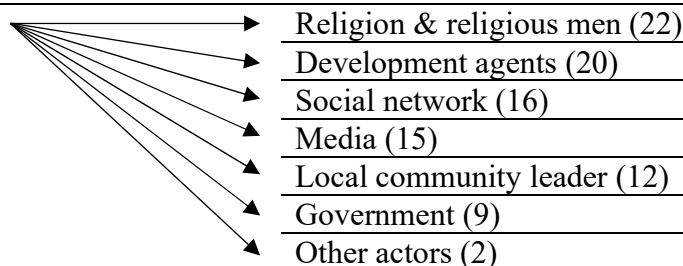
Efficiency and suitability of extension services (31)

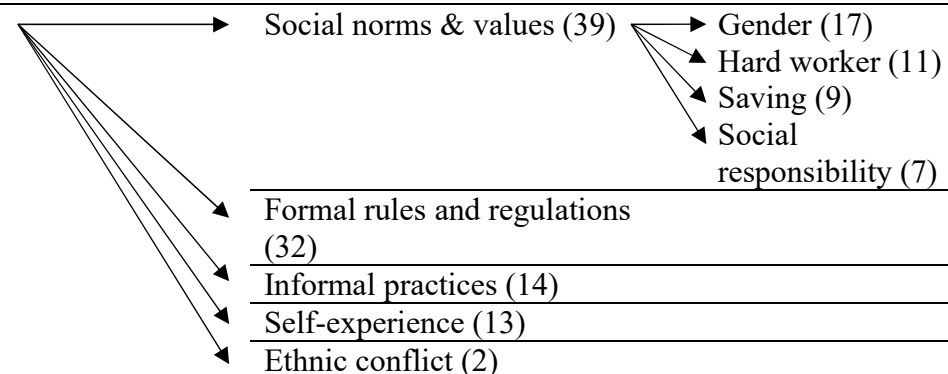
Availability and accessibility tools & (natural) resources (24)

Continued availability and accessibility tools & (natural) resources (25)

Continued availability and accessibility of assistance from extension office (4)

System (111)

Actors (53) 

Processes (87) 

Categories mentioned by DAs (2)

Note. The numbers in brackets indicate the amount of times the code has been used in the interviews.

Table C2

| <i>Explanation the codes in the code-book</i> | | |
|---|--|--|
| Code | Meaning | Example |
| Knowledge about climate change and weather info | Refers to statements made about experienced climate change and weather phenomena. | “Now there are long sunny seasons with hotness, and there is a late start of the rain season. There are coughs in humans due to the wind which is increasing, and disease outbreaks in animals, and crop diseases...” [<i>Nathan</i>] |
| Cause of climate change, and/or weather transformations | Includes comments made about the cause of climate change and/or weather transformations | “Climate change is not very visible. There is yield variation and crop failures, but we don't know the exact causes of these. These could be nature, but this is a guess.” [<i>Matthias</i>] |
| Impacts of climate change, and/or weather transformations | Relates to comments made about the impacts of climate change and/or weather transformations | “There is heavy rain during harvesting time - untimely rain. A shortage of water during summer, rain time, while there is rain during winter, when there shouldn't be. The seasons exchange. There is rain variability. Clouds and mist are increasing. This all causes crop reduction.” [<i>Tobias</i>] |
| Source of climate change- and weather information | Refers to comments made about where the farmers get their information from regarding climate change causes and impacts and weather predictions | “Farmers have no skill of weather forecasting or information, so they rely on the experts for this information.” [<i>Matthias</i>] |
| Awareness of extension services | Highlights comments about the services the | “Soil- and water-conservation practices are from the governmental |

| | | |
|---|---|--|
| | farmers know the extension office provides | extension services. Forest management and replanting trees as well. Just as promotion of grazing areas for livestock - to combat free grazing. They also promote changing crop varieties, using improved seed varieties, using credit and promoting poultry production.” [John] |
| Accessibility of extension services | Includes remarks about to what extent the extension services are accessible to the farmers | There is no difference in services for Mere-Mieti and Ilkim. They can all use it. But in application some might be laggards. There is a good follow up in Mere-Mieti, because it is surrounding the office, we can help them day and night. In Ilkim there is less application - it is not surrounding, but further away. [Joanna] |
| Efficiency and suitability of extension services | Refers to comments on what makes certain extension services/adaptation strategies efficient or not in the personal context of the farmers | “The planting of trees is the most effective. It reduces degradation of the soil and helps to increase water. Also, irrigation works very good and using disease resistant seed varieties. And trading and labour work are effective. Migration however, is not that effective, for example to Saudi Arabia.” [Aaron] |
| Availability and accessibility of tools and (natural) resources | Includes statements about the availability and accessibility of the required resources, for example natural resources of financial resources, and tools such as machinery | There is a shortage of water, even when you practice irrigation, there is water reduction. Therefore, the government should help to install pumps to use ground water. Flood carry dust into the place of water |

| | | |
|---|---|---|
| | | conservation; therefore, this is now dry and filled with sand. [David] |
| Continued availability and accessibility of extension services | Includes comments about the guidance of the extension office available at the start of the implementation process | I trust the extension agents the most because they give training, they follow-up and supervise the implementation. You get assistance when implementing what you learned in the trainings.” [Julia] |
| Continued availability and accessibility of tools and (natural) resources | Relates to comments about the guidance of the extension office available during the implementation process | There was a delay in supply caused a shortage of fertilizer. Some farmers didn't use it as DA suggested they need more information - especially for farmers in Ilkim. [Benjamin] |
| Religion and religious men | Refers to remarks about the influence of religion or religious men on the adaptation implementation behaviour of farmers | “Praying is an important strategy, because climate change is a natural happening, you should pray to nature and nature is God.” [Lily] |
| Development agents | Includes statements about the influence of the development agents on the adaptation implementation behaviour of farmers | “I get the most information from the extension agents, because they explain reasonable why something is useful.” [Tobias] |
| Social network | Relates to statements about the influence of the farmers’ social network on the adaptation implementation behaviour of farmers | “I get the most information from the extension agents/trust them the most because they explain reasonable why something is useful.” [Gabriel] |
| Media | Includes comments about the influence of the media on the adaptation | “Social media is not that much trustworthy because you are not physically in touch or in control with the spreaders of the information. |

| | | |
|-------------------------|---|---|
| | implementation behaviour of farmers | Social media is not local context specific and the advice of the extension services is.” [Matthias] |
| Government | Includes statements about the government’s influence on or responsibility for the adaptation strategies | “The government or we as a collective should expand irrigation. This will change our livelihoods for the better. The government should introduce it, work on it and then the community can expand it.” [Anna] |
| Other actors | Highlights comments relating to other actors that the abovementioned ones. For example, comments about farming cooperatives | “Cooperatives provide no information, only supplies for farming. And short trainings on how to use the supplies they deliver. For example, on how to use chemicals correctly.” [Aaron] |
| Social norms and values | Concerns remarks about the influence of social norms the adaptation implementation behaviour of farmers | The religious men are very respected and their recommendations are valued. They encourage us to pray to avoid diseases and to work together, not to quarrel. In our society you should be a positive thinker. [Julia] |
| Gender | Relates to remarks about the influence of gender or gender norms on the adaptation implementation behaviour of farmers | “[The extension] services are available for both men and women. Poultry is mostly done by women (as head of households), because you can combine it more easily with tasks focusing on the household.” [John] |
| Hard worker | Refers to comments about the value of ‘being a hard worker’ in society | “Increasing working opportunities is something we should do in society. We can help each other with labour exchange and with irrigation as well. Also, religious men stimulate people to work hard.” [Anna] |

| | | |
|-----------------------|--|--|
| Saving | Highlights statements about the value of 'saving' in society | "Values in society are for example, increasingly, saving, however expenditure per household has increased due to expensive ceremonies such as weddings and funerals. People find it difficult to spend less on that, because they might be seen as bad family members." [Aaron] |
| Social responsibility | Relates to remarks about the value of 'social responsibility' in society | "Farmers support not to cut trees or cattle to graze in the forest. This is because of their own beliefs - so apart from rules, it is a practice. They help implementing rules, however sometimes during the night, wood gets stolen." [Joanna] |
| Self-experience | Refers to remarks about the value of 'self-experience' in determining the efficiency and suitability of adaptation strategies for one-self | I trust self-experience and social network the most because we farmers have direct experience, something social media and the extension services haven't. [Matthias] |
| Informal practices | Includes comments about the value of 'social responsibility' in society | "Solving conflict between borders, when there is a conflict of borders we use "erikenderta", as system in which elder from either conflicting side chose who is as fault. The organization of grazing lands is done by informal rules. It is organized locally and often based on social network. The ownership of these lands lies within social groups." [Gabriel] |

| | | |
|------------------------------|---|--|
| Formal rules and regulations | Highlights comments about the formal rules and regulations in society | “Land-use, there are punishments for the wrong use of land. Or when you do not participate in soil- and water conservation. You can be prisoned for cutting trees. But other than that, no approval is needed for implementing adaptation strategies.” [<i>Lily</i>] |
| Ethnic conflict | Relates to statements about the ethnic conflicts in Ethiopia | “Peace is the most effective, then all other strategies can be implemented.” [<i>Julia</i>] |