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Assessing Implementation Processes of Food Securing Innovations among Rural Farmers in Tanzania

Storylines of upgrading Improved Cooking Stoves, Optimized
Processing Machines, and Market Oriented Storage Strategies.

Master thesis in the study program Integrated Natural Resource Management

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Abstract.

The project Trans-SEC - *Innovating Strategies to Safeguard Food Security Using Technology and Knowledge Transfer: A People-centred Approach* has addressed the food security challenge in Tanzania by exploring strategies for upgrading the local rural food value chains (FVC). Upgrading strategies for food security (UPS) have been identified, screened, tested and implemented in four case studies sites (CSS) in the semi-arid Dodoma and sub-humid Morogoro regions (Graef et al., 2014).

This master thesis investigates the implementation of three Trans-SEC UPS: Improved Cooking Stoves (ICS), Optimized Processing Machines, and Optimised Market Oriented Storage (OMOS). To identify success stories and implementation challenges I interviewed the farmer groups and the Trans SEC researchers involved in the trials and implementation of these UPS to identify success stories and implementation challenges. I have gathered a total of 59 interviews using the Process Net-Map technique and conducted 5 focus group discussions. I asked the interviewees to identify the most important actors involved in the UPS implementation, to recall the main activities and challenges encountered, and to rank the actors according to five Criteria: *Influence*, *Income* generated by the UPS, improvement in *Food* security, *Knowledge*, and *Trust*. The storylines are reviewed looking at factors enabling the successful creation of a space for change using concepts from the literature on innovation systems and participatory action research.

The findings highlight that the farmers perceive positive transformations not only of their livelihoods, but also in their attitudes toward new ideas and new modes of thinking. The results also suggest the importance of facilitating the learning, the links between actors, and the participation in creating a solid basis for innovations and for the successful implementation of the UPS.

Keywords: Food security upgrading strategies, process Net-Map, storylines of implementation processes, Tanzania

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Acronyms and Abbreviations

AGRA Alliance for a Green Revolution in Africa

CSS Case Study Site

FSIN Food Security Information Network

FVC Food Value Chain

HLPE High Level Panel of Experts on Food Security and Nutrition

ICS Improved Cooking Stoves

IPC Integrated Food Security Phase Classification

IFAD International Fund for Agricultural Development

MAFC Ministry of Agriculture, Food Security, and Cooperatives

MLDF Ministry of Livestock Development and Fisheries

MS/MT Maize Sheller/Millet Thresher

OECD Organization for Economic Cooperation and Development

OMOS Optimized Market Oriented Storage

PAR Participatory Action Research

SSA Sub-Saharan Africa

UPS Upgrading Strategy

USAID United States Agency for International Development

WFP World Food Programme

Chapter 1. Introduction

1.1 Rural Innovations to Improve the Food Security of Smallholders

Food insecurity is a global issue involving the absence or deterioration of different food security dimensions: Food availability, access to food, food utilization and stability of food over time (FAO, 2008). FAO et al., estimates that between 2014 and 2016, 795 million people were undernourished (FAO et al., 2015 p. 8). Last year, 108 million people faced crisis levels of food insecurity¹ (FSIN, 2017, p. 15).

Global food insecurity is expected to be exacerbated in the future due the increase in world population and climate change. Negative effects of climate change on agricultural productivity will affect every world region after 2030 (FAO, 2016 p. xi). At the same time, the consistent population increase, led by developing countries, will create a greater demand of agricultural products, posing new challenges to agriculture capability to fulfill nutritional needs. Changes in agricultural systems toward more sustainable production pathways are advocated to deal with these prospects. In this context, investing in solutions addressing small hold farmers is considered crucial. Small hold farmers of less than 1 or 2 hectares contribute to high shares of food production, especially in developing countries, where they produce 80 percent of the food (FAO, 2014 p. 9). At the same time, they are highly vulnerable to the impact of climate change, poverty, and food insecurity (FAO, 2016 p.8). Enhancing their livelihood could have positive effects on all the food security dimensions (FAO, 2016 p. 54). Smallholders produce food for the domestic market and for their own livelihood, creating important safety nets. Moreover, they contribute to preservation of management of biodiversity and cultural heritage, and to income generation (HLPE, 2013 p. 12, 46, 53).

In the process of supporting smallholders, innovations in farming systems play an important role. Through the introduction of new ideas, technologies or processes, the smallholders can improve their resilience to climate change and face the food security challenge. Given the

¹ Crisis level of food insecurity corresponds to the Integrated Food Security Phase Classification (IPC) phase 3 or above [minimal (phase 1), stressed (phase 2), crisis (phase 3), emergency (phase 3), famine (phase 5)] (IPC Global Partners, 2012)

complexity of innovations, which often involve different actors and diverse social environmental factors, there is an increased interest in agricultural innovation systems (FAO, 2014 p. xii; FAO, 2016 p. 50). Important elements in agricultural innovation systems are the promotion of research and development, fostering the links of interaction between farmers and scientists, the empowerment of farmers, and enhancing co-learning, negotiation and participation. Moreover, local knowledge is integrated with new sources of knowledge provided by agriculture research and extension service to support innovation (UN, 2017 p. 15).

The dissemination of improved farm management practices focusing on smallholders is considered a priority in the development perspective for agriculture transformation in Sub Saharan Africa (SSA) (AGRA, 2014 p. 16 ; AGRA, 2016 pp. 259–260). SSA is the world region with the highest prevalence of undernourishment (FAO et al., 2015 p. 18). The rapid population growth, which is expected to reach 2.1 billion in 2050, will lead to increasing food demand, which could further increase undernourishment prevalence and could threaten the already endangered natural resources (AGRA, 2016 p. 78; OECD-FAO, 2016 P. 60). Smallholders dominate the agricultural scene and produce 80 percent of the food . They are faced with multiple constraints, such as post-harvest losses, exposure to unpredictable weather events, high transportation cost and lack access to input and output markets. Raising their incomes, for instance by fostering the uptake of improved technology and by investing in improvements to the local value chains, could help overcoming smallholders challenges (AGRA, 2016 p. 129).

In the frame of the research on agricultural innovations in SSA, the Trans-SEC project *Innovating Strategies to Safeguard Food Security Using Technology and Knowledge Transfer: A People Centered Approach* is exploring strategies for upgrading the local rural food value chains, with the purpose of improving the food security of smallholders in Tanzania. The Project has tested twelve upgrading strategies (UPS) in four Case Study Sites (CSS) over a period of five years in the semi-arid Dodoma region and sub-humid Morogoro region. These are good practices and/or technological innovations that are likely to improve productivity, efficiency or economic return of a food system, and reduce related risks to the livelihoods of its stakeholders (Graef et al., 2014a p. 8).

The project uses a participatory framework, which promotes the active participation of the farmers in the implementation of the UPS. In each CSS, the farmers participating in the project were divided in groups (UPS Groups) and engaged in the trial and the implementation of one UPS. This configuration opens the room to the possibility of different dynamics of implementation due to the diversity of social and environmental conditions influencing the work of each UPS group.

1.2 Research Objectives

Trans-SEC project will officially come to an end next year. The degree of change brought about by the introduction of the UPS can be captured by studying in the detail of the actions and experiences of the people involved in the implementation. Success stories and implementation hurdles emerging from the multiple realities of the experience of the stakeholders may provide valuable insights for further improving the strategies.

The purpose of this master thesis research is that of analyzing the process of implementation referring to three Trans-SEC UPS: Improved Cooking Stoves (ICS), Optimized Processing Machines (Maize Sheer and Millet Thresher) (MS/MT), and Optimized Market Oriented Storage (OMOS). In particular, this research aims at providing a representation of how the implementation of each UPS looks like across the CSS and according perception of the different stakeholders.

This thesis also aims at contributing to Trans SEC by improving the understanding of the current implementation of the strategies. This purpose is also shared by the master thesis research of Diana Naikoba from Hohenheim University, which deals with three other Trans-SEC UPS: Rainwater harvesting, kitchen gardens with green leafy vegetables, poultry-crop integration.

The main goal of this research is answering the question:

How has the implementation of the Improved Cooking Stoves, Optimized Processing Machines and Market Oriented Storage UPS unfolded, according to the researchers and farmers involved in the project?

Additional sub questions are:

1. What are the success stories and the challenges encountered during the UPS implementation?

2. What differences and similarities emerge in the UPS implementation in different case study sites?

It will discuss implementation storylines through the lenses of the innovation systems perspective and participatory action research approach (PAR). In particular, I will look at the processes, which communication agents may apply to facilitate the creation of a space for enabling innovations. The action and research activities conducted throughout the strategies' implementation followed the participatory action research approach. This approach will be taken into account to discuss how the UPS implementation unfolded according to the perception of those involved.

The method I used to investigate the trajectories followed by the Trans-SEC UPS is *Process Net-Map*. This novel methodology developed by Schiffer et al. (2017) allows the interviewee to map the actors involved in a project, and to recall the main events occurred and actions taken. Moreover, it provides the possibility to enlist the challenges connected to implementation, and rate the actors' influence according to selected criteria. Based on the previous research conducted by Halle et al. (2017), the criteria I chosen for ranking the actors are: *Influence*, *Income generation*, *Food security*, *Knowledge*, and *Trust*. In total, I conducted 59 interviews using Process Net-Map, and 5 feedback discussions. Interviewees belonged to two stakeholder groups: the farmers from the CSS, who were involved in the UPS implementation and divided in UPS groups, and the researchers from different organizations, research institutes and universities involved in Trans-SEC.

To analyze the data, I employ qualitative content analysis. The materials involved in the qualitative content analysis were: the content of the feedback discussion rounds and the summaries of the steps and challenges identified during the interviews, and the entire transcription of some of the interviews conducted. In addition to this, I use the Mann-Whitney U test for comparing the Criteria ratings from the different CSS, contrasting the results of the interviews with the UPS groups with the Trans-SEC researchers interview.

The thesis is structured as follows. Chapter 2 describes the background of the research. This includes an overview of the state of agriculture and agricultural extension system in Tanzania and the presentation of Trans-SEC organization and design, and the Trans-SEC CSS. In Chapter 3, the literature on innovations and participatory action research is reviewed. Chapter 4 introduces and explains in detail the research methodology used, the stakeholder selection criteria and the methods of data analysis. In Chapter 5, the results are presented for each UPS under investigation. In chapter 6, these outcomes are further discussed. Moreover conclusions are drawn and recommendations are put forward.

Chapter 2. Research Background

In the following sections, I provided an overview of the state of agriculture in Tanzania and of the structure of Tanzanian agriculture extension services. Moreover, I describe the Trans-SEC analytical framework, the main actors involved, and the Trans-SEC CSS. This overview serves to frame the context of this master thesis research and to clarify the elements of the project and actors that will be referred to in the next chapters.

2.1 The State of Agriculture in Tanzania

Agriculture is one of the major economic sectors in Tanzania. The agricultural sector contributes about 25 % of the GDP (URT, 2016). Agriculture is also a primary source of livelihood, and employs 70% of the population. The agricultural production consists mainly of food crop production, with maize being the major crop, and is carried out by rural smallholder farmers. These work 84% of the cultivated land, and are extremely poor and vulnerable to food security (USAID, 2010 p.6). In rural areas, the incentives for the creation of jobs outside the agricultural sector are low and the population is trapped in poverty (URT, 2016 p. 1).

In the past sixty years, Tanzanian agriculture has experienced processes of nationalization and then liberalization. After the independence, in 1961, the agriculture was shaped by policies in line with *Ujamaa*, the African socialism system, promoted by the first Tanzanian president Julius Nyerere. Enterprises, extension services and industries were nationalized and agricultural prices and markets were controlled by the state. Forced villagization made thousands of farmers to be relocated in developing villages, to promote collective farming. The failure of these policies caused a major economic crisis, which led to a forced liberalization of the economy in the mid-eighties. The agricultural sector was privatized and the government's role in agriculture was since then limited to regulatory and public support functions (Ellis and Mdoe, 2003 pp. 1369–1370; Puttermann, 1995 p. 312; URT, 2008 p. 1). Despite macroeconomic reforms implemented by the structural adjustments programs after the liberalization, the agricultural potential for growth and poverty reduction is still to be explored (USAID, 2010, p. 6). Agriculture still depends mainly on rainfall and on obsolete technology, and the agricultural productivity is low and unpredictable. The government in

1999 has launched the “Tanzania Development Vision 2025”, which is a long-term vision to guide economic growth and development. This vision includes a plan for agricultural transformation to achieve modernization of the sectors of food security and food self-sufficiency (URT, 2009 p. 1).

The agricultural extension system plays an important role in providing services to the farmers and promoting development. The major financier of the extension system is the public sector, mainly under the lead of the Tanzanian Ministry of Agriculture, Food Security and Cooperatives (MAFC). The MAFC is responsible for seven agricultural research zonal centers (ARIs) situated throughout the country. Other important governmental institutions are the Ministry of Livestock Development and Fisheries (MLDF) and the Sokoine University of Agriculture and Education (SUA), which operated in the frame of the Sasakawa Africa Fund for Extension. The extension system is decentralised, therefore the MAFC supports the work of the Local Government Authorities, which provide services at the district level.

Besides the public sector, other organisations providing advisory services are private for-profit firms and private non-profit agencies. NGOs are active in providing training, technology transfers, and often promoting participatory approaches. In addition to this, Farmer-Based (Community-Based) Organizations and Cooperatives, organised under the National Network of Farmers Group in Tanzania (Mtandaowa Vikundi vya Wakulima Tanzania -MVIWATA (*Swahili*: “how to”), assist farmers in accessing credit and provide them with information on agricultural technologies².

Figure 1 below, visualizes the providers of agricultural extension services in Tanzania. The arrows linking the different organisations to the farmers indicate the provision of extension services. Since the public extension services are decentralized, the local government authorities are responsible for organizing the provision of extension services at local level. The local government authorities employ village extension officers, which work closely with farmers in the villages. The village extension officers report to district extension officers. Beside the staff employed by local government authorities, other providers of extension

²This information has been retrieved from the Global Forum of Rural Advisory Service (Gfras) available at <https://www.g-fras.org/en/world-wide-extension-study/africa/eastern-africa/tanzania.html>

services include: public institutions under the MAFC and MLDF, such as the ARIs and SUA, NGOs, MVIWATA and private for-profit firms.

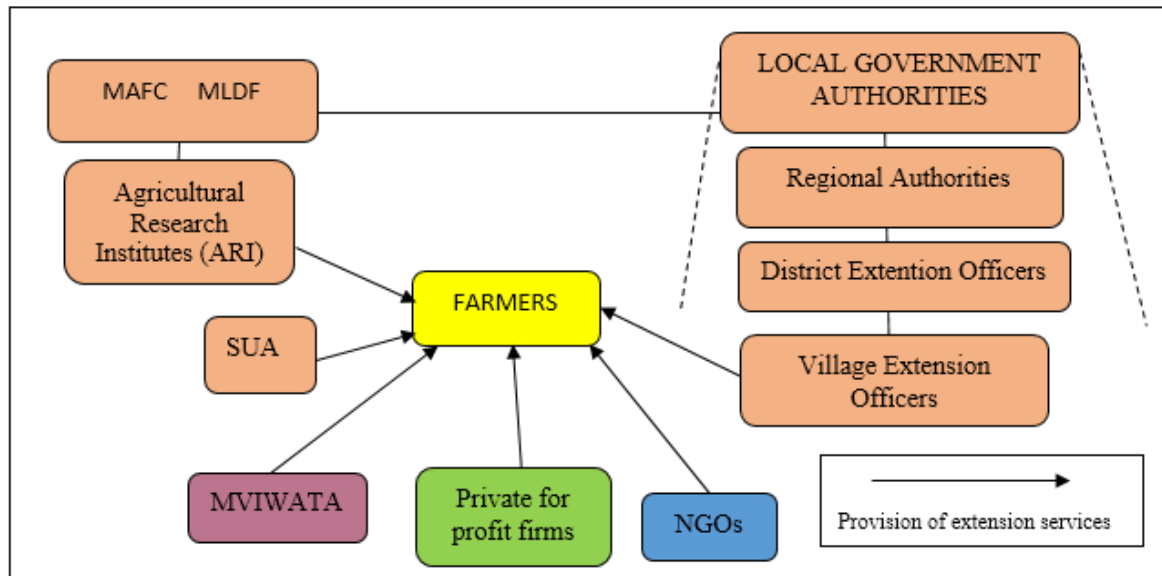


Figure 1: The providers of agricultural extension services in Tanzania

The Trans-SEC project is a five-year project which started in May 2013 and will end in 2018. It is financed by the initiative "Securing the Global Food Supply – Globe" under the framework program "National Research Strategy Bio Economy 2030" and includes different research partners forming a consortium of medium size. The consortium includes seven German research institutes, five Tanzanian partners, and two international CGIAR centres (see figure 2). The coordination among partners includes inter- and intra-organisational development. The central organisation of the activities is entrusted to a German partner, the Leibniz Centre for Agricultural Landscape Research (ZALF), and a Tanzanian partner, the Sokoine University of Agriculture (SUA), which is responsible for the Tanzanian sub-coordination (SUA). ZALF and SUA coordinate their national partner clusters (Graef et al., 2014 p. 13; Trans-SEC deliverable 2.1.1).

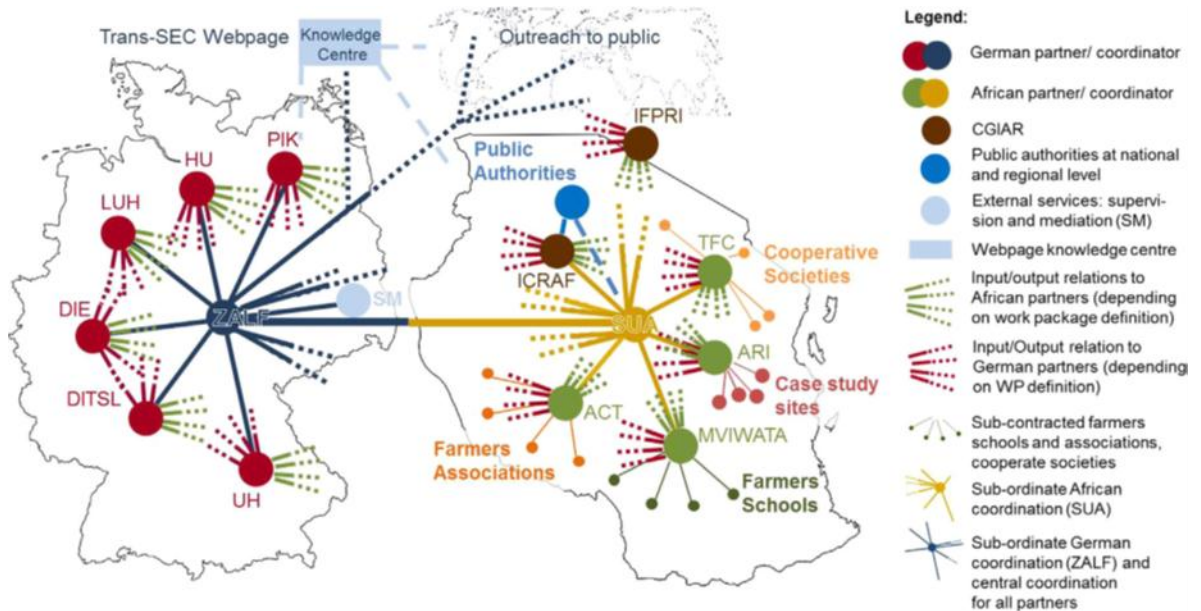


Figure 2: The organisation of Trans-SEC consortium.

Source (Graef et al. 2014 p. 14)

Trans-SEC utilizes a framework which has been specifically designed to be holistic, to foster a high degree of co-learning and integrate the food value chain sector, components and steps. The framework includes recurring and interactive procedures, which are organized in eight steps. These are: (1) A mapping of stakeholders and inclusion of stakeholder knowledge on the FVC; (2) the selection and study of the CSS, and the inclusion of the inventory of value chain components; (3) the screening, (4) the assessment, and (5) the selection (5) of promising UPS; (6) the UPS testing; (7) the assessment of their sustainability and opportunities of outreach, and (8) the risk assessment using different models simulating possible scenarios under different socio-environmental conditions (Graef et al., 2014 pp. 11–12).

The process of identification of the UPS essentially consists in the process of screening among possible UPS alternatives, which were inventoried for each component of the FVC (natural resources, food production, processing, markets, consumption) and the selection of a limited number of UPS on the base of a participatory process involving all the stakeholders. The list of alternatives was put together by analyzing similar strategies and innovations which had already been implemented in other research and development projects in Tanzania, and through a revision of the literature on food security. Additional socio-environmental and

organizational criteria, such as the feasibility and compatibility with CSS requirements, were also taken into account in the inventory. Among this list of alternatives only one UPS per value chain component was selected, on the base of the outcomes of consultations with farmers from CSS and researchers (Trans-SEC Proposal). Next, the UPS were tested during field trials, implemented, and exposed to different assessments. The results of this process will reveal opportunities for dissemination, which will be further evaluated against possible future scenarios based on socio-ecological simulation models (Trans-SEC Proposal)

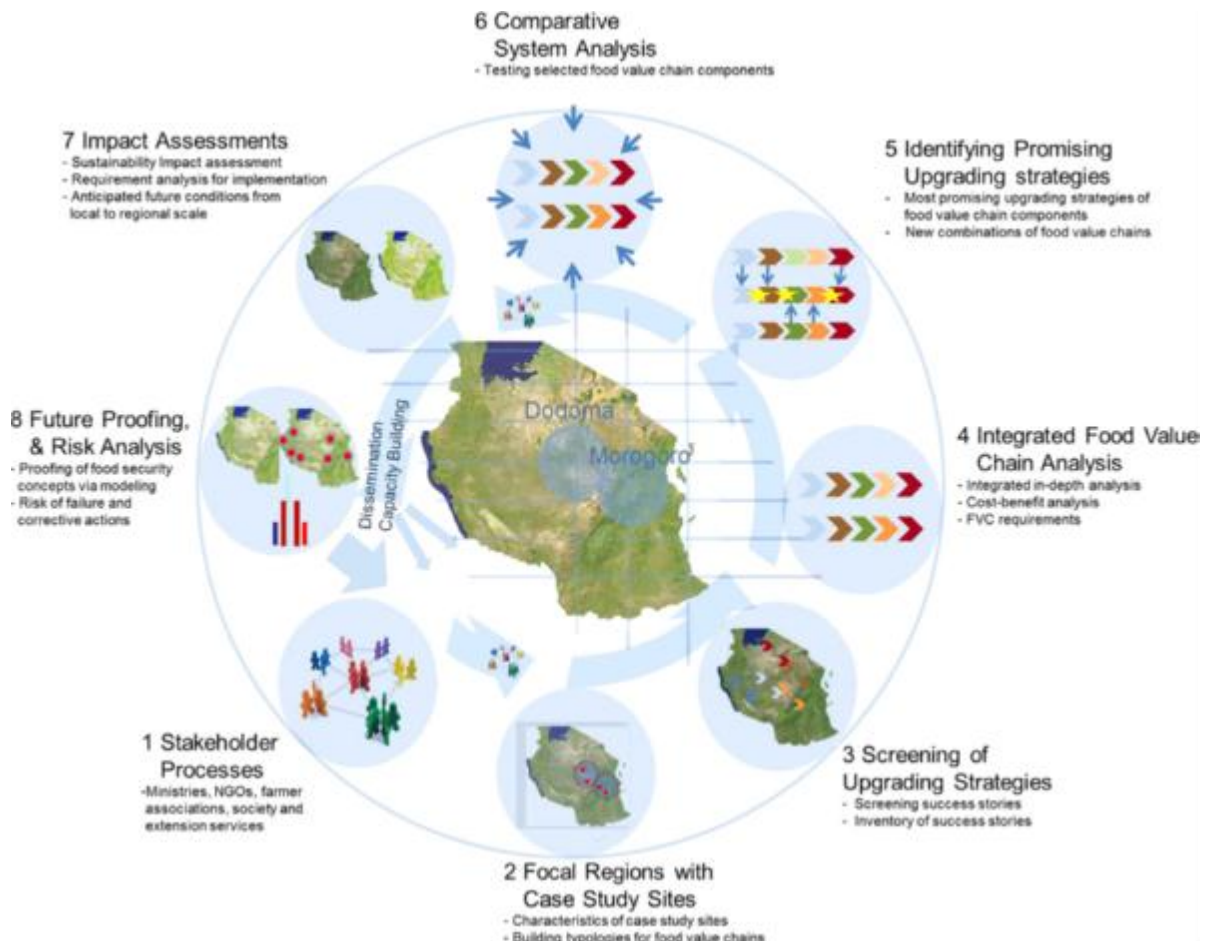


Figure 3: The Trans-SEC relevant analytical steps.

Source: Graef et al 2014 p. 11

The selection and the trials and implementation of the UPS at the CSS level involved, in practice, several stakeholders' engagement activities through focus group discussions, interviews and workshops, impact assessment and surveys.

After a mapping of the existing stakeholders for the UPS in the different CSS and across district and regional levels, a set of different focus group discussions were organized with the farmers from the CSS, which had been selected for participating in the project. These focus group discussions helped determining the state of food security and the constraints to it, and helped providing definitions of food security, which were later used for measuring the impact of the strategies. Moreover, they provided the basis for the final decision on the most promising strategies to be subjected to trials and implementation.

Along with focus group discussions, a household baseline survey was conducted to assess the socioeconomic conditions of the villages. The survey involved 150 household members, which were later involved in a two-day workshop and focus group discussions. The household members were presented the final UPS alternatives resulted from the screening, and were asked to choose among these alternatives and organize in groups (henceforth *UPS groups*) for the implementation of one UPS. A total of 27 groups were formed in each CSS. The researchers offered the groups additional workshops focused on group management, leadership and training on UPS management. After the group formation and the group leadership election, the UPS were carried out in the CSS, by the UPS groups, with the supervision of Trans-SEC experts. The monitoring and evaluation of the strategies was also conducted simultaneously during the trials. The findings will help the dissemination of the UPS through the existing channels (Trans SEC-Deliverable 2.1.1).

2.2.1 The Actors Involved in the UPS Implementation in the CSS

The implementation of the UPS in the CSS has involved mainly two groups of actors: The UPS farmers' groups from the CSS, and the four Trans-SEC organisations: ZALF, SUA, ARI, MVIWATA. We have collected storylines of the implementation of the UPS from these stakeholders.

The farmers selected for the implementation of the UPS at case study sites are the protagonists of the implementation of the strategies at the CSS and the ultimate beneficiaries of UPS. The UPS trial and implementation of the strategy was carried out inside organised farmer groups, the UPS groups.

UPS GROUPS. The members of the UPS group are farmers of the CSS selected for being involved in the Trans-SEC project. Each UPS group is trained by Trans-SEC researchers on the specific activities required to run the UPS, but is left to manage and implement the strategy autonomously. In order to facilitate group work training, workshops on group management were offered. Each UPS group accounts included established positions, which are elected by the entire group and serve the purpose of facilitating the group activities. These are: A group leader, a group secretary and the group treasurers.

The **group leader** was elected by the group members and is charge of leading the group, and coordinates the meetings and the group activities.

The **group secretary** usually organises the correspondence, the official meetings, and the admission of new members.

The **group treasurer** is responsible for keeping the group funds and dealing with all the activities required for administering the funds. For instance, the treasurers of the UPS investigated in this were responsible for accounting the group earnings from the activities of harvest processing and building stoves, and for selling the improved storage bags in OMOS UPS group.

The researchers involved in the UPS implementation coordinated the activities on field, based on their expertise.

ZALF. The Leibniz-Centre for Agricultural Landscape Research (ZALF) was involved throughout the process of design of the project and UPS implementation. It took part in most of the working packages of the project³. The ZALF researchers were involved in the planning of the activities for implementation of the UPS in the villages (UPS screening, household surveys, UPS evaluation), and in the management of the activities on field (planning of stakeholder participation and monitoring and impacts of the UPS).

³ The Trans SEC working packages include: Scientific coordination management (1), Participative Stakeholder System and Knowledge Transfer (2), Food Value Chain and Risk Analysis (3), Natural resources (4), Food Production System (5), Post Harvest Processing, Biomass and Waste Product Utilisation (6), Commercialisation Trade, Policies and Institutions (7), and Integration and Dissemination (8) (Trans SEC proposal).

SUA. Sokoine Agricultural University, like ZALF, was also involved in most of the working packages of the project. SUA researchers come mainly from the fields of agricultural economics and agricultural engineering. In the CSS, they were directly involved in the identification of food security criteria, in the inventory and decision making of the UPS, in setting up stakeholders' workshops and training, and in the monitoring and implementation of the UPS.

ARI. The Agricultural Research Institutes (ARI) responsible for the regions of CSS, namely ARI Ilonga and ARI Dodoma, coordinated the research activities on field, and took part in the stakeholder mapping activities, in the identification of food security criteria, decision making about the UPS. Moreover, they contributed to the workshops on group formation and group management, to the UPS implementation, and to the monitoring and dissemination activities.

MVIWATA. The national farmer association *MVIWATA*, together with ARI, is directly responsible for the implementation activities in the CSS. The contribution of *MVIWATA* to the implementation of UPS is focused on the activities involving interaction with the farmers at the local level and on the social aspects relevant for the UPS implementation. This includes, for instance, organizing trainings and workshops on the UPS farmer group management, and in facilitating and coordinating the UPS farmers group business management.

2.2.2 The Trans-SEC CSS

The four Trans-SEC designated CSS are: Ilakala and Changarawe, in the Kilosa district that is within Morogoro region, and Iloilo and Idifu in the Chamwino district in the Dodoma region. The CSS represent different climatic regions, different market access options, and different rain cropping systems. This diversity in the CSS characteristics provides opportunities for testing the UPS under different conditions. Other selection criteria included the number of stunted children below 5 years as an indicator for food insecurity, available logistics, infrastructure and facilities, differing wards, soil types, and an average size of 800-15000 households (Trans-SEC Project Proposal).

Ilakala and Changarawe are located in the sub-humid region of Morogoro. These villages receive on average 900-1000 mm rainfall per year, through two rainy seasons from March until May and from October to December. Agricultural production is mainly based on maize, sorghum, legumes, rice and horticulture, and partly on livestock.

Idifu and Iloilo are located in the semi-arid Dodoma region. This is one of the areas in Tanzania most affected by draught, and is characterized by a long dry season starting late April and lasting until early December, and a short single wet season starting in December and lasting until mid-April. Major economic sectors are agriculture (sorghum, maize, and cassava are the main crops) and livestock sector.

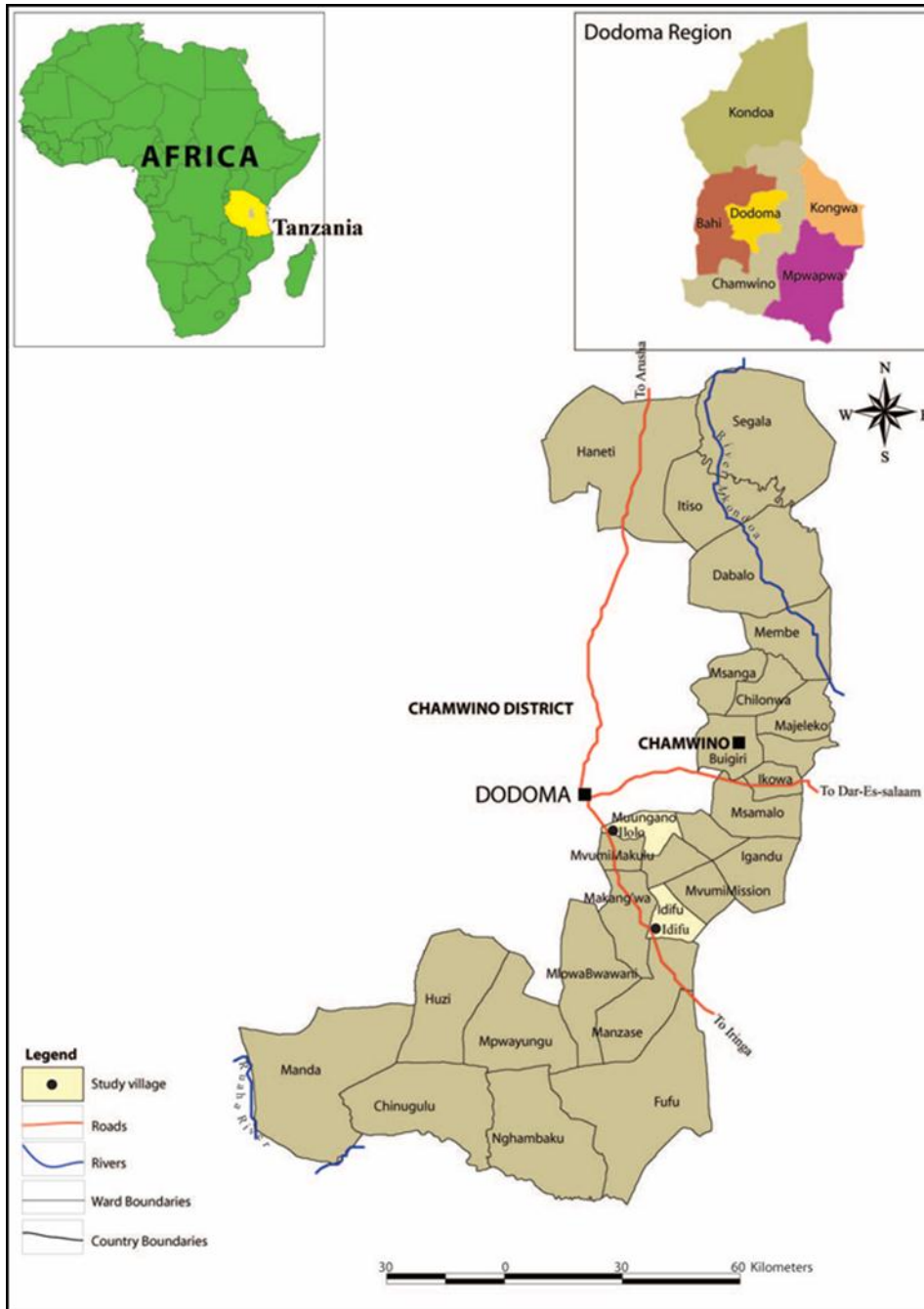


Figure 4: Idifu and Ilo, the Trans-SEC CCS in the semi-arid Dodoma Region (Source Trans SEC <http://www.trans-sec.org/>)

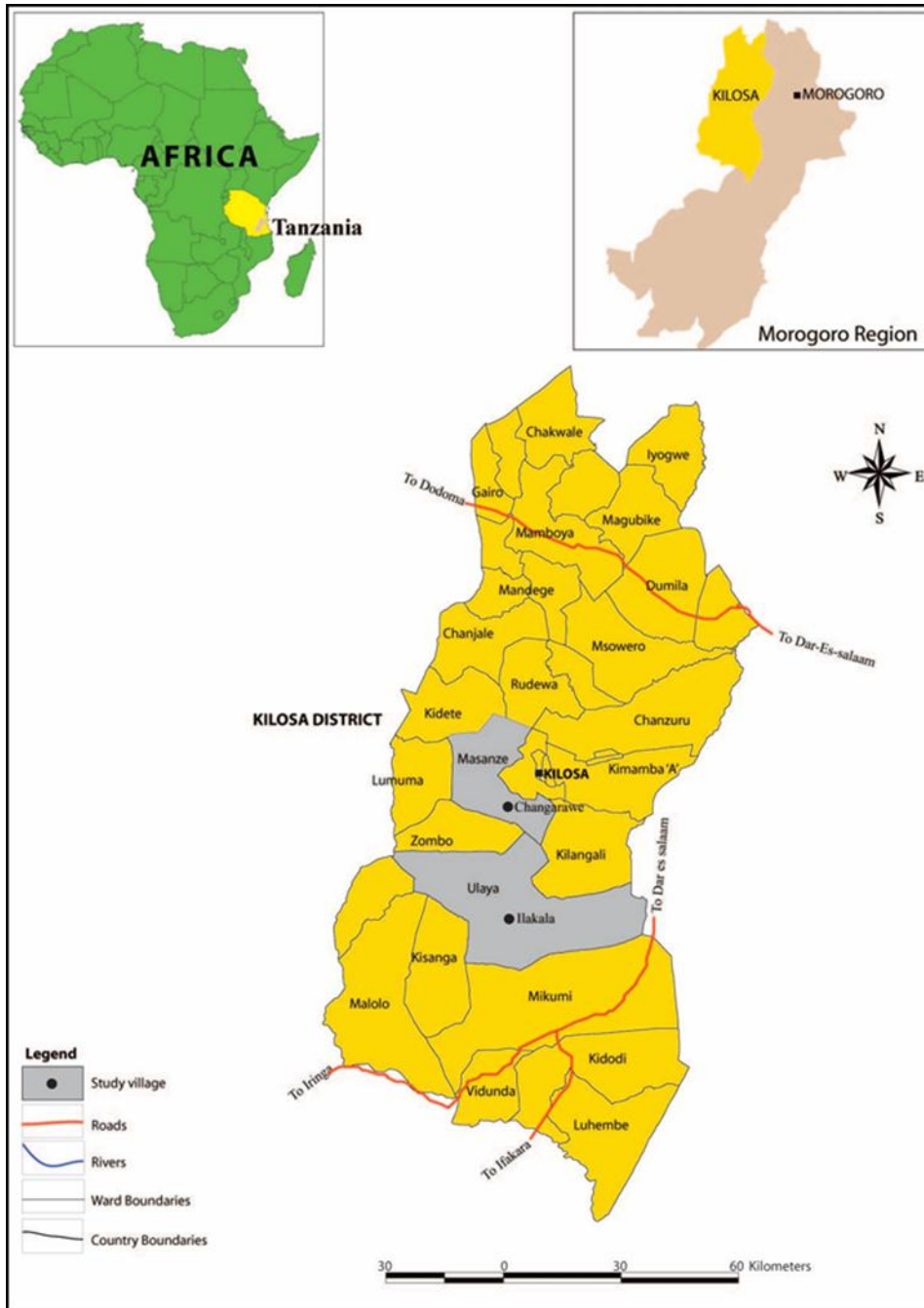


Figure 5: Changarawe and Ilakala, the Trans-SEC CSS in the sub-humid Morogoro region (source Trans SEC <http://www.trans-sec.org>)

Chapter 3. Theoretical Background

In this section, I will review some concepts drawn from the literature on innovations and Participatory Action Research (PAR). I will use these concepts later to reflect on the successes and obstacles emerged in the UPS implementation. I am focusing specifically on systems approaches to agricultural innovation, with special attention on the literature highlighting the role of communication for rural innovations. I assume that the UPS implemented by Trans-SEC in the CSS, with the prospect of being out scaled for national reach, entail not only the dissemination of new technical devices to upgrade the food value chain, but also new modes of thinking, and I also assume that they are embodied in processes of mutual learning. Through the lenses of processes facilitating the communication between actors, such as learning and negotiation, I will seek to understand what has driven the successes and the challenges encountered during the UPS implementation. I will also take into account elements from PAR literature. PAR is the approach adopted in the Trans-SEC project, therefore the outcomes of the implementation of the UPS under investigation in this research are also linked to the results of the participatory actions. For this reason, it is useful to understand how the UPS implementation has unfolded in the frame of the collaboration between researchers and farmers.

3.1 Innovation systems perspective

As opposed to previous approaches to study innovations, systems frameworks, such as the Agricultural Knowledge and Information System and the Agricultural Innovation System, share the idea that innovations are not the outcome of a linear process where knowledge packages are transferred following a top down scheme, but are rather the consequence of a complex system of interactions (Knickel et al., 2009; Leeuwis and Aarts, 2011 p. 23). The innovation is embedded in a social and economic environment, and involves collective processes of mutual learning and communication between heterogeneous actors in social networks (Klerkx et al., 2010 p. 390; Spielman et al., 2009 p. 399). Spielmann et al. (2009) explain that actors usually join networks to gain access to resources and expertise which they lack. The innovation process is facilitated if the network of actors involved successfully

enables information and knowledge exchange. A problem of smallholder farmers in developing countries is that, due to their marginalised position, they cannot easily fit into networks where they can access resources and information (Spielman et al., 2009 p. 401).

In the innovation system perspective, innovations are not only “new technical devices, but also new social and organizational arrangements, such as new rules, perceptions, agreements, identities and social relationships”(Leeuwis and Aarts, 2011pp. 22-23). They encompass a balance between new technical devices (the hardware), new knowledge modes (software), and new organisational arrangements (orgware)(Leeuwis and Aarts, 2011p. 22, adapted from Smits, 2000).

Leeuwis and Aarts (2011) explain that while linear innovation models put emphasis on the adoption, and subsequently on the diffusion, of innovations, and entail the possibility of steering the process of change, innovation system frameworks, on the contrary, recognise the unpredictability of change and recognise the co-evolutionary and interactive nature of innovation processes. Innovation systems in this sense are analysed following an evolutionary perspective. Processes of variation, selection and adaptation allow the most fit actors and strategies to be integrated in the economic and social processes (Spielman et al., 2009 p. 400). Geels (2001) describes how transformations unfold, using the Multi-Level Framework, drawing from the descriptions provided by different scholars in the transition school.

The Multilevel Framework describes three structural levels: *landscapes*, *regimes* and *niches*. The *socio-technical landscape*, consists of the heterogeneous factors such as climate change or migration which influence the interaction of actors. The *socio-technical regimes* are the sets of rules carried out by different social groups which support the incumbent practices. The novelties are processes comprising “new doing and thinking” (Knickel et al., 2009 p. 140, based on (Van der Ploeg et al., 2004), and are developed inside an innovation space called the *niches*, which provide room for developing new ideas and building social networks (Geels, 2001 p. 1260; Hekkert et al., 2007 p. 415). Geels (2001) notes that niches interest the generation of radical novelties or “second order innovations”, which are those innovations that entail new goals and new rules, while incremental innovations, which involve the

“improvement of the performance of an already existing product or of organization modes”, are usually generated at the socio-technical regime level (Brunori et al., 2008 p. 5). The smaller local dimension of the niche protects the novelties from uncertainties which arise at socio-economical regime level, and provides favorable conditions for social learning and consequently for the creation of novelties (Brunori et al. , 2008 pp. 14–15).

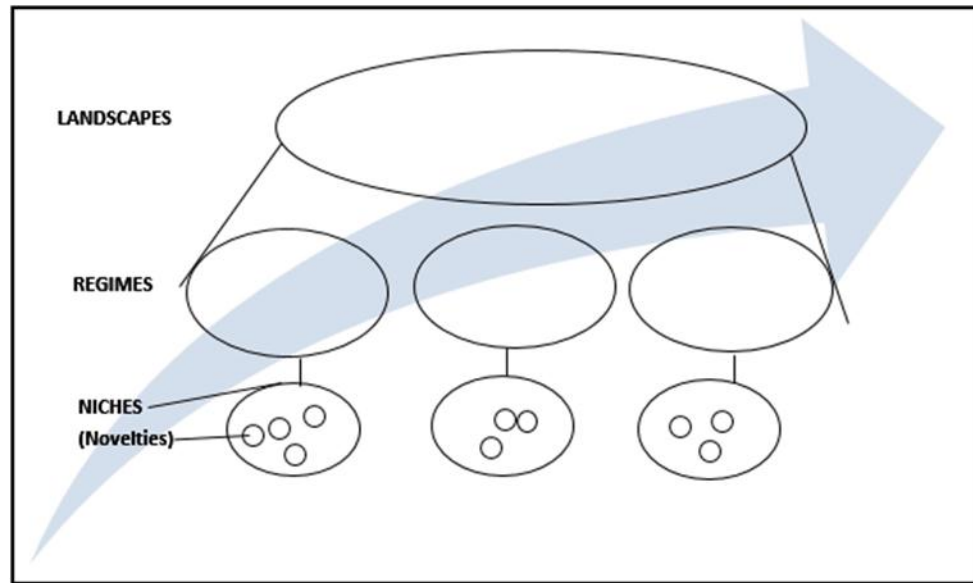


Figure 6: Innovation dynamics. Adapted from Geels (2001 p. 1261) and (Brunori et al. , 2008 p. 14)

Leeuwis and Aarts (2011) describe innovations systems through the lenses of communication. They point out how the everyday discourses and storylines created by interactive actors play a key role in creating room for change, where innovation processes may emerge. This room for change is where the diverging interpretations and opinions of different actors meet and eventually integrate, creating opportunities for innovations. The authors explain that it is through communication (*the Discursive space*), that people with different mental schemes (*Mental space*) connect with each other and with the environment in the *sphere of doing (Inter-actional Space)*. When communicating, the actors bring up diverging discourses and narratives, which are shaped by various influences emerging from the *Socio-institutional space* and from the *Bio-physical space* (see figure 6 below). These spaces entail representations of different factors such as legal or technical constraints to action, or coherence with social values. The outcome of the adaptation of diverging visions creates opportunities for the survival of change initiatives (Leeuwis and Aarts, 2011 pp. 27-28). The authors suggest three processes that facilitate the creation of the space for change:

Network building, supporting social learning, and dealing with the dynamics of power and conflict. These processes respectively consist in: Enabling connections among actors, coordinating mutual learning and the visions of reality, and mediating the possible conflicts which may arise in a context of heterogeneous actors and with changes in the status quo. The authors offer a list of examples of activities that the communication agent may apply to support innovations, and to “change the potential for change”(Leeuwis and Aarts, 2011 p. 29). The communication agents can be also referred to as innovation brokers and is identified as “an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties” (Howells, 2006 p. 720 in Klerkx et al., 2009 p. 413).

The study of Klerkx et al. (2009) discusses the role of innovation brokers in developing countries. In these countries, agriculture innovation brokers are usually not new specialised organisations, but traditional intermediaries, such as research organisations and/or funding agencies. Their role is particularly important for articulating the demand and fulfilling facilitation tasks. The authors highlight that a problem of the actual public and donor funding configuration of the innovation brokers in developing countries is that, due to the lack of financial incentives, the innovation broker’s function may be interrupted once the projects are finished (Klerkx et al., 2009 pp. 430- 432).

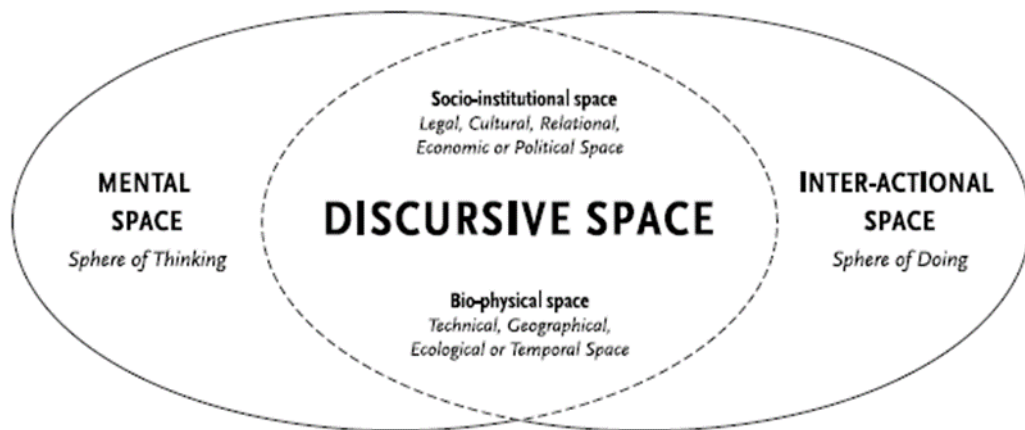


Figure 7: Different types of space and their interrelations(Source Leeuwis and Aarts, 2011 p. 27)

3.1.1 Learning, Negotiation and Network Building to Facilitate Innovation Processes

A key concept in the innovation system approaches is the concept of learning. It is learning within niches that leads to the formation of novelties. Through learning, the different

narratives and discourses are adapted and facilitated, creating opportunities for change. Learning is one of the processes that communication agents might focus on to facilitate the innovation processes. The process of learning and achieving an agreement among different realities is recognised as **Social Learning** (Leeuwis and van den Ban, 2004; van Mierlo et al., 2010 p. 320). Different authors assume Röling's definition of social learning, according to which social learning is: "A move from multiple to collective or distributed cognition" (Röling N.G, 2002 p. 35). *Collective cognition* is when the different perceptions of the actors are coherent, while *distributed cognition* is when the perceptions are shared, even if not unanimously. The *areas of learning* or *learning fronts* perceptions and cognitions which might influence the behavior of actors (Leeuwis and van den Ban, 2004), and include: aspirations, confidence, knowledge and perception of the reality, perception of risk, perception of the risk, perception of responsibility, experienced social pressure, and trust in social environment (van Mierlo et al., 2010 p. 321).

Learning involves change in the areas of learning. Social learning in particular implies building a shared coherent vision of these perceptions in a way that leads to action. Van Mierlo et al. discuss the example of how perceptions may shape a farmer's decision to convert to organic farming. The authors highlight that during the process of deciding to embrace organic farming, the producer puts into question different perceptions and cognitions. For instance, they may consider the risk of up taking organic farming (risk), the trustworthiness of the supermarkets or customers to whom they would have to sell their products (trust in the farmer's social environment), their own capacities in carrying out organic farming activity (belief in own capacities) and so on (van Mierlo et al., 2010 p. 321).

Applying this reasoning to the context of the implementation of the UPS in the Trans-SEC CSS, we may imagine that, when deciding whether to participate in the implementation of a UPS, the main variables that a farmer would consider include: the benefits of the UPS for their own livelihoods (knowledge), the uncertainties associated with up taking the UPS (risk), the attitude and reliability of the customers in the community to whom they provided services (trust in the farmer's social environment), their confidence in being able to implement the UPS (confidence), and their own aspirations, such as improving food security or income (aspirations). A community that is involved in the successful implementation of a UPS will

undergo a modification in the individual and collective perceptions and cognitions. Social learning is the process by which coherence among different actors' perceptions is built, leading to coordinated action (van Mierlo et al., 2010 p. 321).

The ways learning has been discussed in the literature on organizational learning as encompassing three different levels: *Single-loop learning*, *double-loop learning* and *triple loop-learning* (Tosey et al., 2012 p. 291; van Mierlo et al., 2010 p. 321). *Single loop* learning consists in learning “how to do things better” (van Mierlo et al., 2010 p. 321) This includes improving a certain situation without necessarily changing the values, attitudes or norms supporting it. Value, attitudes or norms are instead the subject of *double-loop* learning. This is the learning that occurs when people reflect on the governing variable and change their actions accordingly (Tosey et al., 2012 p. 292; van Mierlo et al., 2010 p. 321, based on . This is the learning that occurs when people reflect on the governing variable and change their actions accordingly (Argyris and Schön, 1996). As van Mierlo et al (2010) explain, this would include, for example, learning how to apply the principles of organic farming and how to interact with the subsequent new networks, actors and institutions created by this new system. In the context of the Trans-SEC strategies, this would be when the farmers apply new principles and values which are different from the ones which previously regulated their practices and perceptions. Some scholars identify a third, higher level of learning, the triple-loop learning (Tosey et al., 2012 p. 292). *Triple loop* learning involves learning about the learning, or *meta-learning* new ways to improve the learning process itself (Medema et al., 2014 p. 27). The learning loops are applicable to the study of innovation. For instance, van Mierlo et al. 2010 use the concept of single and double loop learning for studying learning processes in some Dutch programs aimed at accelerate sustainable development in specific contexts.

The conditions surrounding learning affect its development in relevant ways which have been discussed in the literature on communication in rural innovations. Leeuwis and van den Ban, (2004) provide examples of conditions which might favor or challenge learning, many of which are linked to psychological aspects. Learning is influenced by the relative importance, urgency and personal involvement that people attribute to a problem. In addition to this, people's motivations to learn are influenced by: The confidence in being able solve the

problem; the clarity of the problem; its perceived complexity, triability, and observability; the connected social consequences and risks associated with new ideas; and the social and environmental facilitating or hindering the spread of new ideas (Leeuwis and van den Ban, 2004 p. 155-161). The discussion of learning conditions made by van Mierlo et al. 2010 suggests additional factors, namely: the balance of power in negotiation processes, the factors facilitating or hindering the formation of networks, and the role of facilitators and process leaders (van Mierlo et al., 2010 p. 322).

Other processes that a communication agent might focus on to facilitate the innovation processes include assisting *network building* and the *processes of negotiation and conflict management* among the parties involved, also called *innovation process management*. **Network building** involves enabling the connections of stakeholders, for instance by improving the cooperation between the actor networks, or by linking stakeholders with similar interest, or by screening available initiatives (Leeuwis and Aarts, 2011 pp. 30-31; (Klerkx et al., 2009 p. 413). **Negotiation** is an instrument to facilitate the conflicts driven by the heterogeneity of the actors involved. Leeuwis and van den Ban, (2004 pp. 171, 172) highlights that conflicts may arise from the competition of differing cultural values, norms, resources and interests, power and influence, and knowledge. The process of mediation is closely linked to social learning since it implies building shared visions and comprehensive perceptions. *Integrative negotiation* is pointed out as an optimal negotiation approach. This is an approach to negotiation which consists in finding creative solutions that satisfy all the interests of the users, and which avoid settling conflicts simply by introducing unstable compromises involving redistribution of benefits, as it often happens during *distributive negotiations* (van Mierlo et al., 2010 p. 322, Leeuwis and van den Ban, 2004 p. 169).

3.1.2 Innovation Histories

To reconstruct how the implementation of the Trans-SEC UPS unfolded, we will consider the main events and activities, and we will investigate them using the Process Net-Map tool. The literature on innovation processes suggests comparable methodologies: the innovation histories and the innovation journeys.

Innovation histories is a method for studying innovation processes, which focusses on tracking the learning and change encountered during a process of change, and aims at understanding how innovation happens, singling out the success factors and identifying potential improvements. This method consists of writing down the history on an innovation based on the experiences of people involved, listing key events concerning the innovation, drawing matrices describing the relationships between actors involved, writing up the learning history, and identifying the changes that have occurred (Spielman et al., 2009 p. 403;(Douthwaite and Ashby, 2005). Analogously to innovation histories, *innovation journeys* involve identifying key events. This method has been used by Klerkx et al. 2010 to study two cases of sustainable agriculture in the Dutch agri-food sector.

3.2 Participatory Action Research

Participatory Action Research (PAR) is a research approach which presents important advantages in addressing the needs of marginalized communities. Research frameworks following PAR are utilized today in many agricultural research and development projects in developing countries. PAR developed in the context of the-anticolonial movements of the 20th century. The early contribution of the Brazilian educator Paulo Freire to PAR is particularly relevant. Reflecting on the methods to best address adult literacy, Freire highlighted the importance of creating a non-hierarchical dialogue where researchers and ‘researchees’ are placed on the same footing, and learn and contribute equally to problem solving (Glassman and Erdem, 2014 pp. 209–210).

There is no commonly agreed definition of PAR. Greenwood et al (1993 p. 177) refer to it as a “research approach that emphasizes co-learning, participation and organizational change”. Baum et al. (2006 p. 854, drawing from Minkler and Wallerstein, and Grbich), describe it as a “collective, self-reflective inquiry that researchers and participants undertake, so they can understand and improve upon the practices in which they participate and the situations in which they find themselves”.

PAR develops from *action research*. Action research is an umbrella term covering a variety of approaches which emphasize the integration of research and action. The term action research was first introduced by the social psychologist Kurt Lewin (1946). Lewin describes

action research as a spiral involving cyclically: planning, acting, observing, and evaluating the results of the action as a form of revised planning for the following action loop. The idea is that research is a continuous process of learning from experience which entails the possibility of changing the actions during the process (McTaggart, 1994 p. 315).

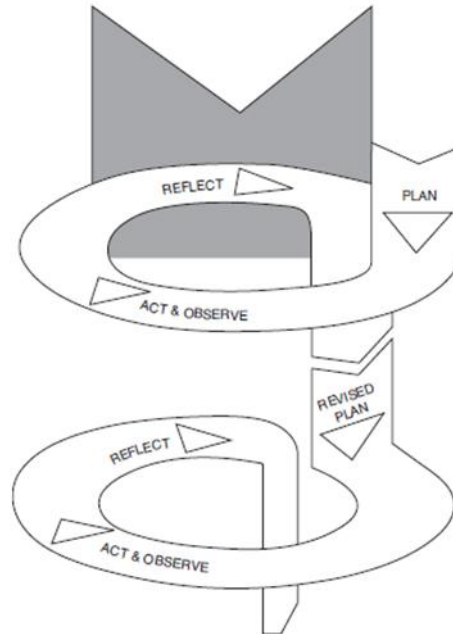


Figure 10.1. The Action Research Spiral

Figure 8: The action cycle (Source: Kemmis and McTaggart, 2005 p. 278)

PAR shares the core values of action research; However, PAR involves an even greater focus on participation. While action research has been typically applied in the context of industrialized countries, PAR was developed in the context of research on marginalized communities within developing countries. What distinguishes the most PAR from action research is the additional importance attributed to the interaction between the researchers and the stakeholders involved in the process (Khan and Chovanec, 2010 p. 34-35; Baskerville, 1999). The researchers and participants collaborate and share the responsibility of the research outcome (Pain, 2004 p. 652). PAR realigns the social settings, since all parties bring knowledge to the action research process. The researchers contribute with their theoretical knowledge, and the members of the community add their practical knowledge, which they have accumulated by living in the context under study. The participants are involved in the whole research process and are free to reorganize the research settings without the obligation of following externally predefined outcomes (Baskerville, 1999 p. 17). The aim of PAR is

also that of empowering the marginalized community by involving community members in the decision-making process, and allowing them to become more powerful agents (Baum et al., 2006 p. 854, Whyte, 1989 p. 368).

Shared PAR principles include participation, cooperation and co-learning between researchers and community, community empowerment and capacity building, and balance between research and action (Minkler M., 2000 p. 192, based on Israel et al., 1992; Khan and Chovanec, 2010 p. 36).

In the agricultural context, participatory action research is particularly beneficial because it helps researchers improving their understanding of complex agricultural systems, and helps identify the opportunities for technologies to best fit the farmers' needs as well as the environmental conditions (Martin and Sherington, 1997, p. 198). Farrington and Martin (1988) propose a revision of participation approaches in farmer research. They highlight how the role of researchers is that of understanding the farmers' goals and constraints and their indigenous technical knowledge. The research process does not have a strict sequence of stages, but is interactive and flexible. The farmers' perspectives are included in the problem definition through various methods, for instance, focus groups, surveys, interviews, and case studies. These interactions are essential to help farmers become aware of alternative technologies and their benefits. Farmers can also be introduced into the research by directly participating in the trials. This can occur by simplifying the techniques used for the trials to make them more accessible to farmers, or by letting the farmer control the trial directly to evaluate the outcomes jointly with the researchers. Moreover, the experimentation can be jointly designed by farmers and researchers or redesigned based on the farmers' evaluation. Finally, farmers can participate in the dissemination of technologies.

Gonsalves et al. (2005, p. 20-21) describe the attributes of the *participatory learning and action research* approach in the context of the development of innovations for agriculture. They highlight that, in comparison to other approaches, PAR involves a greater focus on including the stakeholders in the process, and assumes that innovations are driven by mutual learning and embedded in contexts where different actors and networks have different interest power and access to resources. In the process of action research, a diversity of actors

is considered, and platforms for negotiation and learning processes are built. A collaborative relationship between farmers and researchers is created, in the form of a partnership.

Chapter 4. Research Design and Methodology

This chapter is dedicated to the discussion of the research methods. The process influence mapping technique, which is the main tool utilized, will be explained in the first paragraph. Next, the structure of the feedback discussions will be presented (paragraph 4.2), and the criteria used for the stakeholders' selection and data collection (paragraph 4.3) and the analysis mode will be clarified (paragraph 4.4). The limitation of the research and the challenges encountered during the field research will be discussed in paragraph 4.5.

4.1 Process Net-Map

Process Net-Map is a participatory mapping technique developed by Schiffer et al. 2017⁴ to study the implementation of programs, projects or services in detail. So far, this novel method has been used to analyse the implementation of a social security programme in India (Raabe et al., 2010) and to study the veterinary service delivery in Uganda (Ilukor et al. , 2012). The focus of these studies was understanding the influence of actors involved in the implementation and the entry points for corruption in the programme/service design.

In this research, Process Net-Map will not be used to track the factors undermining the performance of the project, but we will use it to provide the detailed picture, of what the implementation of these innovations looks like according to the perceptions of the major actors involved: The UPS farmer groups in the CSS and the researchers. The technique shows some similarities to the innovation histories methodology, which is recommended for studying innovation processes (see chapter 3). In the innovation histories method, the focus also lies on identifying the actors' relationships and the learning processes on the basis of the history of the innovation (Douthwaite, and Ashby 2005). Process Net-Map may also fulfil this function. While the innovation history method requires the preparation of workshops and the collaboration of a core group consisting of a facilitator, an analyst, a journalist, Process Net- Map has the advantage of permitting an easier visualisation of the events and of the relationships between actors, which could easily fit the interview format. In addition to this,

⁴Process Net Map has been developed by Regina Birner with input from Jennifer Hauck at UFZ and from researchers at IFPRI.<https://netmap.wordpress.com/process-net-map/>

it allows the inclusion of different themes which could interest the research, and makes the challenges and the successes encountered along the implementation process explicit.

A Process Net-Map interview consist of three main steps:

1. Implementation Steps,
2. Towers of Influence,
3. Challenges.

The first step involves asking the interviewee to remember the most important steps encountered during the implementation and to draw action links among the stakeholders involved. During this phase, the interview partner is asked to name the most important actors involved in the implementation. The actors mentioned are then written down on small actor cards and laid on a blank poster. In a second step, the interviewee is asked to remember the events occurred in chronological order. For each implementation step mentioned, an arrow indicating the action links between actors involved is drawn. If new actors are recalled, these are added to the chart. Listing the steps taken serves to draw a detailed picture of the implementation practice, which might differ from how it was described in the initial formal project design. This also helps discussing the dynamic of change generated by the UPS in the communities and the trajectory followed by the UPS.

The second step of a Process Net-Map interview is that of building the “*towers of influence*”. These consist in placing tokens over the identified actors. The tokens are small pieces of wood which can be stacked easily and serve for ranking the actors according to different criteria of interest. Each actor can receive from one up to five wooden tokens which proportionally to its value according to the criterion at hand: Very low, low, average, high, very high for values of one to five. After placing the tokens, the interviewee is asked to motivate the assignments. The criteria I used for ranking the actors were five: Influence, Food Security, Income, Knowledge and Trust. I selected these criteria, drawing from the research of Halle et al. (2017), to look at different aspects of the innovation process and of the implementation of the specific Trans-SEC strategies.

The **Influence** criterion is used to outline the influence of the various actors in the implementation process and the power structure. This criterion may help shedding light on

the room for action of the different stakeholders in the UPS implementation. Ideally, in a participatory process every actor would have a role and be important for the outcome of the process. Hence understanding the degree of influence may provide insight on the effectiveness of PAR.

The **Income** criterion was chosen to investigate the perceived opportunities of adding revenue to the farmers' households through the UPS implementation. Income generation is a driver for change and opportunities for smallholders. Some of the Trans-SEC UPS involve developing business opportunities, which also help disseminating the technology. This aspect is often reflected in the values assigned to this tower and hence might provide insights on how opportunities for generating income might influence the perception of success of the UPS.

Food Security is another aspect relevant in the food value chain approach chosen by Trans SEC. Trans-SEC aims at enhancing food security and rural livelihoods of smallholders. Even if not every UPS is designed to bring about an increase in food availability, this criterion can provide relevant insights on the opportunities of the strategy and perception of food security brought about by the UPS.

The **Knowledge** criterion aims at ranking the level of mutual learning generated by the strategies. This is a major criterion for a participative action research, and it is also important for providing opportunities for change to occur. High level of learning and interaction are associated with opportunities of enhancing transformations.

The **Trust** criterion was used to gather insight on the perceived trustworthiness of the actors. This element, although difficult to bring up without introducing biases, which are inevitable due to the nature of this subject, is important for processes of change entailed by innovations, and for comprehending the stakeholder history. This indicator supports the discussion on the existing cooperation or transparency and sustainability.

4.2 Feedback discussion

After the individual interviews, a meeting with the group members to present a summary of the results of the single interviews was organized. The meetings served to verify the general group perceptions of the UPS implementation, to get further insight on the results, and clarify aspect not completely covered during the single interviews. In total, five feedback discussions, one for each UPS group, were conducted. To facilitate the feedback discussion, the results were translated in Swahili and presented in the following order. Firstly, a comprehensive summary of all the steps provided by group members in the single interviews, integrated with the map of actors involved was presented. The group members were asked to comment on the steps identified and to add possible missing activities or remove any irrelevant steps. Next, the outcome of ranking the actors was explained, by displaying the average of the towers gathered during every interview. Lastly, the summary of each implementation challenge mentioned was presented. The group members were asked to comment on the challenges and, possibly, to identify the most relevant issue encountered during the implementation. During any feedback discussion, identifying the most important challenge was not possible due to the diverging opinions of the group members. The discussion on the most important challenge provided, however, a good starting point for reflection on the motives influencing the challenges. The discussion was concluded by asking questions on the perceived changes brought by the implementation of the strategy and the group activities.

4.3 Selection of the interviewees

The two main groups of stakeholders interviewed were: the UPS group members, and the researchers and the professionals who had been directly involved the trial implementation of the strategy in the villages and in the design and coordination of the activities. For each strategy, approximately six UPS group members and five researchers were interviewed. In total 59 interviews were conducted, 25 with researchers and 34 with UPS group members.

The interview sample included, for each UPS, at least one representative of the principal Trans-SEC organisations directly involved in the implementation. These are ARI,

MVIWATA, ZALF and SUA (see chapter 2). The researches from these organisations were selected using a snowball approach, by asking each interviewed researcher for names of other researchers who could provide valuable information on the implementation of the strategy.

The selection of the interviewees from the UPS groups took different variables into account. The criteria of age, gender, economic status, and locality were used as general criteria for the selection of interview partners in every UPS group. The interview partners included ideally elderly as well younger individuals from different locations in the village. Moreover, the interview sample should comprise a balanced representation of genders and income groups. These criteria could allow a broader representation of the implementation by integrating multiple perspectives. Due to limitations in the number of interviews for each UPS group and due to the group heterogeneity, following these conditions was not always possible.

In addition to these criteria, the interviews with the group leader, group secretary and treasurer from each group were prioritized. These individuals were thought to be more knowledgeable on the group dynamics, as well as the history of the strategy implementation.

Other criteria specific to the UPS group were chosen based on the goals and structure of the single strategy. For instance, in the ICS UPS groups, interviews with the group members in charge of training other group members on the stove construction were highlighted as important.

To improve the diversity of the interview sample we thought to include people who had dropped out of the group. These individuals can provide a more diverse perspective on the group dynamics and shed light on aspects of UPS implementation, which interview members might be reluctant to expose. These would include, for instance, conflicts in the group or transparency and trust issues. The group dropouts were identified by asking their contacts to the group leader, however, given the bias that this would imply, more often the Trans-SEC field assistant suggested the contact. Another instrument used to find out about contacts of ex members was through informal talks with members of the village during gatherings at the local pub, or more frequently during transect walks. These consisted in walks across the villages to get acquainted with the village and community, and to verify the state of the local

resources. During the tour, some households where Trans-SEC strategies were being implemented were visited. The walks were useful to get a picture of the social dynamics in the village and to find potential contacts for the interviews, for instance to identify the group dropouts.

4.3.1 Selection of the villages

The Trans-SEC project has tested and implemented UPS in four CSS, two villages in the sub-humid region and two villages in the semiarid region (chapter 2). The investigation of UPS implementation in the scope of this research has focused on only one CSS per climatic region. The choice of the CSS was made on the base of the outcomes of the initial interviews with the experts. At the end of each interview, the researchers were asked to point out the village in the sub-humid or semi-arid the region where most implementation challenges or success stories had occurred. Following this criterion, the village of Changarawe was chosen for assessing the implementation of the improved processing machine strategy, due to the perceived problems derived from a recent flooding which had challenged the activities of the group. The improved cooking stove group in Ilakala was indicated by the researchers as an interesting example for investigating the challenges resulting from the implementation of competing stoves constructed by a project from a new NGO. Idifu, in the semiarid region, was chosen for the practical impossibility of finding an accommodation for researchers in Iloilo, the other CSS in the semi-arid region. Moreover, Idifu was perceived as more challenging in comparison to Iloilo.

			MS/MT (24)	OMOS (15)	ICS (20)
UPS GROUP MEMBERS (34)	Sub-humid region	Ilakala (13)		Group Leader (1) Group secretary (1) Group treasurer (1) Group members (2) Group dropout (1)	Group Leader (1) Group secretary (1) Group treasurer (1) Group members (2) Stove constructors (2)
		Changarawe	Group Leader (1) Group secretary (1) Group treasurer (1) Group members (3) Group dropouts (2)		
	Semi- Arid	Idifu (13)	Group Leader (1) Group secretary (1) Group treasurer (1) Group members (2) Group dropouts (1)		Group Leader (1) Group secretary (1) Group treasurer (1) Group members (2) Stove constructors (2)
RESEARCHERS (25)			ZALF (1) SUA (3) MVIWATA (3) ARI Ilonga (2) ARI Dodoma (1)	ZALF (1) SUA (4) MVIWATA (2) ARI Ilonga (2)	ZALF (1) SUA (1) MVIWATA (2) ARI Dodoma (1) ARI Ilonga (1)

Table 1: The Interviewees (UPS group members and researchers), per each UPS in the different CSS

Table 1 shows the interview samples for each UPS divided by stakeholder type and geographic region.

4.4 Data Analysis

The results of Process Net Map interviews and outcome of feedback discussion were analysed using both, qualitative and quantitative data analysis. The feedback discussion and the first and third phase of the Process Net Map interview, namely the identification of implementation steps, were analysed using quantitative content analysis method, while the ordinal ranks assigned to each tower were statistically compared using the Mann Whitney-U test.

4.4.1 Qualitative Data Analysis

Qualitative content analysis was chosen to retrieve and structure the most relevant information from the content of the Process Net-Map interviews. This method permits an

analysis of the content of a qualitative research through a classification of the text according to determined categories. Assigning codes and labels to the content of the material collected helps reducing the information to the most relevant topics to be researched, and makes explicit and implicit relevant dimensions under investigation (Bengtsson, 2016 p. 8).

The materials analysed were: The single steps and challenges identified by each interview partner, the entire transcription of a number of single Net-Map interviews and the entire content of each feedback discussion. For each UPS, the content of approximately four interviews with group members and three interviews with researchers was transcribed and analysed.

The materials were analysed with the qualitative data analysis software MAXQDA. The codes used for the classification are based on concepts from literature on innovation systems and PAR (see annex II). Moreover, were highlighted references to: storylines of successes and challenges, key activities and events occurred in the UPS implementation and the criteria for ranking the actors during the Net-Map interview.

4.4.2 Quantitative Data Analysis

Quantitative data analysis was employed to analyse the outcomes of the second phase of Process Net-Map interviews, namely the construction of towers of influence depending on the selected criteria. The ranking of the actors, which were set on a scale of zero to five, across regions and stakeholder types, were compared. The comparison, for each strategy, focused on the rankings of UPS group members from different geographic regions and the rankings of UPS group members from both geographic regions and researchers. The goal is verifying the existence of significant differences across the stakeholders' groups and regions.

The statistical comparison was carried out by using the Mann-Whitney U test. This nonparametric test allows a comparison of small samples of independent subjects, such as the UPS groups interviewed, in which the scores are rated through a subjective and not very precise scale, such as the towers of influence in the Process Net Map, and therefore it can be considered to have a merely ordinal, and not necessarily equally space value (Nachar, 2008 p. 13). The scores of the groups were compared to assess determinant differences. The

grouping variables use were: Region (villages in the sub-humid or semi-arid region) and stakeholder group (researchers and UPS group members). The scores of the towers provided by UPS group members in the semi-arid region district were compared to those of group members from the sub-humid region. In the same way, the scores of towers assigned by researchers were compared to those assigned by all group members from both regions for each UPS. The two hypotheses were that the scores attributed by interviewees during the construction of towers of influence have either a homogenous or an unequal distribution in the two groups. To test this, the scores attributed to each actor were ranked and ordered and the U value was calculated. The U value indicates the number of times the observations in one group follow the observations in the other group when all the scores from one group are placed in ascending order (Nachar, 2008 p. 16). If the U value is equal or less than a critical value at a given significance level, there is a significant difference in the attributions of the tower of influence for that actor.

4.5 Limitations of the Research Design

In this paragraph, I would like to reflect upon shortcoming of this research design and on the limitation of the methodology criteria I chose for collecting the data. If, on the one hand, the research design allowed to gain useful insights on the UPS implementation and the methods used provided numerous advantages, on the other hand I am aware that I may have overlooked certain aspects.

Conducting research on field, by visiting and living in the CSS over a period of about a month revealed to be fruitful for different reasons. I could understand the reality of the life in the village and the constraints faced by the farmers, and I was allowed to get in direct contact with the UPS groups in the CSS. I was able to get to know the UPS group members and listen to their opinions and motivations and of what influences the dynamics of the UPS implementation. At the same time, my knowledge and contact with the UPS group members and the socio-environmental context was challenged by the linguistic barrier. Every interview and contact with the locals was possible only through a translator, which made the process of interaction longer and more difficult. I perceive this as a limiting factor to interpreting the results gathered.

Process Net-Map tool revealed to be useful for gathering results on the UPS implementation. The interviewees could easily grasp the meaning of the questions asked and were actively engaged in visualizing the process of implementation, which also improved their concentration during the interview. Moreover, I could gather numerous qualitative data. A shortcoming in my Process Net-Map interview guidelines was perhaps the choice not to provide a clear definition of the criteria for ranking the actors. The inability to clarify the criteria for the selection of the towers led probably to different interpretations of the meaning of the towers of influence. For example, the researchers' understanding of food security and learning criteria, appear to differ from how UPS group members conceive these criteria. This would also be an interesting aspect to further research.

In addition to this, the interviews might have been influenced by a social desirability bias, since the respondents, especially the UPS group members given their stake, might have answered the questions in a favorable manner. In particular, I had the impression that the interviewees, especially the UPS group members, would praise the work of their UPS group and hide events which they believed would reflect badly the UPS group's actions.

The choice of focusing only on two stakeholder types, the UPS group members and the researchers, was driven by the need of getting further insights on the implementation, which other stakeholders might have been unaware of. Including other stakeholders, such as community members not directly involved in the UPS, might have provided a more diverse interview sample. However, this was not possible due the time constraint.

Chapter 5. Presentation of the Results

This chapter aims at presenting the findings from the individual interviews and feedback discussions with UPS groups. The findings are grouped by UPS, and organised as follows. Firstly, the history of the UPS implementation is described; This is a comprehensive summary of the implementation step, of the major activities and events mentioned by all interviewees, both Trans-SEC researchers and professionals, and by UPS groups from both climatic regions. Differences in the sequence of activities and events among CSS will be eventually discussed. After the description of the UPS implementation, the challenges faced will be clarified. These are also reported in the form of a summary of the recurrent issues, as referred by interviewees. After these, a summary of the successes brought about by the UPS implementation will be added. I infer successes mainly inferred from positive comments from the interviewees' answers to the questions: *Has your involvement in the process changed your daily life, habits and attitude or not? If yes, how? If yes or no why? and How are you going to continue with the strategy after the project's end? (see annex I)*. Finally, the results of the Towers of Influence are presented, and the final results of the comparison of towers across the different CSS and across UPS group and Tran-SEC researchers is highlighted.

5.1 Improved Maize Sheller and Millet Thresher Machines (MS/MT)



Figure 10: Millet Thresher Machine.



Figure 11: Maize Sheller Machine

The Maize Sheller (MS) machine in Changarawe and the Millet Thresher (MT) machine in Idifu have been introduced as strategies to improve the processing of the harvest, to reduce human labor and to improve farmers' livelihoods. The traditional processing techniques, which consist in beating bags containing the harvest with a stick, lead to losses of produce, and require several hours of work and great strength. Improved processing machines contribute to upgrading the food value chain by decreasing post-harvest losses and improving the quality of the food outcome (Trans-SEC Fact sheet 3). The operationalization of this strategy in the CCS has consisted, in practice, in introducing the machines in the villages for the UPS groups to use. The UPS groups shelled or threshed their own harvest, and, upon request, the harvest of other farmers in the community and outside the community. These activities involve the provision of a service to clients. For this reason, the UPS group members have received training on business management by the Trans-SEC organizations.

5.1.1 The MS/MT Implementation Steps

Based on the steps referred by Trans SEC researchers and UPS groups, and confirmed in the feedback discussion rounds, the UPS implementation in both villages has been established as follows.

Firstly, researchers and professionals from ZALF, MVIWATA, SUA and ARI conducted planning activities. These included: the screening of CSS and scoping of the UPS, ex ante impact assessments and the definition of the FVC components and food security indicators. The researchers studied the solutions to upgrade the local value chains and improve food security, which are most compatible with the local conditions and the farmers' needs. Baseline surveys were conducted in the CSS to verify the local conditions and to gather information about the households to be included in the UPS trials. The village extension officers, through the village leaders and sub-leaders, informed the communities that a research project would take place in their village, and that the researchers would conduct interviews and other activities involving the community. The initial preparative activities resulted in the identification and selection of a limited number of UPS per CSS. The optimized machines for improving harvest processing were determined to be promising solutions in every CSS.

After the identification of the most promising UPS, the Trans-SEC researchers organized a two-days meeting with the community members selected to take part in the UPS implementation. During this meeting, the researchers presented the most important aspects of each UPS, their benefits, and the activities required for their implementation. Later, the participants were asked to choose one UPS and to form groups (henceforth *UPS groups*) for the implementation of the chosen UPS. The meetings included workshops on how to form, manage, and lead groups, and on how to select group leaders. Moreover, the participants were trained on how to management each specific UPS.

The participants who selected the Maize Sheller and Millet Thresher Machines UPS were mostly interested in the time savings and the reduction in the need for physical strength offered by this solution. Initially, however, there was a misunderstanding concerning the requirement for joining this UPS group, which caused defections from the groups. Selling milling and threshing services to clients entails generation of earnings, which could consistently advantage the UPS members; for this reason, it was agreed within Trans-SEC that an entry fee for joining the group would have to be introduced, and that the UPS group members would have to contribute to the machine purchase. This choice was made to improve the ownership of the strategy. However, upon learning that they would have to pay for the purchase of the machine, many participants who initially chose this UPS group decided to defect. In Idifu, most of the participants who initially joined the group dropped

out of the Strategy. When the final UPS group was formalized, the group members chose their leader, the group secretary, and the group treasurer.

The trial and implementation of the strategy followed the formation of the groups. Initially, training on how to use the machine and how to run an enterprise were provided by MVIWATA and SUA. A business model to run the strategy was studied by SUA researchers and agreed upon by group members, following a participatory business planning approach. At the same time, the groups decided their internal organization, and redacted a formal agreement which defined the different aspects of group work, such as the organization of group meetings, the criteria for the integration of new group members, and the tasks of each group member. They were helped in this by the MVIWATA team. Concerning the issue of the contribution to the machine purchase, a compromise between the Trans-SEC researchers and the UPS group members was reached. It was decided that the machine would be purchased with Trans-SEC funds, and that the group members would have to pay back half of the price of the machine with part of the income generated by the activities of shelling and threshing for clients. To finance the specific requirements of the UPS, such as purchasing the machines and providing materials on credit, Trans-SEC established an *Innovation Fund*.

The selection of the machine type was made by UPS groups after being informed by Trans-SEC researchers on the individual machine's features, and their advantages and disadvantages. The machine suppliers were screened and selected by SUA researchers. MVIWATA team took care of accompanying the group leaders to the machine suppliers to select the machine, and of ordering the machine. The machine suppliers delivered the machines in the villages.

Once the machines were delivered, additional training on how to operate the machine was provided by the MVIWATA and SUA teams. During the group meetings, the organization of group activities was further defined. The groups organized the management of the milling and threshing in detail, decided the price of each bag of produce processed, defined working schedules, and organized the means of transport for moving the machines from one place to another.

The operation of the machine was challenged by frequent mechanical failures: In both villages, the machines needed to be repaired more than once. Initially, the group processed the harvest of its own members. Later, the milling and threshing services were offered to clients from the CSS and the nearby villages. Transporting the machines from household to household is an issue mentioned in both villages as problematic: The machines are heavy, and paying transporters to pull the machine is expensive. This difficulty was eventually dealt with by introducing wheels and other solutions to facilitate the pulling.

The machine use on behalf of group members was constantly monitored by Trans-SEC researchers. Impact assessment, business assessments and follow-ups were conducted throughout the UPS trial.

After starting to operate the machines, the UPS groups were formally registered in the national list of businesses, and bank accounts were opened in their names by the MVIWATA team professionals. By suggestion of the researchers, the UPS groups attempted to engage in extra activities outside the milling and threshing work: The UPS group in Idifu planned a future group farming activity, intending to work a field of millet jointly. This activity has not started yet, due to unfavourable weather conditions that are hindering the work. The groups have also started repaying the loan for purchasing the machine with the earning of milling and shelling.

Activities forecasted for the future include additional impact assessments, training, and promotion of the UPS. Moreover, in line with Trans-SEC plans, opportunities for outscaling and upscaling will be considered. In addition to this, the UPS groups will repay the remaining part of loan for purchasing the machine, and then they wish to buy additional machines for threshing or milling, or transportation means.

The central groups of actors identified by the interviewees are, as expected, the UPS group members and the Trans-SEC researchers. Other actors which have been linked to the activities and the steps of the project are the machine suppliers, the customers for which the UPS group member process the harvest, and the mechanics who repaired the machines. Another central actor which is constantly involved in the UPS implementation is the field assistant, a professional hired by Trans-SEC to monitor the implementation of the UPS on

field. Although the clients from other villages to whom the UPS groups provided their services are important for the UPS group business activities, they were not considered relevant in the MS/MT implementation process. Other actors mentioned by some interviewees, but not considered relevant for the MS/MT implementation at the village level were: The village extension officer, the district extension officer, the village executive officer, the banks, the TFC (Tanzania Federation of Cooperatives) and ACT (Agricultural Council of Tanzania). These latter are non-governmental organizations which in the Trans SEC project are responsible for the regional and national stakeholders' involvement (Trans- SEC deliverable 2.2.1).

No consistent differences have emerged in the activities described by the interviewees from the different regions. A major flooding event, which occurred in Changarawe in 2016, has ruined the produce, and consequently reduced the amount of maize that needed shelling, and the capacity to pay back the loan. Nonetheless, the implementation sequence was not changed.

The description of the MS/MT implementation process by different stakeholder groups (researchers and UPS group members) does not differ significantly. All events and activities are described coherently by all respondents. It should be noted that the steps described by the researchers, especially those involved on field in the implementation, were more exhaustive, since the researchers had a better understanding of project design. On the other hand, the UPS group members often provided a detailed description of the implementation phases which they were actively involved in.

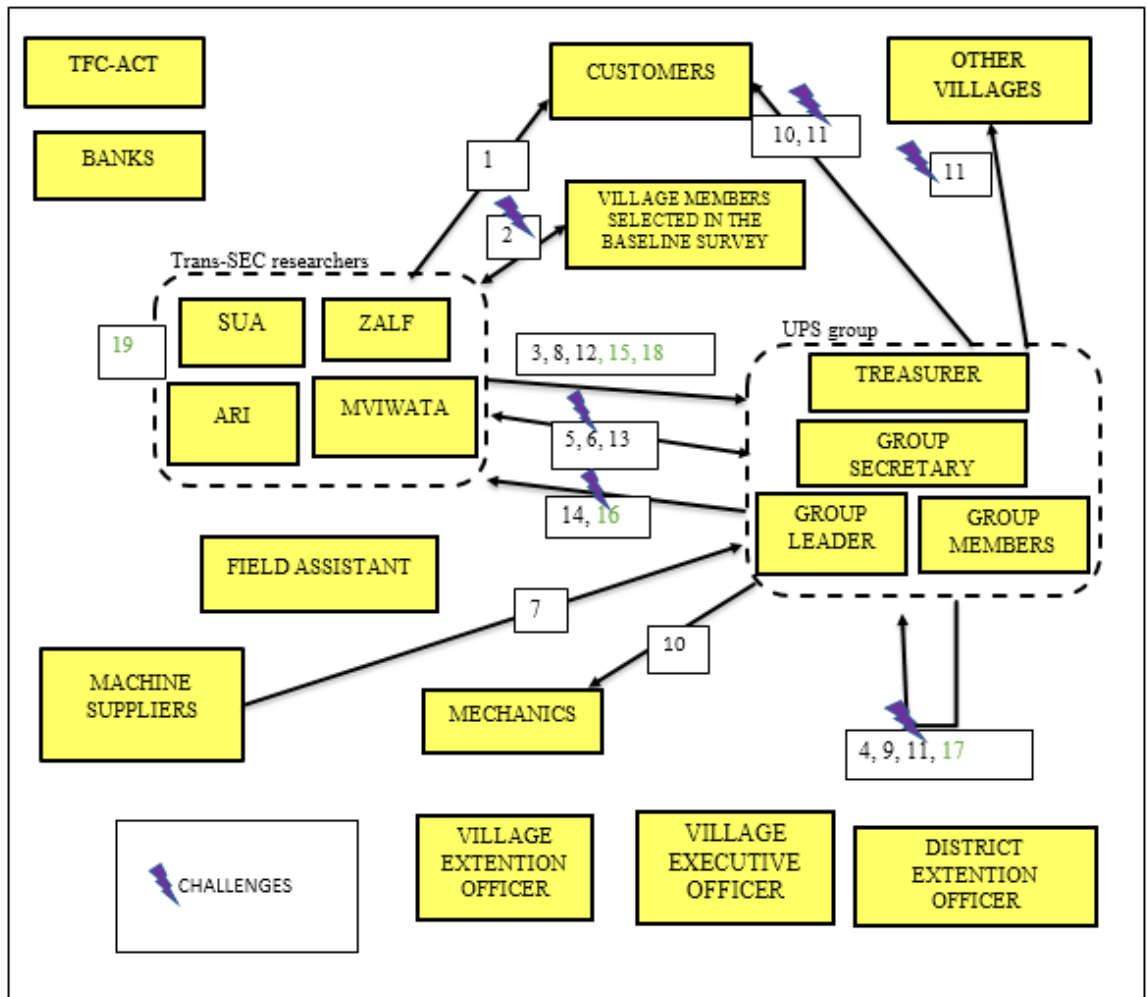


Figure 12: Maize Sheller / Millet Thresher UPS, Changarawe and Idifu: Summary of the Process Net-Maps






1. Planning the implementation in the villages. Screening the CSS. Definition of the candidate UPS. Baseline survey.
-  2. Meeting with the project's participants. Presentation of the candidate UPS. UPS selection. Group formation and definition of roles.
3. Definition of business model to run the UPS.
Training on enterprise management.
4. Organization of group meetings. Elaboration of group constitutions.
5. Discussion and decision to introduce innovation fund.
-  6. Selection of the MS/MT, the machine suppliers, the price of the machines.
7. MS/MT purchase.
8. Training on how to operate the machines.
9. Group meetings for organizing the group activities and deciding the price of the services provided.
10. Machine repair and introduction of technical improvements.
11. Machine use.
 -  a. Threshing/ shelling for group members.
 - b. threshing/ shelling for the community.
 - c. threshing/ shelling for other villages.
12. Monitoring follow-up on data collection and business evaluation. Impact assessment and business evaluation.
13. Groups registration and opening of bank accounts.
14. Loan repayment.
- FUTURE ACTIVITIES**
-  **15. Impact assessment.**
-  **16. Loan repayment.**
- 17. Start group farming activity.**
- 18. Increase training and promoting the UPS at the district and regional levels.**
- 19. Scaling out.**

Figure 12 Continuation

Figure 12 shows the summary of the MS/MT implementation steps described by all interviewees. The representation replicates the configuration of a typical Process Net-Map interview.

5.1.2 The Challenges encountered during the MS/MT Implementation

A first challenge encountered in the implementation of this strategy occurred during the initial meeting for selecting the UPS and forming groups. Many participants who initially stepped forward to join this UPS group stepped back when they learned that they would have to pay an entry fee to be part of the group, and would have to contribute to the purchase of the machines. New farmers were recruited to replace the defections. These were willing to pay an entry fee to be part of the group, since they were on average financially better off, and were more motivated. This amounted to an additional selection step for the participants of this UPS group in comparison to the other groups.

“Before the idea of introducing the innovation fund, the farmers were supposed to contribute to the budget to purchase the machine, but they did not want to. Some of them were saying that this is a project for the benefit of the farmers, therefore the farmers should not have to pay.” (Researcher, Kilosa, March 2017)

“Initially, we group members did not know that we would have to pay to be part of the group. We are poor, so all the initial group members dropped out of the group. New people not selected for being part of the project entered the group.” (Group member, Idifu, March 2017)

Challenges related to the technical side of the machine operation which were recalled frequently by the interviewees in both CSS included the transportation and the frequent machine malfunctioning and failures. In Changarawe, the UPS group hired transporters which would move the machine from household to household to conduct the shelling.

“A major challenge is moving the machine from one point to another. For the group, the cost of hiring transporters is very expensive. I don’t believe the transporters are over charging us. For them, the price they ask is a normal price, but for us it is very expensive. Digging one acre cost 45000 shillings [17€], while transporting something from a location to another costs approximately one third the price of digging an acre. For them it is a normal price, but for us it is very expensive.” (Group member, Changarawe, March 2017.)

In Idifu, wheels and extensions were added to the millet thresher so that it could be more easily transported from one location to another. Transportation, however, still remains an issue. Another major issue is the frequent machine breakdowns, which occurred in every CSS. The experts highlighted how this issue could be traced back to the selection of a wrong machine type. The process of machine selection involved researchers from the MVIWATA, the SUA and the UPS group. The machines were selected by UPS group members informed by researchers from SUA. The SUA team explained the potential benefits and the characteristics of each machine and the group members made a final decision. The group leader was taken to the machine supplier factory to select the machine by the MVIWATA team. MVIWATA was often in charge of the management of social aspects of the project, such as organising workshops of group management, helping the UPS groups registering their group in the Tanzanian national list of businesses, and opening bank accounts in their names. Technical trainings on UPS management were instead supervised by other Trans-SEC researchers.

Although the UPS groups were supported in the choice of the machines, some researchers suggest that the UPS groups were not sufficiently informed and aware of the machine characteristics, and that an appropriate feedback discussion about the process of machine selection was missing. In their opinion, this resulted in the purchase of inadequate machines, which the group members found difficult to operate. This challenge also led to mistrust among stakeholders. It has been suggested by some interviewees that the frequent machine malfunctioning and failures might lead the UPS groups and village members to lose faith in the project.

“The frequent machine malfunctions are a serious problem. When the machine breaks, the customers have to wait, and they get disappointed.” (Researcher, Idifu March 2017).

Loan repayments for the machines have started in some villages, but they have not been completed yet. Reasons for the delays include adverse climatic events: The flooding occurred in Changarawe has reduced the earnings from maize shelling. In the poorer Idifu village, the harvests are frequently challenged by droughts.

Other challenges not connected to technical aspects of the machines are the problems of transparency, communication, and tension among group members. In both UPS groups, transparency issues have emerged. In general, a tendency can be observed to underreport the amount of harvest processed.

The process of collecting the earnings from the threshing and shelling activities has been agreed upon during the group meetings. The group members, when it is time for threshing or shelling the harvest for clients, divides themselves into teams. The amount of harvest processed is reported to the group treasurers who transcribe it in the group records. The group members use part of the earnings for repaying the loan for purchasing the machine and part is their own income. Hiding the amount of harvest processed affects negatively this process.

In Changarawe, the UPS group members have never openly reported a problem of underreporting the amount of maize shelled; however, an ex-group member claimed to have been excluded from the UPS group for reporting cases of wrong transcription in the group record of the number of bags of maize shelled. The group members were cohesive in excluding this individual from the group and in denying the accusations of underreporting the actual earnings of the group. This issue was discussed during the meeting for presenting the results of the interviews, but the discussion was inconclusive.

Similar situation has occurred in the UPS group in Idifu. Interviewees, refer that some group members hid the number of bag of millet threshed to increase their own profit. This issue is cause of discomfort, lack of trust, and tensions among group members and makes collaboration difficult.

“It pains me to see some group members getting rich by lying and hiding the real amount of millet threshed.” (Group member, Idifu, March, 2017).

Interviewed researches hinted that underreporting of the amount of produce processed could be a strategy to delay the loan repayment established with Trans-SEC for purchasing the machine, or even avoid it entirely. Some researchers suggest that monitoring the use of the machine is complicated, and therefore the process of repaying the loan is not transparent.

Other complaints mentioned by farmers are the lack of trust in the mechanics that repair the machines, poor attendance at group meetings, and problems of communication among group members, specifically difficulties in reaching a common understanding when an issue arises.

Issues originating in the social environment within which the strategies are implemented also emerge in the farmer interviews. In particular, alcoholism affects several village members and also UPS group members. This problem is typical of poorer households, not only in the Trans-SEC CSS. Other aspects mentioned are the witchcraft beliefs, which still permeate the mind set and customs of the community members, and sometimes affect negatively the decisions and actions of the farmers. In one CSS, the UPS group payed for a witchcraft ritual aimed at making the machine work again.

5.1.3 The MS/MT Success Stories

Perceived positive change brought about by the implementation of this UPS is mostly linked to the outcomes of the business activity. The UPS group members may see direct results and this influences positively their perceptions about the benefit of the strategy and this consequently impacts the UPS ownership.

“When you open the way to business, when you introduce something which has a business background, you open the minds of the people to think about business. My attitude has changed because of this. This group has changed my mind into a business oriented mind. Now I have this machine and therefore my mind is changed. Before I was thinking in an ordinary way but now I think at the next level, the business level. Now I talk about business with my people.

“A second thing which has changed is money because this machine was meant to generate money. If we generate more money we get more food. If I was 45 kg of weighted now I could be 50 kg because I eat well. So, the weight of my body can change.” (Feedback discussion in Changarawe, March 2017)

“This strategy has changed my life because I can do other activities with the earnings from millet threshing activity” (Group Member Idifu, March 2017)

5.1.4 The MS/MT Influence Towers

The actors with the highest scores in *Influence* were identified to be the UPS group members and researchers. The UPS group members attribute the same level of *Influence* to each Trans-SEC research team (on average 4.8). On the other hand, the researchers attributed different *Influence* scores to each research team involved in the MS/MT implementation. The researchers attributed lower *Influence* ($p < 0.05$) to the ZALF and ARI teams (on average ZALF 3.8 and ARI 3.9).

The scores of the towers of *Income* and *Food Security* indicate a perceived improvement of UPS group members' income and food security. The Trans-SEC researchers have the tendency to attribute UPS group members levels of *Income* which are significantly higher ($p < 0.01$) than those that the UPS Group Members attribute to themselves. On average, the researchers attribute the UPS group members 4.3 *Income* points while the UPS group members assign themselves 2.8 *Income* points. The UPS group members in Changarawe perceived lower improvement in the food security of their group (on average 2; $p < 0.05$) and of the community (on average 0.8; $p < 0.01$) in comparison to the UPS group members in Idifu (on average UPS group members 3.8; Idifu community 3.3). Last year's flooding has certainly played a role in shaping the perception of *Food Security* reported by the UPS group of Changarawe. The comparison of researchers and UPS group members on *Food Security* reveals that the researchers attribute higher *Food Security* ($p < 0.05$) to the communities in the CSS (on average 3.5) in comparison to the UPS group members (on average 1.9).

The mechanics in Changarawe are attributed higher *Income* and *Food Security* scores (on average *Income* 1.8; *Food Security* 1.3) in comparison to the mechanics in Idifu (on average *Income* 3.3, $p < 0.05$; *Food Security* 3.0; $p < 0.05$).

The scores in *Knowledge* and *Trust* are high for every major actor identified by the interviewees. The researchers attribute Machine suppliers lower *Trust* scores (on average 1.7; $p < 0.05$) in comparison to those attributed by UPS group members (on average 3.5).

Table 2: Comparison of the MS/MT Towers of Influence of the Researchers and all UPS group members, and of the UPS group members from Changarawe and Idifu.⁵

	INFLUENCE			INCOME			FOOD SECURITY			KNOWLEDGE			TRUST		
	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D
SUA															
UPS group members (Changarawe and Idifu)	14	4.8	0.4	14	0.1	0.5	14	0.0	0.0	14	1.9	2.4	14	4.8	0.6
Researchers	10	4.2	1.0	10	0.0	0.0	10	0.1	0.3	10	3.7	1.7	10	4.0	1.7
UPS group members from Changarawe	8	4.9	0.4	8	0.3	0.7	8	0.0	0.0	8	0.9	1.8	8	4.9	0.4
UPS group members from Idifu	6	4.8	0.4	6	0.0	0.0	6	0.0	0.0	6	3.3	2.6	6	4.7	0.8
ZALF															
UPS group members (Changarawe and Idifu)	14	4.8 *	0.4	14	0.0	0.0	14	0.0	0.0	14	1.9	2.3	14	4.7	0.6
Researchers	10	3.8 *	1.4	10	0.0	0.0	10	0.1	0.3	10	3.4	1.6	10	3.8	1.7
UPS group members from Changarawe	8	4.9	0.4	8	0.0	0.0	8	0.0	0.0	8	0.9	1.8	8	4.8	0.5
UPS group members from Idifu	6	4.8	0.4	6	0.0	0.0	6	0.0	0.0	6	3.2	2.5	6	4.7	0.8
MVIWATA															
UPS group members (Changarawe and Idifu)	14	4.8	0.4	14	0.0	0.0	14	0.0	0.0	14	1.9	2.3	14	4.7	0.6
Researchers	10	4.3	0.7	10	0.0	0.0	10	0.1	0.3	10	3.3	1.6	10	3.8	1.4
UPS group members from Changarawe	8	4.9	0.4	8	0.0	0.0	8	0.0	0.0	8	0.8	1.8	8	4.8	0.5
UPS group members from Idifu	6	4.8	0.4	6	0.0	0.0	6	0.0	0.0	6	3.3	2.6	6	4.7	0.8

⁵ N= number of Influence Towers

S. D= Standard Deviation

* = significantly different at $p \leq 0.05$; ** = significantly different at $p \leq 0.01$

	INFLUENCE			INCOME			FOOD SECURITY			KNOWLEDGE			TRUST		
	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D
ARI															
UPS group members (Changarawe and Idifu)	14	4.8*	0.4	14	0.0	0.0	14	0.0	0.0	14	1.9	2.4	14	4.7	0.6
Researchers	10	3.9*	1.2	10	0.0	0.0	10	0.1	0.3	10	3.3	1.6	10	3.9	1.4
UPS group members from Changarawe	8	4.9	0.4	8	0.0	0.0	8	0.0	0.0	8	0.9	1.8	8	4.8	0.5
UPS group members from Idifu	6	4.8	0.4	6	0.0	0.0	6	0.0	0.0	6	3.3	2.6	6	4.7	0.8
CUSTOMERS⁶															
UPS group members (Changarawe and Idifu)	14	3.9	0.9	14	0.5	1.1	14	1.9*	1.7	14	2.4	1.4	14	3.2	1.0
Researchers	10	4.1	1.1	10	1.7	1.7	10	3.5*	1.3	10	2.2	1.0	10	3.1	1.0
UPS group members from Changarawe	8	3.8	0.7	8	0.9	1.4	8	0.9**	1.4	8	1.9	1.0	8	3.4	1.1
UPS group members from Idifu	6	4.0	1.1	6	0.0	0.0	6	3.3**	1.0	6	3.0	1.7	6	3.0	0.9
GROUP LEADER															
UPS group members (Changarawe and Idifu)	14	4.4	1.0	14	2.8*	1.3	14	2.8	1.6	14	4.1	0.9	14	3.7	1.3
Researchers	10	4.3	0.9	10	4.2**	0.8	10	3.7	1.1	10	4.1	1.1	10	3.6	1.2
UPS group members from Changarawe	8	4.3	1.2	8	2.3	0.5	8	2.0 a	1.5	8	3.8	1.0	8	4.3	1.5
UPS group members from Idifu	6	4.5	0.8	6	3.5	1.8	6	3.8 b	1.2	6	4.5	0.5	6	3.0	0.6
GROUP MEMBERS															
UPS group members (Changarawe and Idifu)	14	4.5	0.9	14	2.8 *	1.3	14	2.8	1.6	14	4.1	0.9	14	3.9	1.3
Researchers	10	4.0	1.2	10	4.1 *	1.0	10	3.7	1.1	10	4.1	1.1	10	3.6	1.2
UPS group members from Changarawe	8	4.3	1.2	8	2.3	0.5	8	2.0 *	1.5	8	3.8	1.0	8	4.3	1.5
UPS group members from Idifu	6	4.8	0.4	6	3.5	1.8	6	3.8 *	1.2	6	4.5	0.5	6	3.5	0.8

⁶ The clients that buy the service of the UPS group

	INFLUENCE			INCOME			FOOD SECURITY			KNOWLEDGE			TRUST			
	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	
GROUP SECRETARY																
UPS group members (Changarawe and Idifu)	14	4.4	0.9	14	2.8 *	1.3	14	2.8	1.6	14	4.1	0.9	14	3.8	1.3	
Researchers	10	3,9	1,2	10	4,2 *	0,8	10	3,7	1,1	10	4,1	1,1	10	3,6	1,2	
UPS group members from Changarawe	8	4.3	1.2	8	4.3	1.2	8	2.0 *	1.5	8	3.8	1.0	8	4.3	1.5	
UPS group members from Idifu	6	4.7	0.5	6	3.5	1.8	6	3.8 *	1.2	6	4.5	0.5	6	3.2	0.4	
TREASURER																
UPS group members (Changarawe and Idifu)	14	4.5	0.9	14	2.8 *	1.3	14	2.8	1.6	14	4.1	0.9	14	3.9	1.3	
Researchers	10	3.9	1.2	10	4.2 *	0.8	10	3.7	1.1	10	4.1	1.1	10	3.5	1.1	
UPS group members from Changarawe	8	4.3	1.2	8	2.3	0.5	8	2.0 *	1.5	8	3.8	1.0	8	4.3	1.5	
UPS group members from Idifu	6	4.8	0.4	6	3.5	1.8	6	3.8 *	1.2	6	4.5	0.5	6	3.5	0.8	
MECHANICS																
UPS group members (Changarawe and Idifu)	14	3.9	1.4	14	2.4	1.2	14	2.1	1.1	14	0.5	1.1	14	3.0	1.4	
Researchers	5	3.4	1.1	5	2.8	1.1	5	1.2	1.3	5	1.4	1.1	5	2.2	1.1	
UPS group members from Changarawe	8	3.5	1.7	8	1.8 *	0.7	8	1.4 *	0.5	8	0.5	1.1	8	3.4	1.4	
UPS group members from Idifu	6	4.5	0.5	6	3.3 *	1.2	6	3.0 *	1.1	6	0.5	1.2	6	2.5	1.4	
MACHINE SUPPLIERS																
UPS group members (Changarawe and Idifu)	14	4.3	0.9	14	0.8	1.5	14	0.7	1.3	14	1.4	2.1	14	3.5 *	1.3	
Researchers	10	2.9	1.4	10	2.4	1.8	10	0.9	1.7	10	1.1	1.4	10	1.7 *	1.4	
UPS group members from Changarawe	8	4.0	1.1	8	0.8	1.2	8	0.8	1.2	8	0.9	1.6	8	4.0	1.2	
UPS group members from Idifu	6	4.7	0.5	6	0.8	2.0	6	0.8	1.8	6	2.2	2.5	6	2.8	1.2	

FIELD ASSISTANT															
UPS group members (Changarawe and Idifu)	14	3.9	1,1	14	0.0	0.0	14	0.1	0.5	14	2.2	2.2	14	3.6	1.3
Researchers	7	3.1	0.9	7	0.4	1.1	7	0.6	0.8	7	2.6	1.4	7	4.3	1.0
UPS group members from Changarawe	8	3.9	1.4	8	0.0	0.0	8	0.0	0.0	8	1.9	2.2	8	3.6	1.5
UPS group members from Idifu	6	4.0	0.9	6	0.0	0.0	6	0.3	0.8	6	2.7	2.3	6	3.7	1.0

Table 2 summarizes the results of the Influence Towers referring to the actors identified as important in the implementation by the majority of the interviewees. The table reports the comparison of the Influence Towers identified by MS/MT UPS group members from Changarawe and Idifu with the Influence Towers assigned by Trans SEC researchers involved in the MS/MT implementation involved in the ICS implementation (first and second rows below each actor); and the comparison of the Influence Towers assigned by MS/MT UPS group members from Changarawe with the values assigned by group members from Idifu (third and fourth row below each actor).

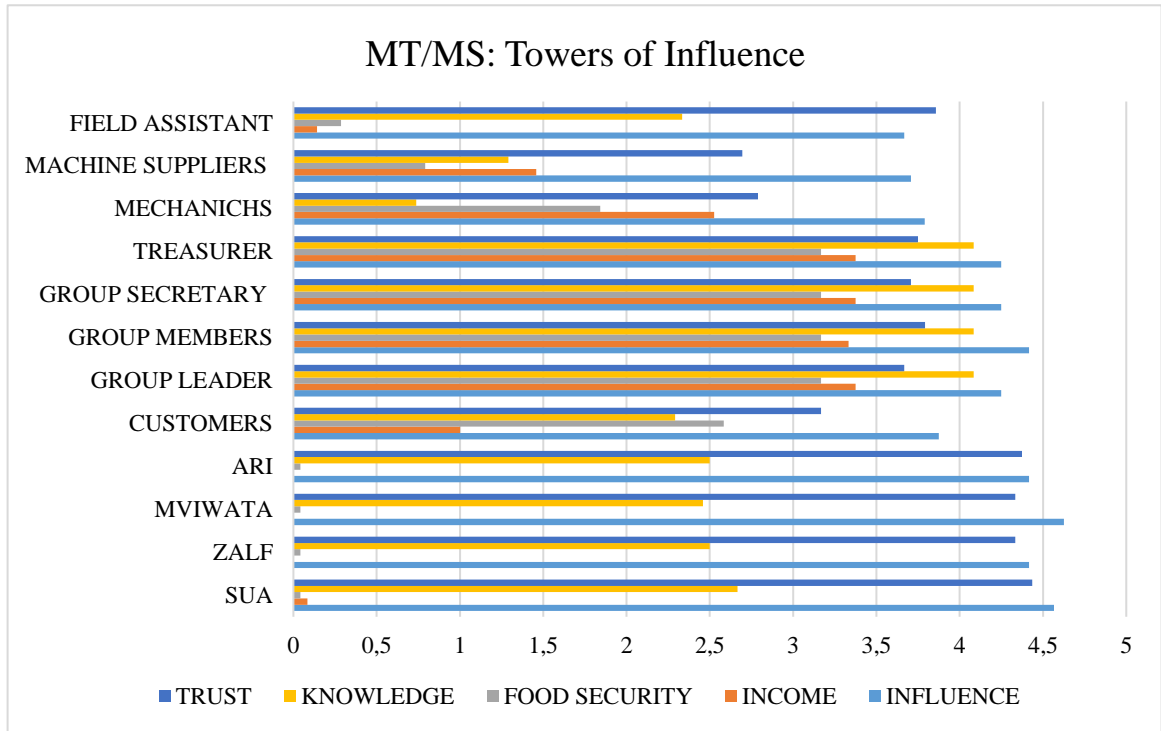


Figure 13: Maize Sheller / Millet Thresher UPS, Changarawe and Idifu: Towers of Influence.

Figure 13 describes the averages in the values attributed by all UPS group member (Changarawe and Idifu) and researcher to the different tower criteria.

5.2 Optimized Market-Oriented Storage in Ilakala (OMOS)



Figure 14: Improved storage bags

The majority of smallholders tend to sell their produce right after the harvest, when the food prices are lower. Storing efficiently the harvest until the lean season is, in fact, rather problematic, due to the great losses caused by pest and animal attacks. The storage of grains can be improved by using improved storage bags, which, in addition to reducing losses to animal and pest attacks, permit a longer storage of the produce, and consequently improve the households' food security, and increase the possibilities of selling the grains at a convenient price. Due to the low productivity in the semi-arid region, which makes harvests so scarce that not enough surplus is produced for consumption during the lean season, this UPS was implemented only in the sub-humid region, in the villages of Ilakala and Changarawe. The interviews were carried out in Ilakala.

The UPS focuses on testing four different types of storage with improved storage bags:

- Super bags (IRRI bags),
- Purdue Improved Cowpeas Storage (PICS) bags,

- Polypropylene bags, tested both with and without an insecticide treatment.

The bags differ by price, product retention time, and durability. The IRRI bags cost 10.000 Tsh (3.80€) each, and can store grains for five seasons. PICS bags cost 4000 Tsh (1.50€) each and can store the grains for up to three seasons. The polypropylene bags were the ones already used most frequently by farmers: they cost only 1000 Tsh (0.38€), but they last only for one season (Trans-SEC Fact sheet 7)

A second goal of the strategy was that of disseminating knowledge about the benefits of the improved storage bags to farmers not directly involved in the UPS groups. The strategy is part of a bigger package aimed at facilitating market-oriented storage. This package also involves the introduction of a Mobile Integrated Market Access System (m-IMAS) to link smallholders to food markets and food traders though (Trans-SEC UPS Fact sheet 9).

5.2.1 The OMOS Implementation Steps.

Like in the case of the improved processing machines (MS/MT) described above, in Ilakala the implementation of this strategy included an initial phase of planning. During this phase, the researchers from the major institutes involved in Trans SEC studied the CSS, screened possible UPS, and conducted various workshops with village members, with the purpose of identifying the major challenges connected to agriculture and food security, and of finding possible solutions. Optimized storage bags were found to be a promising method for upgrading the food value chain, and included in the final list of strategies to be implemented in the village. In Ilakala, the community was informed about the project and the arrival of researchers by the village extension officer and by village leaders and sub-leaders. The researchers conducted a baseline survey to obtain a better understanding of the households to be included in the UPS implementation.

Next, the two-day meeting to introduce the project took place. The UPS were explained, and the participants were asked to choose their favorite UPS, and form UPS groups for the implementation. The choice of this UPS was driven by the prospect of improving the storage and decreasing the post-harvest losses. According to the interviewees, unlike in the case of the other UPS, not many women chose to take part in OMOS, because it required lifting and

handling heavy bags. After the group formation, the group members selected a leader, a group secretary and a group treasurer.

The three types of bags to be used in OMOS were selected by the Trans-SEC researchers during a preliminary phase, before starting testing with the UPS group. The researchers also determined that the improved storage bags should be distributed to farmers at a discounted price. For this purpose, the “Innovation Fund”, was used. This fund covers the additional costs of UPS implementation and serve to facilitate the UPS uptake. The innovation funds allowed the provision of the improved storage bags at a lower price.

The ARI researchers distributed the improved storage bags among group members, and trained them on how to use the bags correctly to store the grains. After this, the actual trial phase began. Three parameters were tested: germination, insect damage, and grain weight. The opinion of the farmers on the improved storage bags’ performances and attributes were also assessed.

At the end of the testing, the UPS group members were convinced by the advantages of the improved storage bags. The IRRI and PICS bags showed the best performance during the testing phase. The improved storage bags were initially distributed under credit by Trans-SEC. However, the discovery of a more convenient bags’ provider led to change the type of improved storage bag distributed: Another program was in fact providing improved storage bags at a reduced price of 3000 Tsh (1.14€). The group members soon started employing the improved storage bags, and began spreading awareness about the benefits of these bags to other village members. The improved storage bags were also presented during farmer field days, in which the strategies were presented to neighboring villages, and became quickly popular in the neighboring villages too.

During the improved storage bags’ trials, the UPS group also met to organize group activities. These consisted principally in spreading awareness about the characteristics and advantages of the improved storage bags to the community. During the meetings, the UPS group also started writing a group constitution, which is an agreement over the major rules to be respected by group members. This was, however, never completed, since the group lost commitment to group activities, and stopped meeting regularly. The activities of the group

remained limited to selling the improved storage bags, which are provided by Trans-SEC, to the other farmers from the community and to farmers from nearby villages. The proceeds of the sales are then returned to the researchers through the field assistant.

Monitoring and impact assessments were carried out throughout the implementation process. Part of the monitoring consisted in checking who was using the improved storage bags, how many people paid for improved storage bags, and how frequently the improved storage bags were opened and closed. This usually happens at intervals of three months. ARI researchers took care of the technical sides of the trials, such as compiling reports on the improved storage bag conditions every three months and monitoring the improved storage bag use. The MVIWATA team dealt with the social aspects connected to the implementation of the strategy, such as organizing workshops, and how to form groups, and instructing the groups on how to write a constitution.

With the advice of the researchers, the UPS group also planned how to engage in different group activities. An idea of creating a shared storage facility for all the community to use was discussed. To gather the money necessary to build a granary, the group planned to start by cultivating together a field. This activity was, however, never put into practice, because of the reduced commitment to group activities.

Activities prospected in the future include: further promoting the UPS and registering the group in the list of business groups. The researchers plan to buy more improved storage bags to sell in the village, and to improve the link between the farmers and bag suppliers, and to create a business concept aimed at better linking the UPS groups to bag suppliers and markets. In addition to this, this UPS should be linked to the Mobile Integrated Market Access System (m-IMAS). The ultimate goal is scaling out the UPS for national outreach.

The central groups of actors identified by the interviewees are the UPS group members and the Trans-SEC researchers. Other actors which have been linked to the activities and the steps of the project are the bag suppliers, the community of Ilakala, and the members of other villages which were made aware of the benefits of the improved storage bags and which bought improved storage bags from Trans-SEC. The Trans-SEC field assistant is also important for mediating the improved storage bags testing and dissemination. Other actors

mentioned by some interviewees, but not considered relevant for the OMOS implementation at village level were: The village extension officer, the district extension officer, the village executive officer, the banks, TFC (Tanzania Federation of Cooperatives) and ACT (Agricultural Council of Tanzania). These latter are non-governmental organizations which in the Trans SEC project are responsible for the regional and national stakeholders' involvement (Trans- SEC deliverable 2.2.1).

Like the MS/MT implementation, the village members selected in the baseline survey were identified as a distinctive actor in the description of the initial implementation activities linked to the UPS selection. Except for these activities, they were not considered important for the UPS implementation.

The following figure shows the OMOS implementation steps. The representation replicates the configuration of a typical Process Net-Map interview.

The description of the OMOS implementation process by different stakeholder groups (researchers and UPS group members) does not differ significantly. The researchers, especially those involved in the implementation on field, describe more in the detail the activities connected to the improved storage bags' monitoring and testing and have a greater knowledge of initial planning phases and future activities. The UPS group members offered a closer viewpoint on the implementation activities in which they were involved. They describe in the detail each activity undertaken by the group.

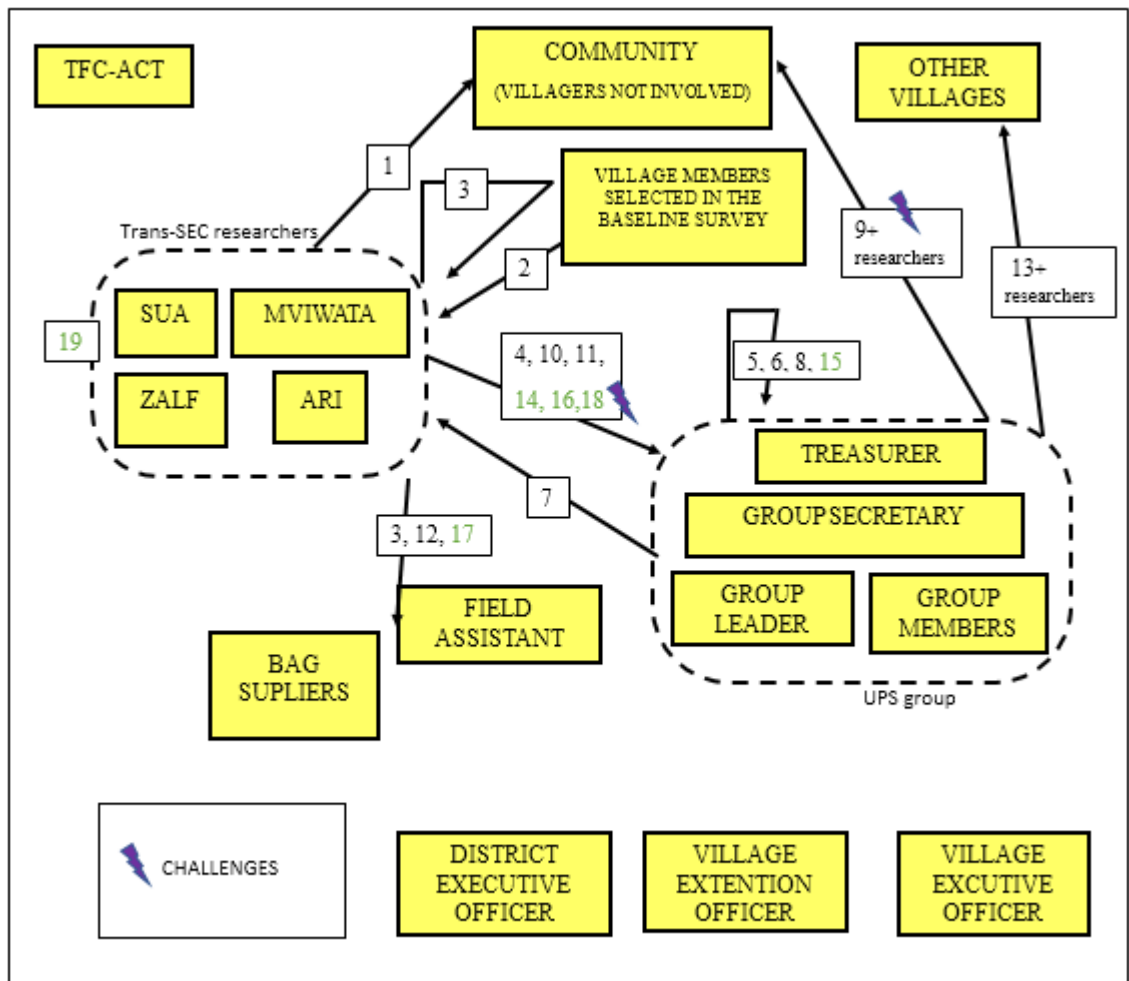


Figure 15: Optimized Market Oriented Storage UPS, Ilakala CSS: Summary of the Process Net-Maps

1. Understanding OMOS. Planning the implementation in the villages. Screening the CSS. Definition of the candidate UPS. Baseline survey.
2. Meeting with the project's participants. Presentation of the candidate UPS. UPS selection. Group formation and definition of roles.
3. Gathering supplementary information from bag suppliers. Identification of the improved storage bags. Buy bags, providing bags to ARI for selling in the CSS.
4. Training on group management and how to use the improved storage bags. Distributing the improved storage bags to group members.
5. Group meeting to discuss how to mobilize the community and organise the group. Discussion on group constitution.
6. Testing the improved storage bags.
7. Decision about improved storage bags.
8. Improved storage bags use .
9. Mobilization of the community. Spreading awareness about improved storage bags. Mobilization of other villages.
10. Distributing new improved storage bags .
11. Testing. Monitoring the efficiency of the bags. Additional trainings on bags' use.
12. Contacting bag companies for selling improved storage bags to group members or intermediaries.
13. Farmers filed days.

FUTURE ACTIVITIES

14. Buy more improved storage bags and sell them in the village.
15. Cultivate two acres of field, to gather the funds for constructing a storage facility for the community.
16. Group registration and opening a bank account.
17. Involving stockists. Developing a business Idea aimed at linking the farmers to suppliers.
18. linking OMOS to m-IMAS
19. Outscaling/upscaling

Figure 15 Continued

Figure 15 shows the summary of the OMOS implementation steps described by all interviewees. The representation replicates the configuration of a typical Process Net-Map interview

5.2.2 The Challenges encountered during the OMOS Implementation

The most frequent issue highlighted by group members is the lack of motivation to attend the group meetings and be active as a group. After the group formation, the farmers have met only few times as a group. The group has successfully tested the UPS, and there has been a consistent uptake of the improved bags in the community; however, the group does not meet frequently and is not active. This issue was discussed during the feedback round. The UPS group members point out that a lack of opportunities to get additional advantages other than those derived from the decreased post-harvest losses could be the key to understand the lack of engagement and low participation. They suggest that the other Trans-SEC UPS groups involved in business activities are more committed due to the income obtained from the implementation of the UPS. Moreover, they pointed out that missing a consistent group activity and a goal decreases their motivation to attend and organize meetings. The optimised bags are provided by Trans SEC researchers to the entire community, not only to their UPS group, and therefore they do not feel that they play an essential role in the implementation of this strategy. According to the group members, another obstacle to the group meetings is the distance: The group members live far from each other, and therefore communication is difficult.

“The challenge with this group is that people are thinking about the financial benefit, they are not thinking about the other benefits of this innovation: They are thinking about money, people are thinking about quick ways to get cash. This is perhaps why this group works like this.

“This is also a problem of other groups. People were coming in the beginning of the project thinking that at the end of the day they would get money to cover their needs, but they found out there is no money to be got, so they started to drop out from the groups.

“In the maize sheller group, people dropped out at first, but now always more people are interested in the group, because they see that the machine is working, and there is money coming in. Those who have money to pay the entry fee and the group shares can get a lot of benefit, but those who cannot pay the entry fee to join, the group cannot be part of it. People are not valuing the innovation, but possibility

to generate money. If there were any possibility to make money people would be more committed to group activities.

“It makes no sense for us to be a group, since the people who are not in the group can buy the bags for the same price. We gain just this knowledge, which serves only few times, and then is gone. If there is no flow of money, people will not be active.”

(Ilakala, feedback discussion round, March 2017.)

More challenges were mentioned by the researchers. One was the price of the improved storage bags. The farmers were willing to pay was 3000 Tsh (1.14€) per bag. The IRRRI bags, one of the improved storage bag types chosen for the implementation, costed 10,000 Tsh (3.80€), which was too expensive for the farmers, so the bag was subsidized through the Innovation Fund, and provided at the reduced price of 6000 Tsh (2.27€). The discovery of a new program providing similar improved storage bags at a subsidized price of 3000 Tsh (1.14€) was a major turning point.

A problem linked to the acquisition of the improved storage bags is creating a connection between farmers and bag suppliers. Since the demand for improved storage bags is not well established, involving suppliers in a direct contact with the farmers might prove to be a problem. The demand for improved storage bags is however increasing, and so the opportunities to link stockiest to the community.

Another challenge revealed by the experts was convincing the farmers of the benefits of the improved storage bags. The farmers were reluctant to pay for the more expensive improved storage bags initially. The researchers had to convince them by offering trials.

“Convincing the farmer to invest in the improved storage bags was challenging, but we encouraged them to try at least one improved storage bag, buying it for half the price. The next year he would come and buy four or more. Now, when we visit the field, many farmers are asking for these bags.” (Researcher, Kilosa March 2017)

5.2.3 The OMOS Success Stories

Despite the general perception of not obtaining adequate advantages, a perception which is motivated mainly by the impossibility of seeing direct results in terms of income from the strategy implementation, interviews with group members reveal changes in the perceptions and attitudes of the farmers. During the feedback discussion, when asked about the perceived changes brought about by the strategy, the interviewees mention new attitudes. These were not explained in the detail; however, it may be an interesting representation of changes in the perceptions, indirectly indicating the recognition of the advantages of the strategy and motivation to embrace new practices. In addition to this, the interviews with group members reveal how OMOS has positively changed their livelihoods and improved their economic condition.

“The strategy changed my mode of thinking. This year the rain was very unpredictable and when I planted the seeds, many of them died; thanks to the new bags I was not worried about finding new seedlings because I had more, safe at home.” (Feedback discussion, Ilakala, March 2017)

“We received financial benefits indirectly. The improved storage bags helped us save the food for a long time and then sell it at the right moment. Many of us were able to buy more goats and cows with the earning obtained by selling the harvest when the prices were more favorable. Thanks to the new bags one group member was even able to get married⁷.” (Feedback discussion, Ilakala, March 2017)

5.2.4 The OMOS Influence Towers

On average, the values of the Towers of Influence indicate that the most influential stakeholder groups are the UPS group members and the Trans-SEC researchers, particularly the ARI team, who had been more directly involved in the improved storage bags’ trials. Other actors perceived as influential are the bag suppliers and the community members.

⁷In Tanzania, as in many African cultures, the traditional customs for marriage require the groom to pay the bride price. This is a dowry consisting in money or property (most often livestock) transferred to the parents of the bride.

The group members' perception of the *Income* generated by the implementation of the UPS is low (on average 0.3 out of 5). This result mirrors the discussion on lack of motivation in engaging in group activities due to the missed business opportunities.

The Mann-Whitney U test identifies a great variance concerning the *Income* scores attributed to UPS group members ($p < 0.05$). The Trans-SEC researchers attribute higher levels of *Income* generated by the UPS to group members (on average 3.1). On the contrary, the UPS group members do not perceive any positive change in their *Income* (on average 0.8). This result might be due by a bias in the definition of *Income*: While the UPS group members consider *Income* as merely a revenue from an activity, the researchers tend to include in their definition of *Income* the potential increases derived by the savings generated from the decreased produce losses, and from the possibility to sell the produce later in the lean season at a higher price. When asked about the perceived changes attributed to the UPS implementation the farmers suggest that the strategy not only increased food security but also, their general household wellbeing. This confirms indirectly an improvement in the household's income.

“This project has change my life. Now I do not worry that the food in the bags will be destroyed anymore. My wife is happier, and we don't argue over money anymore.” (Farmer, Ilakala March 2017)

The UPS contribution to improving *Food Security* is perceived positively both by of Trans-SEC researchers and UPS group members: The UPS group members assigned themselves, on average, a *Food Security* score of 4.5 and the researchers assigned the UPS group members a score of, on average, 4.4. This holds also for the perceived level of *Knowledge* (on average 4.5 attributed by researchers and 4.3 attributed by UPS group members). This is, according to interviewees, due to the improved knowledge of storing techniques and of the improved storage bags' benefits. The levels of *Trust* attributed by the Trans-SEC researchers to UPS group members were, on average, slightly lower (2.9 against the 3.8 attributed by the UPS group members to their group). ($p < 0.05$).

When rating the Influence and *Trust* of researchers, the researchers attribute lower scores ($p < 0.05$) to the MVIWATA team (3.4 *Influence*; 3.3 *Trust*) in comparison to the UPS group

members (5.0 *Influence*; 4.8 *Trust*). This result may be linked to the lower involvement of MVIWATA team in the activities connected to this UPS in comparison to other UPS.

Table 3: Comparison of the OMOS Towers of Influence of the Researchers and the UPS group members from Ilakala. ⁸

	INFLUENCE			INCOME			FOOD SECURITY			KNOWLEDGE			TRUST		
	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D
SUA															
UPS group members from Ilakala	6	5.0	0.0	6	1.2	2.0	6	1.0	1.5	6	0.8	2.0	6	4.8	0.4
Researchers	8	4.5	0.8	8	0.3	0.7	8	0.1	0.4	8	2.9	2.0	8	3.7	1.4
ZALF															
UPS group members from Ilakala	6	5.0	0.0	6	1.2	2.0	6	1.0	1.5	6	0.8	2.0	6	4.8	0.4
Researchers	8	4.1	0.8	8	0.3	0.7	8	0.1	0.4	8	2.6	1.9	8	3.9	1.5
MVIWATA															
UPS group members from Ilakala	6	5.0 *	0.0	6	1.2	2.0	6	1.0	1.5	6	0.8	2.0	6	4.8 a	0.4
Researchers	8	3.4 *	1.3	8	0.3	0.7	8	0.1	0.4	8	2.1	1.9	8	3.3 b	1.2
ARI															
UPS group members from Ilakala	6	5.0	0.0	6	1.2	2.0	6	1.0	1.5	6	0.8	2.0	6	4.8	0.4
Researchers	8	4.4	0.7	8	0.3	0.7	8	0.1	0.4	8	2.6	1.8	8	3.5	1.3
COMMUNITY (Villagers not involved)															
UPS group members from Ilakala	6	3.3	1.5	6	0.8	2.0	6	3.3	1.9	6	2.3	1.8	6	2.8	0.8
Researchers	6	3.0	2.4	6	2.3	2.1	6	3.5	1.5	6	3.0	1.4	6	3.0	1.7
GROUP LEADER															
UPS group members from Ilakala	6	4.7	0.5	6	0.8 *	2.0	6	4.5	0.8	6	4.3	0.8	6	3.8	0.8
Researchers	8	4.3	0.9	8	3.1 *	1.5	8	4.4	0.9	8	4.5	0.8	8	2.9	1.1

⁸ N= number of Influence Towers

S. D= Standard Deviation

* = significantly different at $p \leq 0.05$; ** = significantly different at $p \leq 0.01$

GROUP MEMBERS															
UPS group members from Ilakala	6	4.7	0.5	6	0.8 *	2.0	6	4.5	0.8	6	4.3	0.8	6	3.8	0.8
Researchers	8	4.3	0.9	8	3.1 *	1.5	8	4.4	0.9	8	4.5	0.8	8	3.0	1.2
GROUP SECRETARY															
UPS group members from Ilakala	6	4.7	0.5	6	0.8 *	2.0	6	4.5	0.8	6	4.3	0.8	6	3.8	0.8
Researchers	8	4.3	0.9	8	3.1 *	1.5	8	4.4	0.9	8	4.5	0.8	8	3.0	1.2
TREASURER															
UPS group members from Ilakala	6	4.7	0.5	6	0.8 *	2.0	6	4.5	0.8	6	4.3	0.8	6	3.8	0.8
Researchers	8	4.3	0.9	8	3.1 *	1.5	8	4.4	0.9	8	4.5	0.8	8	3.0	1.2
FIELD ASSISTANT															
UPS group members from Ilakala	6	4.7	0.8	6	0.8	2.0	6	1.3	1.6	6	0.7	1.0	6	4.0	1.0
Researchers	5	3.8	2.2	5	0.0	0.0	4	1.3	1.9	4	3.8	1.0	4	3.8	1.0
BAG SUPLIERS															
UPS group members from Ilakala	6	4.7	0.8	6	3.3	1.0	6	2.5	2.0	6	0.0	0.0	3	0.9	1.2
Researchers	7	3.4	1.3	7	3.7	0.8	7	0.1	0.4	7	0.9	1.2	7	2.4	1.6

Table 3 above summarizes the results of the Influence Towers referring to the actors identified as important in the implementation by the majority of the interviewees. The table also reports the comparison of the Influence Towers assigned by OMOS UPS group members from Ilakala with the Influence Towers assigned by the Trans SEC researchers involved in the OMOS implementation.

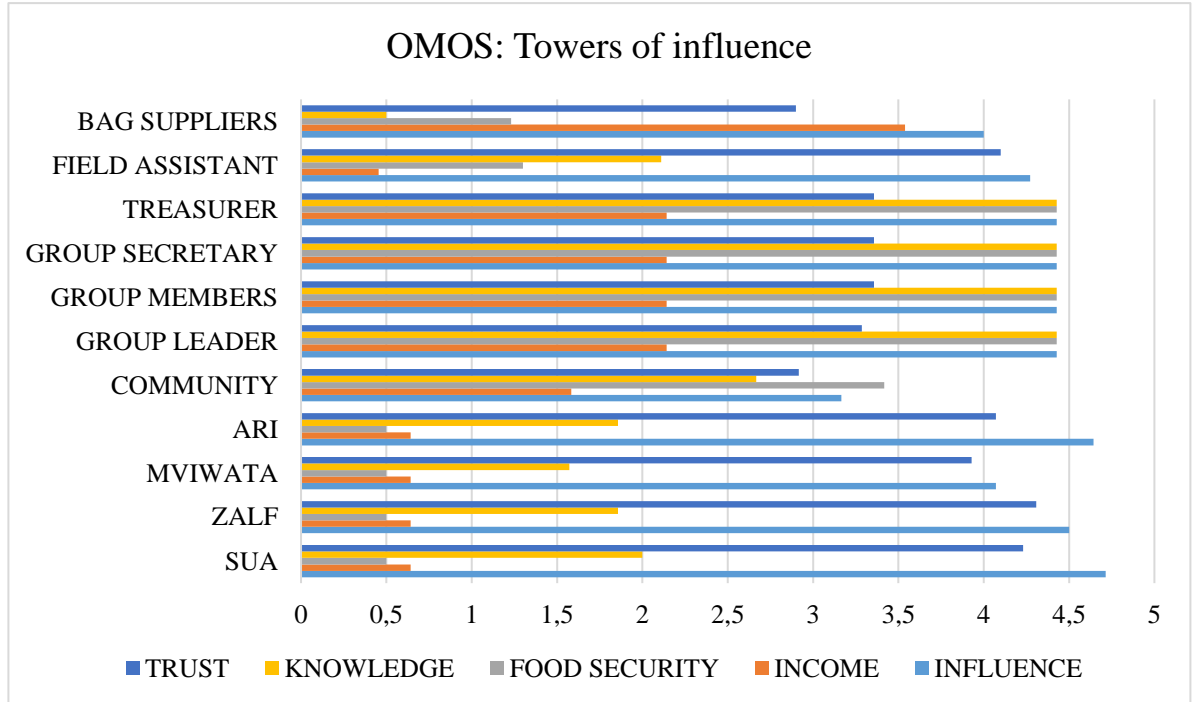


Figure 16: Optimized Market Oriented Storage UPS, Ilakala CSS: Towers of Influence.

Figure 16 describes the averages in the values attributed by UPS group member from Ilakala and researcher to the different tower criteria.

5.3 Improved Firewood Cooking Stoves in Idifu and Ilakala (ICS)



Figure 17: ICS, Idifu, March 2017

Improved Firewood Cooking Stoves is a strategy designed to improve the livelihoods of rural farmers by decreasing the quantity of wood used for their daily cooking activities. Especially in semi-arid regions, where the availability of wood is scarce and exploitation of woodland sources puts further pressure on the ecosystem balance, decreasing consumption of wood may bring consistent benefits. The stove is also meant to improve the quality of cooking by providing a better alternative to the traditional three-stone stoves. Three-stone stoves require greater use of firewood, require a longer cooking time, and lower the quality of the food cooked. The improved cooking stoves are built with local material and are based on existing traditional. This UPS has been tested in both the semi-arid and sub-humid region and involves training on stove construction and dissemination activities. Firstly, UPS groups were trained on how to construct improved stoves. Later, they constructed the stoves for interested clients, contributing to the dissemination of the strategy in the CSS and the nearby villages (Source: Trans-SEC Fact sheet 5).

5.3.1 The ICS Implementation Steps

As mentioned before, the implementation of the UPS in the CSS involved initial planning activities. The Trans-SEC researchers conducted workshops and various assessments to screen the CSS and the more promising UPS. They studied the challenges faced by smallholder farmer and the conditions for UPS implementation. The Improved Stove strategy was included in the final list of UPS to be implemented in the CSS. This strategy had been implemented in other projects in Tanzania, and was deemed a promising solution for addressing farmer needs in the CSS.

During the two-day meeting for UPS selection and UPS group formation, the improved stove strategy turned out to be very popular among participants. Many chose this strategy because of the perceived advantages of a quicker cooking time, reducing the quantity of firewood required, and decreasing the food exposure to smoke, which occurs often when using traditional three-stone stoves. In Idifu, around 60 people selected this strategy. This led to the formation of additional sub groups for the strategy implementation. In every UPS group, the group members selected their group leader, a group secretary, and a group treasurer. Every subgroup elected a subgroup leader.

After the group formation, the implementation of the strategy in the CSS began. Initially, capacity building training was provided. This included training on: Material needs, group management, firewood preparation and stove management. Firstly, some selected group members, the “trainers”, learned the technique of building stoves. Farmers skilled in stove construction were called from other Tanzanian villages where the improved stoves had been implemented, to teach to trainers. Later, the trainers taught the other group members how to construct stoves.

After the trainings, the stoves were built in the households of the group members. A trial of the test stoves was organized by the Trans-SEC researchers. The improved stove and the traditional three-stone stove were simultaneously used and the quality of the food cooked and stoves’ efficiency were compared. The trial demonstrated the superiority of the improved stoves. The food cooked with the improved stove tasted better and was not ruined by smoke. Moreover, the improved stoves allowed shorter cooking times.

After the trial, the group members promoted the new stoves in the community. They spread knowledge on how the stoves work and about their benefits for the environment and for improving the cooking. The community members were soon interested in this solution and the group members started building stoves for interested clients. The Trans-SEC researchers incentivized the first stove constructions by promising rewards for the number of stoves constructed.

To construct stoves for clients, the group members would usually gather in small groups of three to four and go together to the client household to build the stove. The clients are asked to provide the construction materials: water, clay, iron and bricks. The cost of each stove is 3000 Tsh (1.14€) in Ilakala. This price was considered too high for the clients in the semiarid region, and therefore reduced to 2000 Tsh (0.76€). The researchers provided the tools to construct the stoves and distributed them in the sub groups.

Soon after starting building stoves for clients, the stoves were modified by the group members themselves. They were adapted to the clients' needs and adjustments were made to employ cheaper materials available locally. In particular, the dimensions of the stoves were reduced to permit faster heating, and consequently faster cooking times.

The improved stoves were presented to other villages during the farmer field days organized in the CSS.

The researchers offered, throughout the implementation, additional training on business management and financing and on group management. Moreover, they conducted monitoring missions to assess the uptake and of stoves, and conducted various impact assessments.

The groups would meet monthly. During the first meeting the group constitution was written. Here different aspects of the UPS group organization were defined. These included the modalities of group activities, the conditions to become part of the group, management group earnings, and the terms of leadership election. The group was also registered in the official list of entrepreneurial groups. During the monthly meetings, different aspects of the activities were discussed.

The UPS groups in both regions decided, upon recommendation by researchers, to engage in extra group activities beside the construction of stoves. The farmers of Ilakala are currently engaged in cultivating a cotton field. The proceeds will be invested in other group activities. In Idifu, the idea is to start a business of raising chickens. The activity has not started yet, because of the unfavorable weather conditions which prevent group members from engaging in activities outside their household.

Future steps include out scaling the strategy to other villages, at the district and country levels. This includes understanding the best ways to disseminate information about the stove. There is a potential demand for this strategy in many areas in Tanzania. For instance, the strategy was requested to be implemented in a refugee camp located close to a forest across the border with Uganda.

The central groups of actors identified by the interviewees are the UPS group members and the Trans-SEC researchers. Within the UPS group members cluster, the trainers also referred to by some interviewees as stove constructors were the group members who were first trained on how to construct improved stoves. Other actors which have been linked to the activities and the steps of the project are the clients from the CSS and from other villages for whom the UPS groups construct stoves, and the Trans-SEC field assistant. Other actors mentioned by some interviewees, but not considered relevant for the ICS implementation were: The village extension officer, the district extension officer, the village executive officer, the banks, the TFC (Tanzania Federation of Cooperatives) and ACT (Agricultural Council of Tanzania). These latter are non-governmental organizations which in the Trans SEC project are responsible for the regional and national stakeholders' involvement (Trans- SEC deliverable 2.2.1).

Like for the implementation of the other UPS, the village members selected in the baseline survey were identified as a distinctive actor in the description of the initial activities of UPS selection. Except for these activities, they were not considered important during the implementation.

No consistent differences have emerged in the activities described by the interviewees from the different CSS. The large size of the ICS UPS group in Idifu led to the formation of a

greater number of subgroups for the stove construction in comparison to Ilakala. Nonetheless, the sequence of implementation steps was not changed.

The description of the MS/MT implementation process by different stakeholder groups (researchers and UPS group members) does not differ significantly. The researchers are more knowledgeable about the implementation process as a whole, including the initial planning activities and future steps. On the other hand, the UPS group members are better informed about the implementation phase and the constraints encountered and activities undertaken to overcome the constraints.

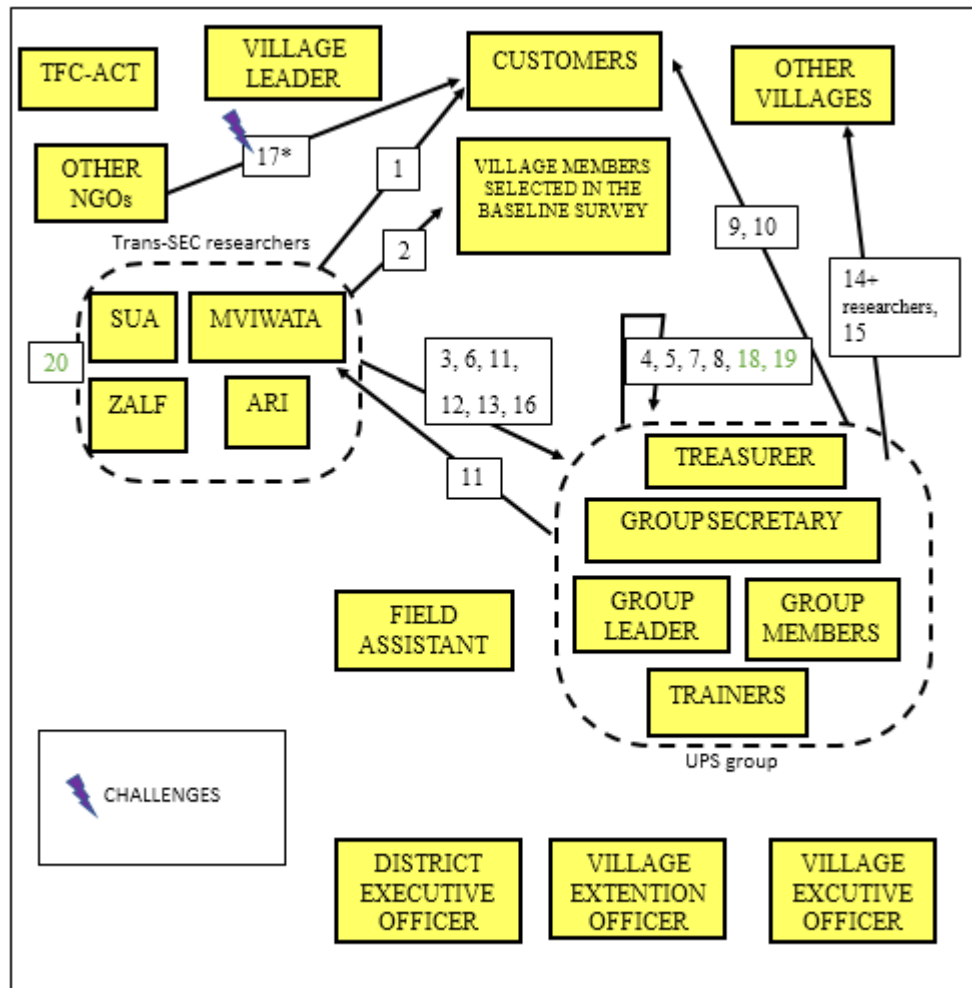



Figure 18: Improved Cooking Stoves, Idifu and Ilakala: Summary of the Process Net-Maps

1. villages. Screening the CSS. Definition of the candidate UPS. Baseline survey.
2. Meeting with the project's participants. Presentation of the candidate UPS. UPS selection. Group formation and definition of roles.
3. Training on capacity building and how to construct stoves. Contact trainers. Training the trainers.
4. The trainers trained other group members.
5. Building stoves for group members.
6. Cooking day to test the stoves.
7. Formation of subgroups.
8. Organization of group meetings. Design of group constitution.
9. Spreading awareness about the stoves in the community.
10. Construction of stoves for customers. Stoves' adaptation.
11. Group registration.
12. Training on financing and entrepreneurship.
13. Monitoring missions.
14. Farmer field days.
15. Construction of stoves in other villages.
16. Impact assessment mission.
17. Other NGOs started building stoves * 

FUTURE ACTIVITIES

18. Group farming.
19. Improving the stove.
20. Scaling out.

* It is not clear when during the implementation other NGOs started constructing stoves in the CSS

Figure 18 Continued

Figure 18 shows the summary of the ICS implementation steps described by all interviewees. The representation replicates the configuration of a typical Process Net-Map interview.

5.3.2 The Challenges encountered during the ICS implementation

Not many significant challenges have occurred during the implementation of this strategy. Soon, the group members have learned how to construct stoves and have also contributed to introducing further improvements to the stoves. For instance, the height of the stove has been reduced to permit a faster cooking. The UPS group have also experimented the use of local materials, which have answered the problem of scarcity of materials and reduced the costs of making the stove.

“We have also taught something to the researchers. We have taught them to make the stove smaller to fasten the heating” (Group member, Ilakala, March 2017)

In the semi-arid area, this strategy has become particularly popular. The tough semi-arid climate, does not permit vegetation to grow as well as in the sub humid area. There is only one rainy season per year which lasts approximately three months. For the longer part of the year the landscape is very dry, with the few bushes and trees are drained. The inhabitants of this region are poorer and more vulnerable to climate change and therefore more sensible to solutions, such as the improved cooking stoves, aimed at coping with the harsh climatic conditions and optimizing water and resources. This could explain why the uptake of the strategy in this region was bigger than in the sub humid region. Reducing the firewood requirements affects positively the landscape and the consequently people livelihoods.

The strategy appears to be popular also among the programs of other research and development projects and NGOs. Although Tanzania regulation on development project does not allow organization to implement similar programs and innovations in the same locations among the same population, in both villages other research and development project had implemented similar stoves while the Trans-SEC improved stove was being implemented. Although the stoves constructed by other organizations were very similar to the Trans-SEC stoves, the modalities of implementation were different. In Ilakala, according to the interviewees' tales, the stoves constructed by the other organization were built with costly materials and did not involve additional training on stove construction. In Idifu, a second organization trained farmers in the improved stove construction and payed them 10000 Tsh, to construct the stoves in village households. The activities of the other organizations influence at a certain extent the implementation of the Trans-SEC improved stoves.

“When the new NGO came in the village and started constructing stoves for free, the other people of the village run to them to get free stoves. Our activities were suddenly shut down.”(Group member, Idifu, March 2017)

“Yes, there is another NGO constructing stoves, but their program was brief and they build a stove which is very expensive. Our stove is cheaper.”(Group member, Ilakala, March 2017)

Outsiders also seem to be interested in the business opportunities offered by this strategy. An interviewee refers that some members of the community have been approached by constructors not belonging to the Trans-SEC UPS group.

“Someone came to us complaining that the stove we build was falling apart. We asked them who built the stove. They named someone not from the village, who is not part of the group.”(Group member, Idifu, March 2017)

Other minor issues are: Decreased interest in the activity of the group, need of additional trainings, transportation, and problems connected to the interaction with the clients. After the initial enthusiasm, the group activities and meetings became less frequent. As referred by the group members during the interviews, the reason for this might be the unfavorable weather condition which also affects water availability for constructing the stoves. Especially in the semi-arid region the drought affects everyone and people think about themselves and their family first. Another reason affecting the group participation might be the lack of potential clients in the nearby area. The improved stoves have been constructed in many households in the CSS and nearby villages. Possibilities of further disseminating the strategy depend on the demand from other villages. For this purpose, transportation is also a limitation. The villages are isolated and the means of transport are costly.

“Another problem is the transportation, if only we could have bike we would be able to go construct stoves faraway.” (Group Member, Idifu, March 2017)

In addition to this, poverty worsen by unfavorable weather condition makes even the small price of the stove, which is 3000 Tsh in Ilakala and 2000 in Tsh in Idifu, matters for the household budget.

In both regions, some group members recall that learning how to construct the stove has been difficult some group members and recommend additional training or a repetition of the training. In Idifu, it was pointed out that the group trainers are more knowledgeable on constructing stoves and more efficient than other group members. This statement however, has been denied by the majority of group members during the feedback discussion.

“There is a problem in learning some people are slow learners and some people learn quicker. This was a challenge but slowly everybody learned.”(Group member Ilakala, March 2017)

Another complaint reported in both villages is a lack of trust in clients. The community members were initially reluctant to pay for the construction of stove, they would have rather preferred receiving the stove for free. This attitude is also noticed in interactions with clients. Stove constructors in both CSS report meeting clients unwilling to pay the stove construction and or, to provide the requested construction materials.

“We ask the clients to prepare the materials for the construction. However often we find that the clients have not prepared any material. They say that we are the experts and we should build the stove and know the correct materials.”(Group member, Ilakala, March 2017)

The perception of the outcomes of this strategy is however in both regions positive. The UPS group are optimistic about the prospects of the group.

“When the Trans-SEC project is over we will still continue this strategy, we will still continue building stoves.”(Group Member, Ilakala March 2017)

5.3.3 The ICS Success Stories

The implementation of this strategy has triggered a change in the perceptions of the participants. They claim to be motivated to continue the group activities after the project end

“The strategy and its implementation changed our life. It gave us the chance to meet different people from different countries and to experiment different ideas. These are a lot of changes. This makes me think that change is possible”. (Feedback discussion, Idifu, March 2017)

“This strategy has a future because it involves learning practical skills, which will be handed down to the future generations. It is something that never dies but remains in people’s lives” (Feedback discussion, Idifu, March 2017)

“I perceive how there has been a change brought about by the strategy in terms of time savings. Since we now spend less time cooking and collecting firewood, we have more time to dedicate to other activities. This is very beneficial because we can produce a lot of things in the field” (Feedback discussion, Ilakala, March 2017)

How are you going to continue with the strategy once the project is finished?

“This strategy has a future. We have already established another project, the group farming. After finishing the group farming we may start a chicken keeping activity and invest and go construct stoves in other villages. We are already mentally prepared for the future” (Feedback discussion, Ilakala, March 2017)

5.3.4 The ICS Influence Towers

The averages of the towers of *Influence* indicated that the most influential stakeholder groups are UPS group members and Trans-SEC researchers. Other actors perceived as influential are the Trans-SEC field assistant and community members and clients from other villages.

On average, the levels of *Income* and *Food security* attributed to group members are middle. The comparison of the towers built by group members and the towers built by experts verifies a variance in the perception of *Food security* attributed to group members ($p < 0.01$) and *Knowledge* ($p < 0.01$) attributed to Trans-SEC researchers. In particular, the Trans-SEC researchers tend to attribute higher scores to the *Food security* improvement to the UPS group members (on average 4.0), in comparison to UPS group members (on average 2.5). Likewise, the UPS group do not recognize any *Knowledge* that the Trans-SEC researcher could profit out of the implementation of the strategy. On the opposite side, researchers claim to be

learning a lot from the implementation of this strategy (on average 4.5). Again, the reason for this discrepancy could be the difference understanding of *Food security* and *Knowledge*. The UPS group members when ranking *Food security* tend to consider only food availability aspect which is not directly targeted by this strategy. On the opposite, the researchers may include food quality aspects when ranking food security among actors. Similarly, the group members convey that the researchers are teaching them and therefore they are not learning. On the opposite side, researchers claim to be learning a lot from the implementation of this strategy because they may include additional aspects in their definition of *Knowledge*.

A comparison between the regions does not indicate any significant difference in the attribution of actors' Influence Towers. The only observable difference concerns the different *Influence* and *Knowledge* attributed to the field assistant. The UPS group members in Ilakala attribute higher *Influence* and *Knowledge* to the field assistant (on average: *Influence* 5.0; *Knowledge* 3.6) in comparison to the UPS group members in Idifu (on average: *Influence* 3.6; *Knowledge* 0.3).

Table 4: Comparison of the ICS Towers of Influence of the Researchers and all UPS group members, and of the UPS group members from Idifu and Ilakala.⁹

	INFLUENCE			INCOME			FOOD SECURITY			KNOWLEDGE			TRUST		
	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D
SUA															
UPS group members (Idifu and Ilakala)	14	4.9	0.4	14	0.0	0.0	14	0.0	0.0	14	0.9 **	1.6	14	4.8	0.6
Researchers	6	4.7	0.5	6	0.8	2.0	6	0.0	0.0	6	4.5 **	0.5	6	4.7	0.5
UPS group members from Idifu	7	4.7	0.5	7	0.0	0.0	7	0.0	0.0	7	1.1	2.0	7	4.6	0.8
UPS group members from Ilakala	7	5.0	0.0	7	0.0	0.0	7	0.0	0.0	7	0.6	1.1	7	5.0	0.0
ZALF															
UPS group members (Idifu and Ilakala)	14	4.9	0.4	14	0.0	0.0	14	0.0	0.0	14	0.9 **	1.6	14	4.8	0.6
Researchers	6	5.0	0.0	6	0.8	2.0	6	0.0	0.0	6	4.8 **	0.4	6	5.0	0.0
UPS group members from Idifu	7	4.7	0.5	7	0.0	0.0	7	0.0	0.0	7	1.1	2.0	7	4.6	0.8
UPS group members from Ilakala	7	5.0	0.0	7	0.0	0.0	7	0.0	0.0	7	0.6	1.1	7	5.0	0.0
MVIWATA															
UPS group members (Idifu and Ilakala)	14	4.9	0.4	14	0.0	0.0	14	0.0	0.0	14	0.9 **	1.6	14	4.8	0.6
Researchers	6	4.0	1.3	6	0.8	2.0	6	0.0	0.0	6	4.3 **	1.0	6	4.8	0.4
UPS group members from Idifu	7	4.7	0.5	7	0.0	0.0	7	0.0	0.0	7	1.1	2.0	7	4.6	0.8
UPS group members from Ilakala	7	5.0	0.0	7	0.0	0.0	7	0.0	0.0	7	0.6	1.1	7	5.0	0.0
ARI															
UPS group members (Idifu and Ilakala)	14	4.9	0.4	14	0.0	0.0	14	0.0	0.0	14	0.9 **	1.6	14	4.8	0.6
Researchers	6	4.3	0.8	6	0.8	2.0	6	0.0	0.0	6	4.5 **	0.5	6	4.7	0.5
UPS group members from Idifu	7	4.7	0.5	7	0.0	0.0	7	0.0	0.0	7	1.1	2.0	7	4.6	0.8
UPS group members from Ilakala	7	5.0	0.0	7	0.0	0.0	7	0.0	0.0	7	0.6	1.1	7	5.0	0.0

⁹ N= number of Influence Towers

S. D= Standard Deviation

* = significantly different at $p \leq 0.05$; ** = significantly different at $p \leq 0.01$

	INFLUENCE			INCOME			FOOD SECURITY			KNOWLEDGE			TRUST		
	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D
CUSTOMERS¹⁰ FROM ILAKALA															
UPS group members (Idifu and Ilakala)	14	3.9	1.2	14	0.1	0.5	14	0.2 **	0.8	14	2.3	1.0	14	3.4	1.0
Researchers	6	3.5	1.5	6	0.8	1.3	6	2.2 **	1.9	6	3.5	1.0	6	3.7	1.0
UPS group members from Idifu	7	4.1	1.2	7	0.0	0.0	7	0.0	0.0	7	1.9	1.2	7	3.9	0.7
UPS group members from Ilakala	7	3.6	1.1	7	0.3	0.8	7	0.4	1.1	7	2.7	0.5	7	2.9	1.1
GROUP LEADER															
UPS group members (Idifu and Ilakala)	14	4.7	0.7	14	2.7	0.6	14	2.4 **	1.0	14	4.4	1.1	14	4.6	0.6
Researchers	6	4.7	0.5	6	3.8	1.2	6	4.0 **	0.9	6	4.8	0.4	6	4.5	0.8
UPS group members from Idifu	7	4.4	1.0	7	2.7	0.8	7	2.3	1.1	7	4.0	1.4	7	4.7	0.5
UPS group members from Ilakala	7	5.0	0.0	7	2.7	0.5	7	2.6	1.0	7	4.7	0.5	7	4.4	0.8
GROUP MEMBERS															
UPS group members (Idifu and Ilakala)	14	4.7	0.7	14	2.7	0.6	14	2.4 **	1.0	14	4.4	1.1	14	4.6	0.6
Researchers	6	4.7	0.5	6	3.8	1.2	6	4.0 **	0.9	6	4.8	0.4	6	4.7	0.5
UPS group members from Idifu	7	4.4	1.0	7	2.7	0.8	7	2.3	1.1	7	4.0	1.4	7	4.7	0.5
UPS group members from Ilakala	7	5.0	0.0	7	2.7	0.5	7	2.6	1.0	7	4.7	0.5	7	4.4	0.8
GROUP SECRETARY															
UPS group members (Idifu and Ilakala)	14	4.7	0.7	14	2.7	0.6	14	2.4 **	1.0	14	4.4	1.1	14	4.6	0.6
Researchers	6	4.7	0.5	6	3.8	1.2	6	4.0 **	0.9	6	4.8	0.4	6	4.7	0.5
UPS group members from Idifu	7	4.4	1.0	7	2.7	0.8	7	2.3	1.1	7	4.0	1.4	7	4.7	0.5
UPS group members from Ilakala	7	5.0	0.0	7	2.7	0.5	7	2.6	1.0	7	4.7	0.5	7	4.4	0.8
TREASURER															
UPS group members (Idifu and Ilakala)	14	4.7	0.7	14	2.7	0.6	14	2.4 **	1.0	14	4.4	1.1	14	4.6	0.6
Researchers	6	4.7	0.5	6	3.8	1.2	6	4.0 **	0.9	6	4.8	0.4	6	4.7	0.5
UPS group members from Idifu	7	4.4	1.0	7	2.7	0.8	7	2.3	1.1	7	4.0	1.4	7	4.7	0.5

¹⁰ The clients to for whom the UPS group members construct the stoves

	INFLUENCE			INCOME			FOOD SECURITY			KNOWLEDGE			TRUST		
	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D	N	Mean	S. D
UPS group members from Ilakala	7	5.0	0.0	7	2.7	0.5	7	2.6	1.0	7	4.7	0.5	7	4.4	0.8
TRAINERS															
UPS group members (Idifu and Ilakala)	14	4.7	0.7	14	2.7	0.6	14	2.5 **	1.2	14	4.4	1.1	14	4.6	0.6
Researchers	6	4.7	0.5	6	3.8	1.2	6	4.2 **	0.8	6	4.7	0.8	6	4.7	0.5
UPS group members from Idifu	7	4.4	1.0	7	2.7	0.8	7	2.3	1.1	7	4.0	1.4	7	4.7	0.5
UPS group members from Ilakala	7	5.0	0.0	7	2.7	0.5	7	2.6	1.0	7	4.7	0.5	7	4.4	0.8
FIELD ASSISTANT															
UPS group members (Idifu and Ilakala)	14	4.3	1.1	14	0.0	0.0	14	0.0	0.0	14	1.9	2.2	11	4.2	1.1
Researchers	6	3.8	1.2	6	0.7	1.6	6	0.2	0.4	6	4.3	0.8	5	3.8	1.3
UPS group members from Idifu	7	3.6 *	1.1	7	0.0	0.0	7	0.0	0.0	7	0.3 *	0.8	7	3.8	1.0
UPS group members from Ilakala	7	5.0 *	0.0	7	0.0	0.0	7	0.0	0.0	7	3.6 *	1.9	7	4.6	1.1
CUSTOMERS FROM OTHER VILLAGES															
UPS group members (Idifu and Ilakala)	11	2.3	0.9	12	0.0	0.0	11	0.0	0.0	12	1.2	1.1	4	2.1	1.5
Researchers	5	2.6	1.1	5	0.2	0.4	5	0.2	0.4	5	1.8	1.9	5	1.6	1.3
UPS group members from Idifu	7	2.1	0.9	7	0.0	0.0	7	0.0	0.0	7	0.9	1.2	4	1.8	1.7
UPS group members from Ilakala	7	2.5	1.0	5	0.0	0.0	4	0.0	0.0	3	1.8	0.5	3	2.7	1.2

Table 4 summarizes the results of the Influence Towers referring to the actors identified as important in the implementation by the majority of the interviewees. The table also reports the comparison of the Influence Towers identified by ICS UPS group members from Idifu and Ilakala with the Influence Towers assigned by Trans SEC researchers involved in the ICS implementation (first and second rows below each actor); and the comparison of the Influence Towers assigned by ICS UPS group members from Idifu with the values assigned by group members from Ilakala (third and fourth row below each actor).

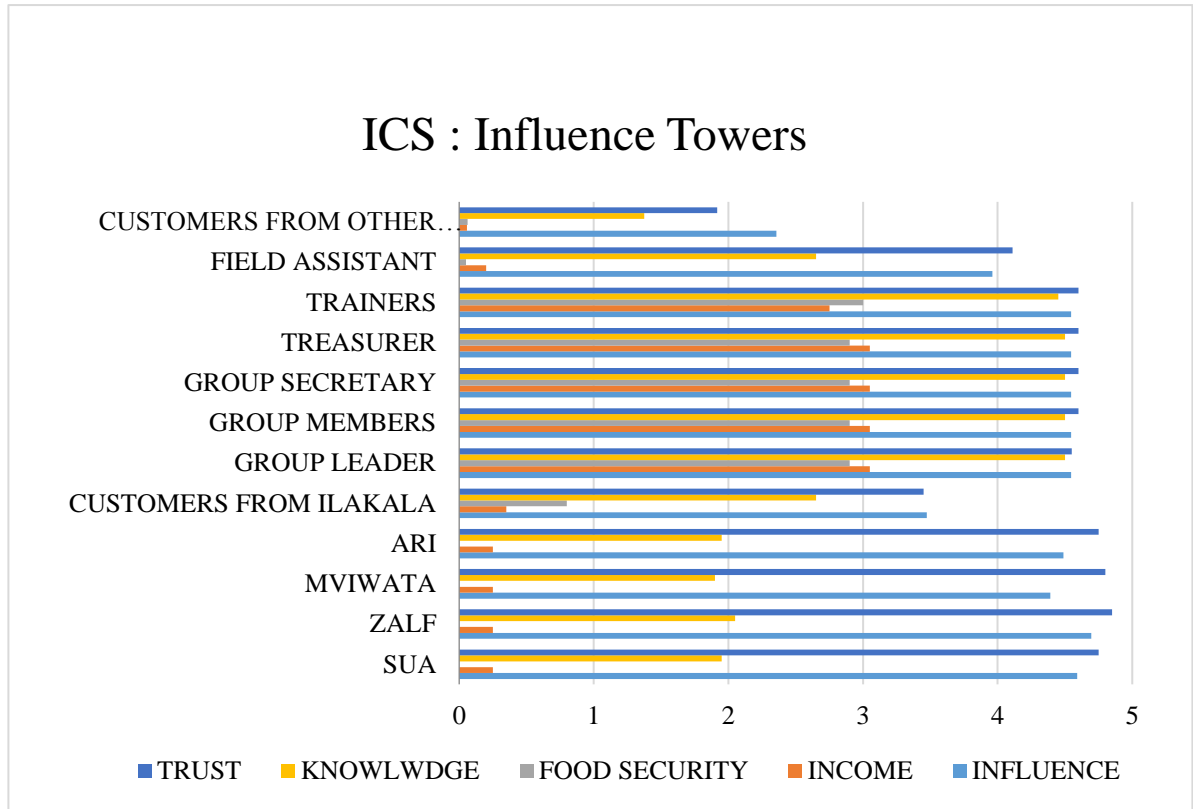


Figure 19: Improved Cooking Stoves, Idifu and Ilakala: Towers of Influence. The averages in the values attributed by the group member and researcher interviewees to the different tower criteria .

Figure 19 describes the averages in the values attributed by UPS group member from Ilakala and Idifu and by the researcher to the different tower criteria.

Chapter 6. Discussion and Conclusions

In this chapter, I will discuss the findings summarized in chapter 5 and draw conclusions. The factors influencing the UPS implementation, the challenges and the successes encountered will be analyzed in greater detail. I will discuss the results through the lenses of the processes facilitating the creation of a space for change, which have been reviewed in chapter 3. I will also look at how the participatory action research (PAR) was carried out in the context of the specific UPS implementation. The main focus is linking to the objectives of this research, which are: Looking at how the implementation of each UPS unfolded, defining challenges and successes, and identifying the differences and similarities among CSS in different climatic regions. Given the specific nature of each UPS implementation and the diversity of the challenges encountered, each UPS will be discussed individually. The differences and the similarities emerged in the UPS implementation in the different regions are summarized in section 6.4. In doing this, I will consider not only the comparison among the scores of the influence towers in the CSS, but also the similarities and differences in the implementation and in the challenges and successes encountered. Section 6.5 and 6.6 are dedicated to reflecting upon Participatory Action Research Approach and to suggest ideas for further research. In section 6.7 a summary of the challenges of every strategy and recommendations are presented. The conclusions of this research and are drawn in section 6.8.

6.1 The Maize Sheller and Millet Thresher (MS/MT) Implementation

The introduction of the Maize Sheller in Changarawe and of the Millet Thresher in Idifu generally followed the guidelines set up in advance in the Trans-SEC participatory framework. Like the other UPS, the selection of the MS and MT strategy is the result of the process of screening the farmers' needs, the available options and building on the farmers' knowledge and preferences. These activities, which also involved exploring the farmers' perspectives, values, problems and aspirations, helped articulating the farmers' demand and facilitating the learning. These processes are considered important for the creation of

opportunities for change (Leeuwis and Aarts, 2011 p. 32). Engaging the farmers in the problem definition and cooperating with them, fostering mutual learning and participation are key elements in PAR (Gonsalves et al. 2005, p. 20-21).

The initial planning phase was a good starting point for the implementation of the UPS. The UPS matched the farmers' needs and preferences. The process of meeting the farmers' preferences was further improved upon by giving the participants the opportunity to choose, among the available UPS possibilities, the UPS which would best fulfill their interests. This step, for this specific UPS, was challenged by the disagreement between farmers and researchers on who would have to cover the cost of purchasing the machine. The disagreement was negotiated and a compromise was reached. This event led to the creation of the Innovation Fund, a fund established to cover the additional costs of UPS implementation. The machines were purchased with the Innovation Fund and the UPS group members took responsibility to repay to the UPS half of the entire cost of the machines. The relationship between UPS group members and researchers was re-defined by the event. The researchers assumed the role of the MS/MT sponsors to whom the UPS group members would have to re repay the loan for purchasing the machine.

The implementation of MS and MT consisted in providing shelling and threshing services to clients and testing the machine used in the CSS. The UPS was run by the UPS group members. The implementation involved two interactive activities: On the one hand, the provision of processing services to clients, which was autonomously organized by the UPS groups, advised by researchers, on the other hand, the set of workshops and trainings provided by the researchers to facilitate the group work.

The selection process had a great influence on the outcome of MS and MT implementation. The selection of the machine was carried out in a participative way. The researchers informed the group members about the characteristics of the machine and the group members made an informed decision accordingly. Once the machines were delivered and put into use, the UPS group members found them more difficult to handle than expected. Moreover, they were difficult to move from one location to another and presented technical problems, which brought to their frequent failure. While this last issue may not be directly attributable to a

wrong machine selection process, but rather to the characteristics of the machine, for which the machine suppliers should be to blame, the other machine issues indicate that in the process of choosing the machine the UPS group's capabilities and needs may have been wrongly estimated.

Despite the technical challenges, the operationalization of the UPS has been implemented in the CSS bringing benefits to the UPS group members. The UPS group members have also autonomously contributed to improving the transportation issues by the introduction of improvements to facilitate the machines' movement from household to household. This indicates motivation in pursuing the strategy and determination to solve the challenges encountered.

Looking at the MS/MT implementation through the lens of PAR we can observe that a consistent degree of participant empowerment has occurred. The UPS group members participated to the decision-making process and actively decided the modalities of the UPS operationalization. During the phases implementation, which involved the choice of the strategies, the formation of the groups and the UPS testing, the UPS group members were actively engaged in the management concerning the issues that affected them directly. They were involved in the definition of the strategies, they autonomously organized their UPS groups, and they managed the MS/MT without external influence, apart for the advice provided by the researchers. This implies a step above the simple information and consultation levels of participation to higher empowerment of the participant (Arnstein 1969). Building on partnership and participation and creating the conditions for the stakeholders to become co-researchers is an important element for a good action research (Bradbury-Huang, 2010 p. 102). We may say that the group members have a sense of responsibility for the outcome of the strategy and therefore the implementation of the strategy has enabled ownership and increased the sustainability (Khan and Chovanec, 2010 p. 36).

In spite of the high participation, the challenges encountered indicate that the process of empowerment still may be improved, for instance by improving the UPS groups' capacity to make the right choices and their ability to communicate and link to external actors and networks, such as machine suppliers. Although the process of machine selection was participative, the UPS group members selected machines which turned out to be difficult for

them to handle. In this case, a further reflection on the drivers of this challenge may be important. Reflexivity is another important element of the process of learning from experience embraced by action research (Bradbury-Huang, 2010 p. 98).

The participatory design of the project and the modalities of the MS/MT implementation have also favored the learning. The interviewees were convinced that they had learned from the UPS implementation. The UPS group members learned "how to do things better" (single loop learning) (van Mierlo et al., 2010 p. 321; see chapter 3) by engaging in the trial of new processing techniques and by working together as a group. Signs of double loop learning, which is the learning about the variables governing a situation (Tosey et al., 2012 p. 292; van Mierlo et al., 2010 p. 321, see chapter 3), may also be found in the storylines of the interviewees. These are mainly linked to the opportunities offered by the implementation of business activities, which imply reflection on new ways of improving the household income and new opportunities of income outside the traditional farming activities. For instance, some UPS group members claim to be more motivated to seek new solutions to improve their income, although they did not provide any concrete example.

6.1.1 The Challenges Emerged During the MS/MT Implementation

Three main challenges were encountered during the MS/MT operationalization phase: Initial conflicts concerning the attribution of the costs of purchasing the machines, frequent machine failures and transport problems, and some cases of underreporting of the amount of harvest processed.

Disagreement on the attribution of the costs of purchasing the machines

The initial disagreement on who should purchase the machines may have originated, as the UPS group members suggest, in the marginalized position of the farmers and their consequent impossibility or reluctance to use their savings for something other than meeting their basic household requirements. The reluctance to invest and take a greater stake in the UPS implementation may, however, also lay in the attitude of relying on others and be dependent on social assistance without creating the conditions for the farmers to share

responsibility for the project's fate. This situation may have developed in the CSS, in decades of aid assistance programs and projects failing to create conditions for building ownership but leaving the communities without support after the termination of the projects' funds. As noted by Klerkx et al. 2009, the innovation brokers in developing countries also face this issue. Due to "funding impatience", innovation brokerage roles are interrupted at the end of projects.

The disagreement was discussed and negotiated among farmers and researchers. The negotiation was in this case distributive rather than integrative, since a compromise concerning the share of loan to be repaid was reached. An integrative solution would have consisted instead in negotiating a creative solution fulfilling both farmers' and researchers' demands (Leeuwis and van den Ban, 2004 pp 171-172; van Mierlo et al., 2010 p. 322). In this case, the interest of the researchers in insisting that the farmers would have to pay the loan was motivated by the desire to build the conditions for ownership and a sense of responsibility. Sharing the costs of innovation is a key strategy to foster a sense of responsibility for the project's fate. Nonetheless, the process of involving the farmers in the decision-making process and addressing their needs is also contributing to building ownership and therefore the initial misperception over the contribution may be just an isolated issue. The success and the recognized benefits of the strategy, and the trust which are built through the interactions between farmers and researchers during the implementation, may ensure that this disagreement will not occur in future collaborations and that the group members will be willing to undertake the entire costs of the machine purchase or at least some of them. On this line, Brydon-Miller et al (2010 p. 20), reflecting on the role of researchers and educators, highlight how "building trust in communities that have every reason to be wary of outsiders and especially of academic outsiders doing research is a long-term project". As noted by Neef and Neubert, (2011 p. 188) one of the factors influencing the participation of the local stakeholders in the research is the outcome of previous "experience with other research project", which might make the local farmers lose enthusiasm and be biased against new researchers.

Problems linked to the machine selection process

The challenges linked to the machine type and to the characteristics of the machine, such as difficult transportation and technical breakdowns, was very important for the outcome of the MS/MT implementation. The problem has been encountered in every village, indicating that this is not just an isolated issue linked to a bad quality of the machine purchased, but may also a problem of miscommunication or misrepresentation of farmer's needs. Perhaps the farmers were not able to articulate their requirements and needs appropriately, since they were unacquainted with this technology. Perhaps cultural and knowledge barriers between farmers and researchers created misunderstandings and hindered communication, leading to a wrong choice of machines.

In light of these facts, for improving the MS and MT implementation, it may be advisable to invest additional time and effort in helping the farmers choose the most appropriate machine.

Hoffmann et al (2007) highlight how participation is not always a benefit for research. In this case, the participation the UPS group members were informed by researchers and led to autonomously make a choice following principles of PAR. The authors also highlight the importance of making the farmers' tacit knowledge explicit. In this case there is no farmer tacit knowledge to be made explicit, but rather hidden inexperience of farmers concerning the machines' requirements. Reflecting on how to make the farmers' unawareness more explicit and how to clarify doubts which farmers may be shy to bring up could also help facing this challenge.

Underreporting of the amount of harvest processed

The problem of underreporting the amount of harvest processed is common to both CSS. In Changarawe, it appears that cases of underreporting the maize shelled might have occurred at the expenses of the researchers. These should have received part of the earning from the UPS group activities as a form of repayment the loan for the machine purchase. In Idifu, underreporting the amount of millet threshed has occurred at the expensed of some UPS group members. Apparently, some UPS group members, while working for the clients, without being noticed by the other group members, underreported the amount of millet threshed to increase their own earnings.

The process of collecting the earnings from the threshing and shelling activities has been agreed upon during the group meetings. The group members, when it is time for processing the harvest for clients, divide themselves into teams. The amount of harvest processes is reported to the group treasurers who transcribe it in the group records. The group members use part of the earnings for repaying the loan for purchasing the machine and the other part is their own income. Hiding the amount of harvest processed affects the possibilities of repaying the loan for purchasing the machine.

The problem of underreporting the harvest processed may be also described as an opportunistic behavior problem. The incentive to engaging in this sort of behaviour may be driven by the lack of a sanctioning mechanism. Leeuwis and Aarts, (2011 p. 31) suggest that “dealing with dynamics of power and conflict” is one of the communication strategies which an innovation broker may focus on to facilitate innovation processes. In this case, there is not much of a relation of power among stakeholders, however the opportunistic behaviors may lead to conflicts inside the UPS groups and may have negative consequences for the sustainability of the MS/MT. Reinforcing the trust among group members, leadership, and negotiation of the conflicts may be therefore in this situation important.

6.1.2 The Success Stories Emerged during the MS/MT implementation

This strategy is appreciated by the users especially for its contribution to the improvement of their household incomes. The modalities of implementation, involving participation, addressing farmers’ needs, and creating opportunities for generating income have created conditions for enabling the innovation.

Changes in the potential for change, which is ultimately the aim of the agents facilitating innovation processes (Leeuwis and Aarts, 2011 p. 32), can be observed in the storylines of the interviewees. In particular, the creation of opportunities for being involved in activities creating return has triggered the motivation of the UPS group members and enhanced the ownership of the strategy. The empowerment created may also a good sign indicating the possibility of further enhancing collective action and building social capital (Neef and Neubert, 2011 p. 189).

6.2 The Optimized Market Oriented Storage (OMOS) Implementation

The implementation of OMOS in Ilakala, like the MS/MT UPS, generally followed the guidelines set up in advance in the Trans-SEC participatory framework. The initial activities of screening and close involvement of the farmers in the decision about the strategy created the premises for carrying on the implementation of a strategy coherent with the farmers' preferences and needs.

The OMOS implementation phase consisted in testing the improved storage bags and disseminating them in the CSS. This process involved further addressing the farmers' preferences and engaging the UPS group members in the testing, creating a close collaboration and co-learning with researchers. Hoffmann et al (2017) explain that there is an intrinsic benefit in involving the farmers in the testing, since farmers have greater opportunities of observation in their own local context and disseminating the innovation through their social networks. This is the approach chosen by Trans-SEC. The test consisted in assigning the improved storage bags of different prices and materials to the UPS group members to test. The farmers learned how to use the improved storage bags and the new techniques for storing the harvest. Organizing experiments and practical actions was very important to convince the UPS group members and also other farmers in the community about the benefits of the improved storage bags and facilitated the learning. These activities are also indicated by Leeuwis and Aarts, (2011 p. 32) as examples of communicative strategy supporting social learning. The UPS group members also contributed to spreading awareness about the improved storage bags benefits in the CSS.

No unexpected event or major challenge requiring substantial changes in the OMOS implementation were encountered during the implementation. The only change which was introduced was a shift in the type of improved storage bags to be distributed. Initially the improved bags had to be distributed at a subsidized price, due to the impossibility for the farmers to pay the full price. The discovery of a government project providing similar improved storage bags, at a subsidized price, meeting exactly the farmers' willingness to pay, led to the decision to link to this program and provide these bags to the farmers. This event

allowed saving costs by providing the improved storage bags at a subsidized price. A key driver for convincing the farmers about the benefits of the improved storage bags was the bag price. The knowledge about providers of improved storage bags at subsidized price has proven important for the outcome of the OMOS implementation. Unfortunately, this could occur only later in the process due to the missing information. “Build on existing initiatives for change and the networks around these “is also another example of communication strategy which Leeuwis and Aarts, (2011 p. 32) suggest for supporting innovations. The possibility to change the process, in this case after the discovery of a new opportunity, is also one of the advantages of PAR. Actionability, “the extent to which the project provides new ideas that guide action in response to need” is highlighted by Bradbury-Huang (2010 p. 103) as a criterion for a good action research.

The challenge of finding information about the subsidized improved storage bags should not be attributed to a lack of effort by Trans-SEC researchers, but rather to the problem of the coordination of development projects at national level. In Tanzania, several projects and programs offer aid and assistance. The coordination of the aid is often not efficient, as I could note when collecting the storylines of ICS implementation. In this case, other organizations were offering the construction of similar improved stoves in the Trans-SEC CSS, over the same period the Trans-SEC ICS were implemented.

Participation during the OMOS implementation has been enhanced by involving the UPS group members in testing the improved storage bags. Moreover, the UPS group members collaborated by convincing other farmers in the community to try the improved storage bags, helping the dissemination of the UPS. Although a certain degree of participation occurred the UPS group members felt they did not fully own the management of this strategy. To make sure that the participants feel responsible for the UPS fate, perhaps the implementation should be re-designed to include a more active role of UPS group members. In addition to this, linking the farmers to other actors and networks, such as the bag suppliers, may be important. So far, the improved storage bags were brought in the village by Trans-SEC researchers and the farmers are not in contact with the bag suppliers. “Arrange contact between disconnected networks who may have compatible interests” and “forge/broker contact between existing

networks and outsiders and/or outside expertise” are also taken as examples by Leeuwis and Aarts, (2011 p. 32) as relevant communication strategies to support innovation.

Nonetheless, the OMOS strategy has achieved the goal of improving UPS group members’ livelihood and therefore should be considered successful in promoting farmers’ empowerment (Neef and Neubert, 2011 p. 189).

All interviewees were convinced that they had learned from the UPS implementation. As highlighted in Hoffmann et al (2007 p. 358), researchers and farmers have “comparative advantages in the generation and dissemination of agricultural technologies” and they may both benefit from shared knowledge. In this case, the researchers got feedback from the farmers about the quality of the improved storage bags, and the farmers learnt how to store the harvest in the improved storage bags, indicating signs of single loop learning (van Mierlo et al., 2010 p. 322). It would be difficult to state that double loop learning has been established during the OMOS implementation. However, from the statements of the UPS group members, signs of changes in the perception which may lead to coordinated action may be found.

6.2.1 The Challenges Emerged during the OMOS implementation

As mentioned above, the OMOS strategy did not encounter any major challenge. Minor challenges encountered are the low commitment of engaging in group activities and the initial difficulty encountered by the researchers in convincing the farmers about the benefits of the improved storage bags.

Low commitment to group activities

The low commitment of UPS group members to group activities is the main challenge reported in the implementation of this strategy. The commitment to group activities does not influence the performance of the UPS, since all the activities of distribution and awareness spreading in the CSS have been working efficiently and there has been a great uptake of the improved storage bags. The low commitment affects mainly the sense of empowerment, which is a fundamental character of a participatory approach (Minkler M., 2000; Khan and

Chovanec, 2010). The group members report feeling dissatisfied due to the impossibility of being involved in business activities. The reasons for this could be different. The UPS group members claim that some elements of these strategies do not correspond to their needs and preferences. Although the strategy was very carefully defined during the initial phases of the project and the farmers collaborated closely with the researchers, they developed the desire, probably after observing the work of other UPS groups in the village, to be included in income-generating activities. The strategy itself is indirectly generating income, however the farmers are not able to gear the additional income and the group efforts toward other group activities which would further improve their condition and which could lead to the generation of extra income.

Perhaps training in business management or the development of a different approach to the testing and diffusion of the improved storage bags could be useful and further improved the benefits of the strategy. In this context “organize regular reflection on process dynamics and satisfaction with outcomes” may be a possible strategy to enhance social learning in the frame of innovation processes (Leeuwis and Aarts, 2011 p. 32). This would imply again reflexivity concerning the possibility of changing the implementation process (Prowse 2010; Bradbury-Huang 2010).

Convincing the farmers to buy the improved storage bags

A minor challenge reported by researchers was convincing the farmers to buy and test the improved storage bags. The reason for this was the difficulty for farmers to open up to something new. A formula which has worked in this case was providing trials and subsidizing the improved storage bags at a lower price. Using experiments is one resourceful way to visualize the benefits of an innovation. As highlighted by Leeuwis and van den Ban, 2004 (p. 155-161) triability, and observability are conditions which influence the individuals' motivations to learn.

This challenge may now have become more of a success story since the improved storage bags are very popular and their demand is now high.

6.2.2 The Success Stories Emerged during the OMOS implementation

The success stories that emerged from the implementation of this strategy are related to improvements in the food security and wellbeing of the farmers, which are fully recognized during the Process Net-Map interviews and feedback discussions. This positive result contributes to increasing farmers' awareness of their possibilities and increase the farmers' confidence in being able to solve a problem, which, as indicated by Leeuwis and van den Ban, 2004 (p. 155-161), is one of the aspects influencing the learning and therefore the opportunity for creating the conditions for an environment enabling innovations.

The benefits of the strategy also entailed an improvement of UPS group members skills, practices and awareness concerning the harvest storage. These aspects may also be linked to the outcomes of the participatory research process (Neef and Neubert, 2011 p. 190).

6.3 The Improved Cooking Stoves (ICS) Implementation

The implementation of the ICS, like the other strategies analyzed in this research, has involved a great deal of learning during the planning phase, in which the most promising UPS has been selected. The characteristics of this UPS make it stand out in comparison to other strategies due do to a great involvement of local knowledge and fulfillment local needs. The improved stoves for reducing firewood are not a modern way of cooking, but they fit appropriately the needs and preferences of the rural smallholders, especially in the semi-arid area, where the need of reducing firewood for cooking is more urgent (Uckert *et al* 2017). The perception of the relative importance and urgency of a problem is highlighted as one of the factors which may influence the learning and consequently the innovation processes (Leeuwis and van den Ban, 2004 pp. 155-161). The ICS may be described as an intermediate solution between the modern stoves used in the cities and the traditional three-stone stove. This innovation turned out to be successful not only in the Trans-SEC CSS but in other projects in Tanzania as confirmed by the observation on field.

Although popular and successful, the modalities of implementation of this strategy on behalf of the implementing organization may differ greatly, as we have observed in the different

CSS. To implement the stove, Trans-SEC chose to support the creation of activities generating income. The UPS group members were in fact incentivized to carry on the dissemination of ICS by constructing stoves for clients in the community. The ICS implementation involved capacity building training where the UPS group members learned how to construct stoves from other stove constructors, who in turned learned how to construct stoves in the frame of other research and development projects. Moreover, the stoves were tested together with the researchers and the UPS group members also engaged in spreading awareness about the ICS benefits in their communities. Other programs, as seen in the example of the other stoves implemented in the CSS, preferred other approaches. For instance, in Idifu, another organization aiming at disseminating improved stoves has also favored an approach which involves constructing stoves for the benefit of the community. In this case, however, the organization chose to pay the stoves' constructors for the construction of the stoves for clients. The Trans-SEC ICS implementation systems seems more adequate to improve the ownership of the stove and the empowerment of the community as it goes beyond the aid provision dynamic but fosters the sustainability of the strategy. This is also a goal which a participatory action research approach aims at (Khan and Chovanec, 2010) and which may not be present in the objectives of organization following different approaches. Although the presence, in the CSS, of other organizations implementing improved stoves has influenced negatively the UPS group activities in Idifu, it has not caused a modification of the ICS implementation system and has not significantly impacted the success of the strategy.

The empowerment of the group members has been sustained by creating trust and a sense of responsibility for the outcome of the stove construction. As confirmed by Uckert *et al* (2017 p. 17) “the successful implementation and dissemination was based on strong stakeholder participation within focus group discussion and training sessions, as well as on the feedback loops derived by quantitative and qualitative results of the continued process of monitoring”. The benefits of working in groups has also strengthened the group and created trust ties which facilitate the innovations and which make the strategy very efficient. The UPS group members share a sense of ownership over the ICS UPS.

As noted by Uckert *et al* (2017 p. 17) “knowledge exchange and internal knowledge systems were key factors facilitating capacity building”. Learning processes occurred at different

levels. The UPS group members were trained by the researchers and by other farmers skilled in the art of ICS construction. Before constructing the stove for the clients, the UPS group members tested the stoves with the researchers. This activity further improved the learning and helped visualizing the benefits of the stoves. The UPS group members report having improved the stoves design, making it fit their clients' needs, suggesting single loop learning: the "learning how to do things better" (van Mierlo et al., 2010 p. 321). Additional learning and information exchange occurred between clients and UPS group members, when the stoves were constructed and the UPS group members explain the qualities of the ICS. Some UPS group members state that being involved in the ICS implementation has changed their perception and motivated them to act outside the frame of their usual modes of thinking and practices. This may indicate increased chances for social learning.

6.3.1 The Challenges Emerged During the ICS Implementation

No significant challenges were reported during the ICS implementation. Minor challenges mentioned concerned: The difficulty of some group members in learning how to construct stoves (some group members are fast learners, others slower), trust issues with clients, and the initiation of other projects by other research and development organizations or NGSs at the same time as the activities of UPS group.

Capacity building

Difficulty in learning has been described as a minor challenge. The drivers of this challenge may be vulnerable socio-economic conditions of the farmers. Creating the conditions enabling a better learning are very important even if the strategy appears to be successful. Perhaps the group members should be motivated to find other solutions to improve their learning and to reflect how to better teach the group members how to construct stoves. This, however, is not a significant issue.

Relationship with clients

The relationship with the community, that is the clients for which the UPS group built the stoves, was sometimes difficult. The clients did not facilitate the UPS group member work. The reasons for this may reside in what has been described as a feeling of envy that the members of the community not involved in the project hold toward the UPS group members for being involved in the project. This problem may also be linked to a “dependency syndrome” already mentioned in the case of the MS/ MT implementation for which the community would expect to receive the stove for free and not share responsibility for the outcome of constructing the stoves. Perhaps a closer engagement of the clients in the activities connected to the stove construction would help improving feeling of trust and the responsibility of the rest of the community.

Presence of other projects constructing stoves

As mentioned in the previous chapter, the presence of other projects constructing stoves similar to those constructed by Trans-SEC is an indication of the success of the strategy all over Tanzania. The presence of other programs implementing stoves is an obstacle to the UPS group work, but it also represents an opportunity for highlighting the benefits of Trans-SEC implementation design. The Trans-SEC implementation modality may prove superior and advantage the Trans-SEC ICS uptake. The problem of competing programs may be reduced by supporting connections with the other projects implementing improved stoves and negotiating agreements over the modalities of constructing stoves. These activities connected to the processes of network building and facilitation of negotiation are also recommended to support innovations (Leeuwis and Aarts, 2011 p. 31).

6.3.2 The Success Stories Emerged during the ICS implementation

Overall, the ICS implementation presents several successes. The strategy has been adopted easily by the UPS group members and by the community. Moreover, the ICS fits the needs of the stakeholders as well as their interest. The reasons for the success of the strategy may also stem from a successful implementation configuration, which has fostered mutual learning and exchange between UPS group members and researchers. Moreover, the choice of including mechanisms to improve and generate income has proven successful for

enhancing the sustainability and ownership of the strategy. As noted by Uckert *et al* (2017 p. 17) a “a quick profit, enhanced by supporting a fixed, but low (pro-poor), ‘selling price’ for ICS stoves, was a crucial incentive for stove construction”. In addition to this, the strategy is not complex and its benefits are observable which facilitate the learning (Leeuwis and van den Ban, 2004 p. 155-161). Moreover, allowing the UPS group members to experiment and make adjustments helped improving the stoves and the trust of the UPS group members, and improved the farmer researcher collaboration (Hoffmann et al 2017, Uckert *et al* 2017).

6.4 The Differences and Similarities that Emerged in the UPS Implementation in Different Case Study Sites

The implementation process of each UPSs did not reveal significant differences across regions. The strategies have been implemented following the same modalities in both regions. Regional patterns, such as different environments and climatic conditions, make the semi-arid region more vulnerable. However, the harder climatic conditions have not influenced consistently the way the strategy succeeded or failed to introduce upgraded strategies. The only difference is that the semi-arid regions are more vulnerable to unfavorable weather conditions, and therefore implementation activities are more difficult during the dry season, and the incomes of the stakeholders are lower. For instance, the activities of the UPS group in the semi-arid region are challenged by the fact that there is only one short rainy season per year and therefore the chances to provide millet threshing services are lower. Likewise, activities of the ICS group in the semi-arid region are obstructed by the lack of water, which is essential for constructing stoves. Despite the adverse weather conditions, the ICS stove construction appears to have been particularly successful and the dissemination of stoves has been greater in the semiarid region. The number of stoves constructed in Idifu between 2015 and 2016 was four times higher than that of Ilakala (Uckert *et al.* 2017). This outcome can be attributable to the greater perception of importance and urgency of reduction of firewood used for cooking (Leeuwis and van den Ban, 2004 p. 155-161).

The influence of unpredictable weather condition on UPS implementation performance is observed in the comparison of towers of influence across regions. Across different CSS there

is a difference ($p \leq 0.05$) in the perception of food security brought about by the MS/MT implementation. In the village of Changarawe, in the sub-humid region, the interviewees attribute lower food security scores. This result is attributable to a flooding which has challenged the activities of the UPS group. Apart for this result, the comparison of towers of influence does not indicate any other significant difference across regions

This research has not taken into account cultural differences among the communities under study. For instance, identifying the religion, traditions and values of each community might also bring up significant differences in the implementation. These elements however were not considered. In light of the Tanzanian history and the experience of forced villagization in line with the Ujamaa policy in the '60s (Puttermann 1995), it might be assumed that the farmers' communities in the different climatic regions, despite cultural regional differences, might have not too dissimilar backgrounds.

Cultural differences are, on the other hand, clear in the comparison UPS group members and researcher interviewees. These are highlighted in the scores attributed by researchers, which tend to be higher for some Influence Towers in comparison to those attributed by the UPS group members (MS/MT Income of UPS group members at $p \leq 0.05$; OMOS Income of UPS group members and Knowledge of researchers respectively at $p \leq 0.05$ and $p \leq 0.01$; ICS Food Security of UPS group members and Knowledge of researchers respectively at $p \leq 0.05$, $p \leq 0.01$). As explained by Hoffmann (2007), farmers and researchers have different knowledge backgrounds which, if combined, could create useful synergies and enhance innovations.

When looking at the challenges encountered in the CSS from different regions, we can note that the same kinds of challenges are observable in both regions. The MS and MT machines have had problems in both regions due to frequent machine failures. Inappropriate management of the group earnings has been reported in both regions. In other regions, ICS group members have encountered similar issues with clients when implementing the stove, such as the unwillingness to contribute with materials. Moreover, in both regions other organizations have constructed other stoves. This further confirms that no significant

differences appear in the implementation of the strategies in different regions. The implication of this result may be different. It might mean that the implementation process was equally efficient or non-efficient in delivering the outcomes in different areas. It might imply that the regional differences are not significantly strong enough to determine important changes in the implementation. It might also mean that the implementation could further take into account the regional pattern and make them more implicit in the implementation process.

6.5 Reflection on Participatory Action Research Approach

Overall, the implementation of the strategies follows the participatory framework decided in the project planning phase (Graef 2014 p. 11). The PAR was conducted following activities of planning, acting, observation and re-planning (McTaggart, 1994 p. 315). Unexpected events, such as the disagreement on who should cover the costs for purchasing the MS/MT and the discovery of projects supporting the diffusion of improved storage bags at a subsidized price, have been managed through negotiation, and changes have been eventually introduced to improve the implementation. The co-learning and cooperation between Trans-SEC researchers and farmers close and fosters the empowerment of the farmers. For every strategy in every region the farmers have reached a level of participation going beyond the simple consultation, but involving the farmers' empowerment by including them in the decision-making process. This result is also due to the choice of following the PAR approach which is appropriate for this purpose (Baum et al., 2006 p. 854, Whyte, 1989 p. 368).

The UPS group members find themselves in a better position than when the project started. The members of the MS/MT UPS group have improved their income and food security by starting an activity that generates extra incomes. In addition to this, the changes in the UPS group members' attitudes and perceptions are observed in every UPS, confirming that social learning has occurred (van Mierlo et al., 2010 p. 321). This means that the different perceptions and cognitions of the farmers have been reflected upon and changed accordingly, leading the farmers to pursuing new options. The UPS group members are active in implementing the UPS. The change in the perceptions is an important achievement, because it confirms the fulfillment of the more important goal of the communication agents, such as

the organizations involved in Trans-SEC project, which is that of “changing the opportunities for change” (Leeuwis and Aarts, 2011 p. 32).

At the CSS level, in the long term, the resilience of the UPS and the benefits created by the UPS implementation will depend on the commitment of the UPS group members to continue the UPS and on the degree to which the UPS will be able to survive additional challenges which may arise after the end of the Trans-SEC project. The innovation broker role, which the Trans-SEC project and all the researchers involved in it have assumed, inevitably will terminate with the end of the project and the project funds. As Klerxk et al. (2009) explain, the innovation brokerage function, may be however assumed, after the end of the projects, by the extension agents. In Tanzania there are different providers of extension services which may further support the innovation brokerage functions and make use of the lessons learned during the UPS implementation.

6.6 Ideas for further Research

This study has researched only the micro level of innovation implementation, the niche level where innovations usually arise (Brunori et al 2011 p. 15). In the protected environment provided by Trans-SEC in the CSS, the UPS are facilitated and constrained to fewer factors than at the higher macro levels, where the innovations must also compete with other solutions, leading to the survival of the fittest innovation. The capacity of the UPS and of the innovations to survive and adapt to the constraints existing at higher macro level (Geels et al. 2002) will depend on the degree to which they will prove efficient and able to cope with these constraints. My thesis research has not investigated implementation aspects linked to the existing regimes and landscapes framing the niches. Additional research on these aspects may be useful to explain some dynamics encountered in the implementation. For instance, it could be interesting to study the how research and development projects are coordinated at the district the regional levels. The Process Net-Map interviews may be extended at the district and regional and to government representatives. The Process Net-Map tool, may in this case be used for understanding the origins and drivers of the governmental challenges connected to the coordination of the research and development projects and the work of the various organizations and extension services addressing smallholders. Process Net- Map has

been used similarly for studying issues encountered in the implementation of safety net program in India and veterinary services in Uganda (Raabe et al. 2010, Ilukor et al. 2012). Focusing on further understanding the constraints that arise outside the protected niche level may also be important for detecting opportunities and challenges for the UPS dissemination for national outreach.

6.7 Summary of the UPS Successes and Challenges, and Recommendations

The implementation of each strategy has brought about a degree of transformation in improvement of farmers' food security. The members of the OMOS UPS group in Ilakala, by utilizing the new bags, have improved their food security and their capacity to store their harvest for longer periods. They were able to sell their produce at a favorable moment, consequently improving their income and wellbeing. The group members of the ICS UPS group have constructed several ICS stoves in the CSS and engaged actively in the group's activities. The ICS group members are motivated to continue the ICS implementation and share positive feelings about opportunities of further improving their livelihoods. Overall, it can be noted that the UPS which involved the creation of small scale business activities, such as the ICS and the MS/MT UPS, brought about greater ownership of the strategy and greater transformation of the participants' attitudes toward the new practices. This suggests that enhancing the creation of income-generating activities may be a key mechanism to provide a solid basis for the UPS implementation. This is also in line with the general need of creating opportunities for income generation for smallholders outside the typical agricultural production activities.

The successes of the UPS implementation may also depend on the degree in which processes for facilitating social learning, negotiation of conflicts and network building were enhanced. For instance, linking the OMOS strategy to the work of another program with a similar interest in distributing improved storage bags helped facilitate the UPS uptake. Moreover, the facilitation of the understanding of farmers' needs and preferences in the initial planning phase has been found essential to select adequate strategies.

Each strategy encountered challenges which affected the implementation in different degrees. These challenges are attributable to different factors and may be also addressed by focussing on processes of network building, and on facilitation of social learning, and of conflict resolution. In the case of the MS/MT, the initial disagreement concerning the attribution of the costs of purchasing the machines may have been influenced by the fact that the project was in its initial phases and therefore UPS group members were not yet fully aware of the opportunities offered by this strategy. This issue may be improved by facilitating trust and collaboration among farmers and researchers, for instance by “Making stakeholders talk in terms of proposals and counter-proposals” and “working toward agreements”. (Leeuwis and Aarts, 2011 p. 31). The MS/MT implementation was also challenged by the frequent machine failures and by the experienced difficulties in handling and transporting the machines. These problems may be linked to the machine selection process. Even if efforts to guide UPS group members in the machine selection were made, further improving the specification of farmers’ needs may be important to ensure the right machine choice. For this purpose, for instance, contact with other farmers involved in similar machines or who have encountered and dealt with similar issues may be facilitated (Leeuwis and Aarts, 2011 p. 31). A third challenge encountered during the MS/MT implementation was transparency in handling the group earnings. The amounts of maize shelled and millet threshed are supposed to be reported to the treasurer, which keeps the records of the UPS group’s revenues, but some group members underreported the amount of harvest processed. Underreporting the harvest processed may favor some group members and affects negatively the repayment of the loan for the purchase of the machine. To prevent this behaviour, facilitating trust building among group members, and among group members and researchers may be important. Among the examples of strategies connected with the process of “dealing with relationships of power and conflicts”, Leeuwis and Aarts, (2011 p. 31) suggest to clarify the interest and worries of those involved and to improve the leadership, which seem useful strategies for this case.

A minor challenge encountered during the OMOS implementation was a low commitment of group members to group activities. The UPS group members claimed to lack the motivation to attend the group meetings and be active as a group. They claim that the main reasons for this are the low opportunities to generate profit offered by the participation in

group activities. This issue may be improved by putting further emphasis on the satisfaction with the outcome of the implementation. This may imply, for instance, including in the implementation design small-scale business activities, as for the MS/MT and ICS strategies. Another small issue encountered during the OMOS implementation was, initially, convincing the UPS group members to uptake the improved storage bags. This issue was solved by allowing trials which have helped visualizing the benefits of the improved storage bags. This process is also indicated as effective for supporting social learning (Leeuwis and Aarts, 2011 p. 31)

A challenge encountered during the ICS was the presence in the CSS of other organizations promoting improved stoves. To smooth out the negative effects that the presence of these organizations may have on the implementation of the UPS, links to programs offering similar solutions may be enhanced (Leeuwis and Aarts, 2011 p. 31). Processes of network building in this case may not also serve for improving the links among actors and organization, but also for improving the mutual learning about the strategies and the implementation of the strategies at a higher level. Another minor issue encountered during the ICS implementation was a low enthusiasm of the clients in facilitating the ICS construction. This situation may be improved by enhancing trust building between clients and stove constructors. This may be done, for instance, by understanding the clients' worries and interests and enhancing communication (Leeuwis and Aarts, 2011 p. 31).

6.8 Conclusions

The investigation of the UPS implementation processes was motivated by the goal of answering the main research question *How has the implementation of the Improved Cooking Stoves, Optimized Processing Machines and Market Oriented Storage UPS unfolded, according to the researchers and farmers involved in the project?*

Overall, the implementation of the Trans SEC strategies was carried out following the principles of Participatory Action research. Noticeably the learning and interaction between researchers and farmers proved important for introducing changes and facing the challenges encountered.

The investigation of UPS implementation challenges and successes, in reference to the sub-question *What are the success stories and the challenges encountered during the UPS implementation?* has highlighted different implementation hurdles and success stories.

The Main Challenges encountered implementation were: An initial disagreement between researchers and UPS group members on who should overtake the costs of purchasing the MS/MT machines, delays due to frequent MS/MT failures, underreporting of harvest processed in the MS/MT group, low motivation in committing to group activities in the OMOS group, and the presence of other projects implementing ICS in the CSS. These challenges have not significantly undermined the UPS implementation and may be addressed by focusing on the processes of facilitating social learning, negotiation of conflicts, and network building.

We may say that the UPS, in the perception of those involved in the implementation, have proven successful in improving the farmers' livelihoods. Moreover, the strategies have brought about a diffuse perception of change in the attitudes toward transformation and the modes of thinking, which is observed in many UPS group members' storylines. This indicates a success of the UPS and of the UPS implementation design and in the PAR approach in creating solid bases for innovations. The comparison of the implementation in different climatic regions in reference to the research question *What differences and similarities emerge in the UPS implementation in different case study sites?* suggests that the implementation in different climatic regions presents similar patterns and no important implementation differences.

Summary

This research investigated the implementation of the Improved Cooking Stoves (ICS), the Optimized Market Oriented Storage (OMOS), and the Optimized Processing Machines (Maize Sheller and Millet Thresher) (MS/MT) UPS, which were proposed by the Trans-SEC project to improve food security and upgrade the FVG of smallholders in rural Tanzania.

The research tool chosen for assessing the implementation was Process Net-Map. This innovative method served for understanding how the UPS implementation unfolded, the successes brought about and the challenges encountered during the UPS implementation according to the perceptions of those who were primary involved with their implementation: the Trans SEC researchers and the UPS group members.

The implementation of each UPS consisted in different steps and was shaped by the broader participatory framework. New steps and activities were integrated in the implementation process following the challenges and the opportunities encountered.

The implementation challenges encountered were driven by different factors and events. Challenges identified as influential during the implementation were: An initial disagreement between researchers and UPS group members on who should assume the costs of purchasing the MS/MT machines, delays due to the frequent MS/MT failures, an underreporting of harvest processed in the MS/MT group, a low motivation in committing to group activities in the OMOS group, and the presence of other projects implementing ICS in the CSS.

Overall, the success stories highlight an improvement in the participants' livelihoods during the implementation. In addition to this, an increasingly positive attitude toward the innovation and a motivation to further engage in the UPS implementation.

The comparison of the UPS implementation in CSS from different climatic regions has revealed no significant differences between the implementation processes. The storylines indicate similar implementation steps, and similar successes and challenges.

Both success stories and implementation challenges are linked to the degree in which the processes of facilitating social learning, negotiation of conflicts, and network building were

enhanced. Strategies to face the implementation challenges may also stem from these processes.

Declaration

I, Antonia Zampa hereby declare that the present thesis has not been submitted as a part of any other examination procedure and has been independently written. All passages, including those from the internet, which were used directly or in modified form, especially those sources using text, graphs, charts or pictures, are indicated as such. I realize that an infringement of these principles which would amount to either an attempt of deception or deceit will lead to the institution of proceedings against myself.

Signature

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Date

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Annex I: Interview and Feedback Discussion Guidelines

INTERVIEW GUIDELINES

The structure of the individual interviews following the Process Net-Map method

The indications provided by the Schieffer et al. 2017 on how to use Process Net-Map, have been used as a background reference for developing the guidelines for conducting the individual interviews with the UPS group members and the Trans SEC researchers. In addition to this, the interview guidelines developed by Halle et al. (2017) were used as a baseline for structuring the interview questions.

Following the recommendation of the authors, the structure of the individual interviews involved three main steps:

Step 1: Describing the implementation process.

Step 2: Building Influence Towers.

Step 3: Identifying the challenges encountered in the implementation and the entry points for challenges.

The material required for setting up a Process Net Map interview were: Marker pens, empty poster, empty cards, wooden tokens, a recorder and a camera.

In brief, the structure used in this research for conducting an interview based on the Process Net-Map method involved the following steps:

- The interview partner was asked to name the actors involved in the UPS implementation. The names of the actors mentioned were written down on cards and positioned on the empty poster. (step 1)
- The interview partner was asked to remember the steps and the major activities and events occurred during the UPS implementation in chronological order. These were also listed on the poster. For every activity mentioned by the interview partner an

arrow linking the actors or the groups of actors involved in that activity was drawn. (step 1)

- The interview partner was asked to rank the actors previously identified on the base of the influence they exerted during the implementation and according to other predefined criteria. To do this, the interview partner had to place up to five wooden tokens on top of the cards with actors. The scores attributed to each actor were written down and the entire poster was photographed. (step 2)
- The interview partner was asked to recall the challenges encountered during the UPS implementation process or possible challenges which could arise in the future. These were also marked on the poster next to the implementation step they referred to. (step 3)

Figure 20 below represent the outcome of a Process Net Map interview.

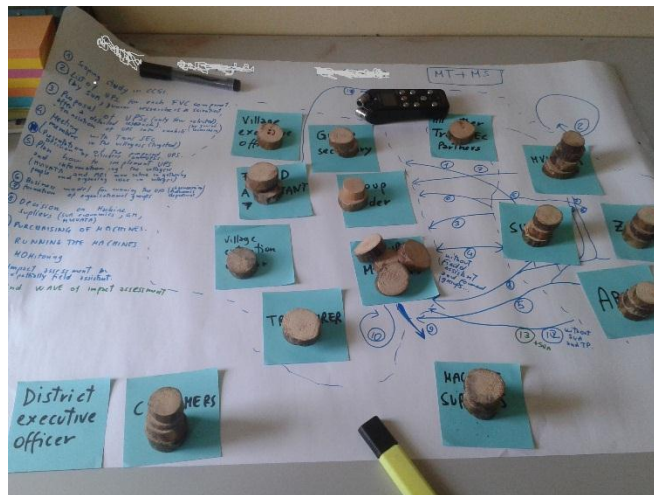


Figure 20: A Process Net Map Interview

The interview guidelines

Each interview was initiated by informing the interview partner about the purpose of the interview and the aim at the research and by asking the consent for proceeding with the interview.

Introductory questions

Initial “setting in” questions aimed at letting the interview partner reflect upon UPS implementation and preparing him/her for the interview following the Process Net Map method.

- Have you already been involved in a Process Net-Map Interview before? During this interview, we will look at the entire UPS implementation, together with you, as an expert of this process.
- Could you tell me something about your role in the implementation process? Do you remember how the implementation of the strategy started?
- How has your food security changed with the UPS implementation?

Step 1: The description of the Implementation steps

Following the Process Net Map structure, the interview partner was asked to name the actors who had been important in the UPS implementation and to follow the implementation activities. On the poster, the actors and actor networks recognized were signed on cards and connected by actors based on the activity they have been involved in.

- Who has been important until today in the implementation of the UPS?
- Do you think these actors have been important in the UPS implementation?
- Please, describe the UPS implementation step by step. You can start at the point where the decision to implement the UPS was made (August 2014).

Step 2: Building Influence Towers

The interview partner was asked to set up Influence Towers, indicating the influence of each actor in the implementation. This process consisted in piling up the wooden tokens next to each actor card. A total of five Influence Towers was set up for each interview. The influence Towers served to rank actors according to different criteria. The criteria chosen for the ranking were:

- Influence
- Income
- Food Security
- Knowledge
- Trust

Influence towers: How strong is the influence of each actor on the UPS implementation?

Could you explain why?

Income towers: How much more income does each actor get out of the UPS implementation?

Could you explain why?

Food Security towers: How much more food does each actor get out of the UPS implementation?

Could you explain why?

Knowledge towers: How much does each actor learn out of the UPS implementation? Who gets the most knowledge out of the implementation out of the implementation of this UPS?

Could you explain why?

Trust towers: Who do you think is the most trustworthy among the actors in the carts?

Could you explain why?

Step 3: Identification of the challenges encountered

The interview partner was asked to mention the challenges encountered in the UPS implementation and entry points for challenges. These were listed next to the implementation step which they referred to.

- Can you please indicate where in the process implementation challenges have been encountered?
- If more than one challenge is highlighted: Could you identify the most important challenge encountered?
- Can you imagine where in the implementation entry points for challenges may arise?

Supplementary questions

Supplementary questions were introduced to further acquire information about the UPS implementation and to understand changes brought about the UPS implementation.

- Do you think something could be improved in the UPS implementation process?
- Has your involvement in the process changed your daily life, your habits and attitude? If yes, how and why?
- Do you think the process was done in a fair way (why yes / why not)?
- Do you think someone from outside the village should be included in the UPS implementation?
- After the implementation, how are you going to continue the UPS? Would you modify anything in the UPS implementation process?
- Did the importance of the stakeholders involved in the process change during the UPS implementation? If yes, how?

FEEDBACK DISCUSSION GUIDELINES

Feedback discussions with the UPS group members were organized at the end of each interview round. The feedback discussion served for presenting the outcome of the individual interviews to the UPS group members and for acquiring further knowledge of the implementation process.

The feedback discussion involved two interactive parts: The presentation of a summary of the individual interview finding, and the group discussion about the results.

Presentation of the results

The summary of the results involved the presentation of each step identified during the individual interviews, the presentation of a map comprehensive of each actor involved and steps identified, the averages of the towers of influence for each actor, and the presentation of a list with all the challenges mentioned during the individual interviews.

The questions in this phase of the Feedback discussion were:

- Do you agree with the summary of the implementation steps which are here presented?
- Would you add any other actor which may be important for the UPS implementation?
- Could you recall any other challenge encountered during the implementation?

Discussion about the results

To initiate the discussion about the results, the UPS group members were asked different about their opinion concerning the results. Moreover, they were asked to discuss about the most important challenge encountered and to order them according to their importance.

- Can you think that of any other step or activity which may be added to improve the UPS implementation?
- What do you think about the representation of towers of influence? Do you think it represents well each actor's influence during the implementation? Why yes? Why not
- Which challenge encountered during the UPS implementation would you say is the most urgent and important?

Final questions

The feedback discussion was terminated by proposing once again the final questions asked during the individual interviews, namely:

- Does your involvement in the UPS change your daily life, habits, attitudes? If yes, how?
- Do you think the UPS implementation is done in a fair way (why or why not)?
- How are you going to continue with the UPS after the termination of the project?

Annex II: The Codes Applied to the Qualitative Content Analysis

