EFFECTIVE COMMUNICATION FOR DISSEMINATING SOIL AND WATER MANAGEMENT PRACTICES TO BRING ABOUT SUSTAINABLE SMALLHOLDER AGRICULTURE IN TANZANIA: CASE STUDY OF MANYARA AND DODOMA REGIONS

Master Thesis

MSc Communication, Health and Life Sciences

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WAGENINGEN UNIVERSITY & RESEARCH

Africa RISING

IITA Research to Nourish Africa

Effective Communication for Disseminating Soil and Water Management Practices to Bring About Sustainable Smallholder Agriculture in Tanzania: Case Study of Manyara and Dodoma Regions.

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PREFACE

Multi-stakeholder communication is a big challenge in several development sectors specifically between researchers and stakeholders who use their findings. Usually it is because researchers lack sufficient strategies and skills that would help to facilitate their communication effectively. The desire to bridge this communication gap between multi-stakeholder partnerships was the main reason that landed me in Wageningen University and Research for my master degree in Communication, Health and Life Science specializing in Communication and Innovation. Course works such as advanced communication sciences, interdisciplinary approaches in communication, innovation management and transdisciplinary designs, intercultural communication, introduction to global change and facilitating interactive processes enlightened me on how effective communication is an essential tool for the success and sustainability of innovation activities especially those addressing smallholder agriculture. This fuelled the zeal in me to conduct research for a thesis in effective communication for disseminating soil and water management practices in order to bring about sustainable smallholder agriculture. The aim was to identify the appropriate and effective channels to disseminate the practices. I conducted my research in Tanzania under a running programme Africa RISING, whose purpose is to provide pathways out of hunger and poverty for smallholder farm families through sustainably intensified farming systems that sufficiently improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base. My six months with the programme has been a great learning experience which gave me opportunity to explore my abilities and interests in research. I got exposed to the net-map tool and several analysis software like Gephi 0.9.2, Ucinet, SPSS 26 that I would not have learnt about in normal circumstances. In addition, I increased my network contacts with people from different backgrounds and above all got the opportunity to travel, learn new cultures and see some new places. All these opportunities are priceless moments and lessons gained.

My heartfelt gratitude and appreciation to all who made this study a success. First and foremost, the Almighty God for the gift of life and good health to execute this study, without good health achievement would have been doubtful. I am thankful to the Africa RISING management team for funding my research and make the desired study a reality. I am most grateful to my thesis supervisors Dr. David Ludwig and Lilian OSullivan, together with my field supervisor Prof. Mateete Bekunda for their unconditional support and supervision. Their intellectual criticisms and opinions, encouragement, advices and mentorship have produced this sweet fruit. My gratitude is to the Africa RISING team for their encouragement, advice and hospitality, they made my stay at the station comforting. My field assistance team, made the data collection period professional, friendly and fun. My appreciation to all the farmers and key informants for their willingness to participate and contribute to the findings, and the local leaders to permit me and my team to work in their villages is without bounds. My sincere appreciations go to my parents and boyfriend for the prayers and encouragement when I felt overwhelmed and stranded in the study process. Finally, I am grateful to the Nuffic scholarship of the Netherlands for financial support of my MSc study.

ABSTRACT

This study investigated effective communication for disseminating soil and water management (SWM) practices for sustainable smallholder agriculture. Higher uncertainties in precipitation and land degradation are potentially the most limiting reasons for poor performance of rainfed agricultural sectors in Tanzania. Despite the increased focus on sustainable intensification of African agriculture and an increase of agricultural innovations with potential to alleviate these, adoption by smallholder farmers is slow. This includes soil and water management practices designed to minimize land degradation and increase productivity which few farmers implement. Studies note that although researchers generate good technologies, the lack of appropriate communication strategies, tools and methodologies lead to poor extension information and technologies resulting in low adoption of the innovations. Therefore, to find a solution to this problem, this study was guided by four research questions: 1) How is the communication flow between stakeholders through channels for disseminating SWM practices? 2) What are the common and preferred communication channels in disseminating SWM practices? 3) What are the motivations for using the communication channels in disseminating SWM practices? 4) How can the communication on disseminating of SWM practices be improved to support sustainable agriculture? The study was conducted in Kongwa District in Dodoma Region and Babati District, Manyara Region of Tanzania. A net-map tool, questionnaires and semi structured interviews were used to collect both qualitative and quantitative data for this study.

Mass media and interpersonal communication are used in disseminating SWM practices information to farmers in Babati and Kongwa districts. But farmers preferred interpersonal channels as sources of SWM information including from extension officers, researchers, fellow farmers, village meetings and mobile phones. The preference was because these channels are not only informative compared to mass media but they are interactive and inclusive, which gives farmers the opportunity for giving feedback on the information disseminate. This influences farmers to not only to get information but also trigger their learning and adoption of the innovation.

Agricultural exhibition events should be organised at village or ward levels to provide practical backstops against which the experts can deliver information and knowledge to farmers, and give opportunity to farmers to access knowledge. It will be helpful to increase the number of extension officers who will facilitate effective communication and dissemination of the information as they seem to be an important link for interpersonal between farmers and other agricultural stakeholders.

Key words: SWM, practices, communication, dissemination, effectiveness, channels, knowledge, information, adoption.

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LIST OF ABBREVIATIONS

Africa RISING	Africa Research In Sustainable Intensification for the Next Generation
ASALs	Arid and Semi-Arid Lands
DAICO	District Agriculture, Irrigation and Cooperative Officer
ESA	East and Southern Africa
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GTZ	Gesellschaft für Technische Zusammenarbeit
HADO	The Dodoma Region Soil Conservation Project
ICT	Information Communication Technologies
IPCC	Intergovernmental Panel on Climate Change
ISFM	Integrated Soil Fertility Management
LAMP	Land Management Programme
LVIA	Local Volunteer International Agency
NGO	Non-Governmental Organisation
NRM	Natural Resource Management
RQ	Research Question
SLM	Sustainable Land Management
SNA	Social Network Analysis
SPSS	Statistical Package for the Social Sciences
SWM	Soil and Water Management
TV	Television
USAID	United Agency for International Development
VBAAs	Village Based Agricultural Advisors

CHAPTER ONE

1.0. Introduction

1.1. Background

In Tanzania, smallholder farmers are more and more vulnerable to environmental instabilities which are increasing the insecurity of regional food supply (Delgadillo Jaime et al., 2016). The IPCC (2007) notes that people living in Arid and Semi-Arid Lands (ASALs) are the most vulnerable and are likely to be hit hardest by climate change due to their low adaptive capacity. Challenges include increasing food demand due to growing population rate, unpredictable climate, and rural poverty due to little control over the environment, and limited access to irrigation and financial means to invest in water harvesting structures or inputs (Delgadillo Jaime et al., 2016; Zemadim, 2016). There is a strong necessity to improve current smallholder agricultural production systems to increase production and the resilience of the food system against future hazards while improving rural livelihoods (Delgadillo Jaime et al., 2016). Other significant reasons behind the poor performance of the agricultural sector in the country are land degradation, limited use of inputs (fertilisers, improved seeds) and poor agronomic practices (Mowo, 2009). The Association for Strengthening Agricultural Research in East and Central Africa (2004) also notes that land degradation is a major constraint to agricultural productivity and household welfare in Eastern Africa, and that few farmers practice soil and water conservation, resulting in a substantial amount of soil loss from agricultural fields.

According to Meinzen-Dick and Di Gregorio (2004), the labour intensity and spatial scales at which most Natural Resource Management (NRM) practices operate primarily restrict smallholder farmers' effective Soil and Water Management (SWM). Besides, inconsistent or scattered conservation efforts are guaranteed to fail because uncontrolled run-off from un-conserved fields upstream can for example destroy the soil and water management structures downstream; hence it is essential to call for collective action to attain landscape-level impacts (Mowo, 2009).

Meijer et al. (2014) emphasise that there is an urgent need for sustainable agricultural practices that can address the mentioned issues. Therefore, it essential to ensure that availability of soil and water management knowledge reaches the intended users so that it can be put into action. Also, concerns on climate change and reducing the contribution of smallholder farmers to global

warming through the current practices must be raised (Mowo, 2009) because their adaptive capacity to respond to the climate change effects are low (IPCC, 2007).

1.2. Problem statement

Tanzania is a democratic republic with a population of over 53 million people located in the East of Africa's Great Lakes, with its 44 million hectares of land being suitable for agriculture and representing 46% of its territory (www.usaid.gov, 2018; Arce and Caballero, 2015). Agriculture is the mainstay of the economy, contributing over 30% of Gross Domestic Product (GDP) and employing 67% of the labour force, with women contributing more than 70% of the labour. Although agriculture's contribution to national GDP declined significantly (46%) is low, it is still an important sector that serves as one of the core activities and income source for rural households (www.usaid.gov, 2018; Arce and Caballero, 2015). According to Arce and Caballero (2015), part of Tanzania's arable land is currently only marginally suitable for agricultural production due to, for example, soil leaching and drought proneness. Moreover, Tenge (2005), estimated that 25 tons of soil are lost per hectare from non-conserved land annually due to erosion by water in the Usambara Highlands, Tanzania. Besides the loss of fertile topsoil, water bodies are silted considerably affecting water amounts and quality (Tenge, 2005).

The country is composed of seven agro-ecological zones with different soils and topography, rainfall regimes, altitude and growing seasons; with dry periods and extreme rainfall during the two rainy seasons that are prevalent in some zones (National Sample Census of Agriculture, 2012). The traditional blend of dry periods and heavy rainfalls, along with an inadequate land maintenance system, exacerbates the erosion process which makes the country's agricultural production increasingly vulnerable to weather-related shock anticipated due to climate change (Enfors and Gordon, 2007).

Although agricultural research and extension in East African countries including Tanzania has been providing technologies and advisory services for Sustainable Land Management (SLM), impacts have been minimal, and governments and development partners concerned that few of the available innovations have been put into use (Mowo, 2009).

Ndilowe (2013) expresses that specialists may design brilliant projects, but the interventions cannot succeed if they are not well communicated to the farmers and other stakeholders. FAO and GTZ (2006) also add that lack of appropriate communication structures, methodologies and tools

result in poor extension information and technologies delivery and finally, low farmers take-up of innovations.

Efforts are in place to ensure SLM in East Africa so that agricultural knowledge is linked to an action that contributes to sustainable improvement in agricultural productivity supported through effective communication of the generated knowledge (Mowo,2009). However, farmers and various stakeholders have proven the current conventional way of communication model to be a failure due to its ineffective decentralization and non-participatory approach (Mowo, 2009). Decentralization process has not been effective enough because majority of the people are not touched by the developments taking place in several sectors due to lack of funding, limited managerial skills and too much interference from the national level. Feedback at the different stages is often absent and does not take institutions or local knowledge and preference into account (Mowo, 2009; Opare et al., 2012).

There is limited documentation of soil and water management technologies that enhance adaptation to climate change in drylands, including the communication channels used to disseminate and communicate the technologies (Recha et al., 2016). Therefore, the study determined which communication channels for disseminating of soil and water management (SWM) practices specifically ripping, 'fanya juu' and 'fanya chini' terraces and tied ridges are used to support sustainable smallholder agriculture in Tanzania.

1.3. Justification of the study

Knowledge generated by this research on enhancement of the communication process between researchers and farmers will be useful for the improvement of livelihoods through increased agricultural production by the smallholder farmers in Tanzania.

The study will enable research institutions to understand, know and apply communication channels that are effective in disseminating SWM practices to support sustainable agriculture.

The results of the study will be used to guide future communication strategies for dissemination and communication of agricultural technologies in rural areas that are promoted by local and international institutions, government and private sectors in Tanzania.

1.4. Research Objectives

1.4.1. Main objective

To investigate the communication channels used and their effectiveness in disseminating SWM practices in Manyara and Dodoma regions, Tanzania.

1.4.2. Specific objectives

1. To understand the communication flow between stakeholders through communication channels in disseminating SWM practices
2. To identify the common and the preferred communication channels employed for disseminating SWM practices
3. To investigate the motivation for using the communication channels in disseminating SWM practices
4. To investigate how communication on disseminating SWM practices can be improved to support sustainable agriculture.

CHAPTER TWO

2.0. Literature review

Communication is an essential process that moulds knowledge and perception, exchange experience, professional communication and in principle can be powerful aid in achieving change (Leeuwis, 2004) However, researchers are frequently less familiar with the use of thecommunication as a significant tool (Cahuhan, 2007). This chapter reviews the literature on the types of communication channels and their effectiveness for the adoption of soil and water management practices. It provides the theoretical and conceptual frameworks for the relationship between communication channels and adoption of SWM practices.

2.1. Communication channels

Communication channels are important tools for technology/innovation promotion. According to Rogers (1983), a communication channel is a means by which a message gets from one person to another. The definition of Akinbile and Otitolaye (2008) assert that, communication channels are pathways through which messages are transmitted to the receiver or audience. The different types of communication channels are described in the following sections

Mass media are diversified technologies or communication channels used to address the mass audience with the intention of reaching a large number of people in a short period. Some mass-mediated channels include radio, television, large-circulation print publications (newspapers, magazines, flyers and posters), the cinema, and public video viewing centres (Okwu, 2011). According to Srampickal (2006), the mass media provide an enormous pool of knowledge and information, serving as tools for development, and complement other approaches.

Rogers (1983) explains that mass media channels are more effective in creating knowledge of innovations while interpersonal channels are more effective in forming and changing the attitude toward the new idea, thus influencing the decision of adoption or rejection of the new idea. Interpersonal channels are communication channels that allow for person-to-person conversation (Dimmick et al., 2011) Moreover, some aspects of communication can be pairs of individuals who interact are different in specific attributes, such as beliefs, education, and social status.

Thus, there is a need for targeting communication channels that will enhance the sharing of knowledge for specific needs. According to Adolwa et al. (2012), there are two groups of channels; disseminative and communicative. Disseminative refers to the uni-directional (or one-way) flow of messages, information or knowledge from source to the recipient while communicative is the multi-directional (or two-way) flow of information/knowledge between source and recipient. Therefore, for scaling up to occur, sufficient attention must be paid within a project, to the development and implementation of a sound communication strategy (Kaplan and Ashley, 2003). The most effective communication strategy is that which will use communication channels that will not only be effective in disseminating but also communicating the innovation to and among the stakeholders.

2.2. The effectiveness of communication channels

Effective communication is defined as "the art of understanding and being understood by the targeted audience" and also as "a means of actualising desired change in both the social and economic transformation in a developing country's context" (Vinod and Marcia, 1974; Akinbile and Otitolaye, 2008). These definitions indicate that the receiver should understand the message and take action to change for the communication to be considered effective. However, they ignore the fact that the information might never reach the intended audience, especially if the channel is not appropriate for the consuming group.

McGuire's model elaborates three components -source, message and channel factors which link to communication effectiveness and can describe how each affects communication and persuasion (Kreuter and McClure, 2004). Dar and Levis (1974) add that four areas to evaluate the information source include; accessibility, ease of use, technical quality and frequency of use. However, Hartman et al. (2014) argue that information may reach the target population more effectively if communicators employ channels consistently used by a community.

Furthermore, a significant feature in communicating knowledge is targeting of information which acknowledges the different information needs of the different users (Schwaab, 2007; as cited by Mowo, 2009). This is important because the targeted knowledge management facilitates better and faster decision making.

Mowo (2009) points out that most researchers lean towards disseminating their research results in recognisable journals (print and electronic) which are not accessed by the majority of the users of the results. This is likely due to the importance of such publications as a performance metric. Moreover, even if the information was accessible, it cannot be used by the majority of the end users (farmers) because the language used is complex to local users' knowledge. Farmers need summarised information presented in ways that will be attractive to read and understand, and the less literate among farmers might need more illustrations than word (Mowo, 2009). Uncoordinated channels of information delivery to farmers resulting from poor communication has been a significant restriction to information flow between researchers and farmers (Rees et al., 2000).

According to Adolwa et al. (2012), interpersonal channels like farmer field days, on-farm demonstrations and workshops enhance interaction and feedback between a source and receiver. Farmer exchange visits and study tours are also innovative approaches that have been proven to achieve enhancement communicating knowledge about the research results to farmers effetively. (Mowo, 2009)

Participatory group media can take form of non-formal education; rooted in the culture of the people using various indigenous media like plays or poems and other cultural programs which can help to create a civic consciousness and subsequent desire for development leading to change. Different groups have noted the importance of participatory group media as a good tool to create awareness and can lead to a change of attitudes (Srampickal, 2006).

As farmers require technologies to enhance productivity, the perception and adoption of technologies relies on the communication strategies and channels that extension agents and researchers use (Akinbile and Otitolaye, 2008). Therefore, a channel can only be useful and effective if the farmer (who is a receiver) clearly understands and is being convinced of the technology (SWM) that is communicated through it and decides to work on the information.

2.3. Soil and water management interventions

Agriculture is the largest single user of water, with about 75% of the world's freshwater is currently used for irrigation. Irrigation accounts for as much as 90% of the total amount of water available in some countries (FAO, 2003). Freshwater underpins food production. Unfortunately, water access for agriculture is low and improvements in access are made very slowly globally (Qadir et

al., 2006). Limited soil moisture contributes to low yields during crop growing season, and soils that are innately nutrient deficient result in low yields with nitrogen and phosphorus mainly lost through erosion processes (Sombroek et al., 1982; Recha et al., 2016).

Mati (2000) notes that in the semi-arid areas, the farmers make an effort to adapt to climate change by accepting practices that improve agricultural productivity, for instance, water harvesting. The SWM interventions are in-situ (direct rainfall conservation) or ex-situ (rainfall plus runoff diversion) systems which include terracing, retention ditches (also known as infiltration ditches), runoff harvesting and the use of improved agronomic practices (Recha et al., 2016). Examples of water collection include deep tillage, dry seeding, mixed cropping, ridges, borders, trash lines, ponds, fog harvesting (Mbilinyi et al., 2005).

Other techniques that are promoted throughout Eastern and Southern Africa include moisture retention terraces and ditches (Abdelfadeeel, 2012). Fanya juu terraces are a well-known technique in Kenya; they are made by digging a trench, generally along the contour, and throwing the soil upslope to form an embankment. The measure is suitable for soil that is too shallow for level bench terracing and moderate slopes below 20% and are found to have a very significant effect on reducing soil erosion in semi-arid areas (Abdelfadeeel, 2012; SUSTAINET EA, 2012). Fanya chini is a similar widespread technique developed in the Arusha region, Tanzania (the soil is thrown downslope instead of upslope), this is applicable on slopes of up to 20%. (Abdelfadeeel, 2012; SUSTAINET EA, 2012).

Tanzania's dependency on rainfed agriculture makes it deeply vulnerable to weather changes, with unreliable rainfall regarding intensity and distribution as one of the most likely and damaging production risks cited by stakeholders (Arce and Caballero, 2015). Also, Arce and Caballero (2015) note drought as a severe risk that happens with lower frequency but with great potential to severely affect agriculture.

2.4. Theoretical framework

This study was guided by the instrumental model and interactive models of communicative intervention to meet its four objectives: communication flow through channels, common and preferred communication channels, motivations for using the communication channels and how communication can be made effective.

2.4.1. Instrumental model of communicative intervention

Leeuwis (2004) describes the instrumental model of communicative intervention as a mechanical view of social change and innovation (the idea is that one can design future society in a logical, organised and predictable way, just as one would design a machine). The role of communication is looked at as an instrumental way (Leeuwis, 2004).

Leeuwis (2004) argues that the instrumental model shares some similarities with top-down print planning whereby society can be manipulated predictably and that it is possible to acquire an acceptable understanding of the reasons for human behaviour which are in turn causes for specific problems in the society.

Aligning with Leeuwis, Adekunle (2013) also refers to the instrumental model of communication as top-down, blueprint planning, and mechanical process. Human behaviour and change are perceived as highly predictive and follows the similar flow of events, where experts draw a plan of action and take to the field for implementation

Richards et al., (2001) state that the instrumental approach as a diffusion/mechanistic approach whereas Rogers (1983) explains that the role of communication is to transfer technological innovation from the development agencies to clients and create the need for change through raising the atmosphere of modernisation among the public. Therefore, the vertical or top-down orientation of diffusion theory is apparent (Richards et al., 2001). This supports the perspectives of Leeuwis (2004) and Adekunle (2013) who refer to the instrumental model as top-down, blueprint planning. In brief, it is something done by experts to non-experts.

Leeuwis (2004) identifies two essential interrelated features that characterise the instrumental model of communicative intervention. First, the forms of communicative interventions take place after the goals and the corresponding policies and innovation have been defined by concerned agencies. The aim is to persuade people to accept policies as developed by policymakers or adopt innovation as developed by scientists. Secondly, communication is used intentionally as a policy instrument (in combination with other instruments) to direct human behaviour, which is thought of as being mostly predictable. In the scheme, the strict distinction is instead made between voluntary and compulsory behaviour (as shown in Figure 2.1).

Compulsory behaviour can emerge from strict coercion that originates from authorising of laws and regulations or restrictions caused by restrictive provisions. While voluntary behaviour emerges from either internal or external motivations. 'Internally motivated' voluntary behaviour is considered to arise from reasoned opinions that can be influenced by the communication intervention whereas externally motivated voluntary behaviour comes from material and social circumstances or financial impulses (subsidies/fines/taxes) brought into being by corresponding policy instruments (Leeuwis, 2004).

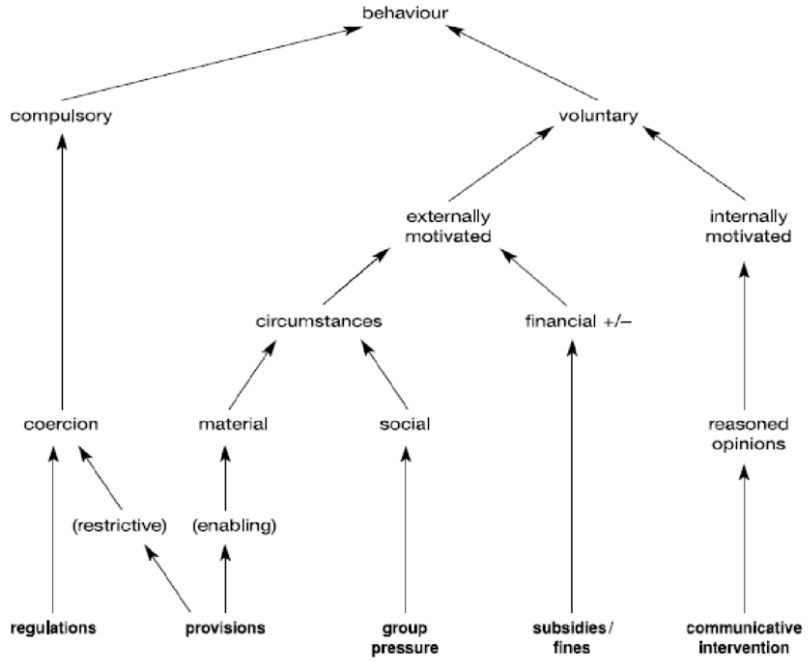

Figure 2.1: The relationship between communicative intervention and other policy instruments aimed at stimulating behavioural change, as conceptualised by Van Woerkum (1990a) in Leeuwis (2004). *Policy instruments in bold*

Adolwa et al. (2012) used diffusion of innovation theory in the analysis of communication and dissemination channels that influence the adoption of Integrated Soil Fertility Management (ISFM) in Western Kenya and found that farmers prefer community-based and mass media channels as the most suitable for the adoption of ISFM technologies. Farmers' field days and radio were considered advantageous by many farmers. The reasons for the preferences related to their accessibility, reliability, informativeness and comprehensibility. In contrast, mass media, ICT and print-based channels were not preferable by the farmers (Adolwa et al., 2012). Rogers (1983) stresses the different roles of 'interpersonal' and 'mass media' channels, being especially useful

in creating awareness amongst potential adopters and in at the end being more effective in persuading actual adoption.

The conceptual framework of Figure 2.2 shows that communication channels can lead to their effectiveness. A communication channel is effective when it is adopted and when more farmers are exposed to it. Also, when farmers accept to use it as a common channel for resourceful information sharing between them, the researchers and other stakeholders. Overall, communication channels and their effectiveness lead to the adoption of an innovation like SWM (Namulondo, 2016).

The types of channels through which message is transmitted include the mass media and interpersonal channels (Akinbile and Otitolaye, 2008). The type of channel used is measured by various means that indicate whether the farmer always uses or never uses specific channels (Okwu, 2011). Therefore, the effectiveness of the communication and dissemination channels (mass media or interpersonal) will vary depending on the stages through which the idea (innovation) is passed on to the farmer. Adolwa et al. (2012) note accessibility which is easy to use and informativeness or understanding of the message through a specific channel are indicators which can be measured for the appropriateness of the existing channels for disseminating SWM practices.

The diffusion of innovation theory states that individuals experience five stages of accepting an innovation namely; knowledge, persuasion, decision, implementation and confirmation (Rogers, 2003). The framework (Figure 2.2) illustrates how communication and dissemination channels and their effectiveness can influence the farmer to adopt or not adopt an innovation through the stages. In the knowledge stage researchers initiate and create awareness of innovation among farmers through mass media with information on how the innovation functions (Adolwa et al., 2012; Namulondo, 2016). During the persuasion stage, farmers interact to seek information relating to the innovation in order to create a favourable or unfavourable attitude towards the innovation. The interpersonal channels are effective in convincing the farmers to become more actively involved in finding knowledge about the innovation (Adolwa et al., 2012; Namulondo, 2016). The decision stage is when the farmer gets involved in activities that would lead to adoption or rejection of the innovation (Adolwa et al., 2012).

However, the farmer's decision making can be influenced by the knowledge gained or persuasion from either mass media or interpersonal channels (Namulondo, 2016) but also the accessibility of the information. Adolwa et al. (2012) explain that the moment the farmer implements the new idea, he/she has already validated it and the researcher's task and other stakeholders are to provide technical support. Whether the farmer rejects or adopts the innovation, he or she may receive information that may lead to later adoption or discontinuance of it (Adolwa et al.,2012). Namulondo (2016) states that the adoption of innovation can be affected by the communication frequency in some social and cultural settings. At the confirmation stage, the farmer or individual has decided to reinforce the innovation and delete any form of uncertainty. The farmer will continually need information throughout the entire process leading to the sustainable application of the innovation; thus, the communication and dissemination channels need also to be effective to support the farmer's decision and action to implement innovation in a sustainable manner.

The relationship between the receiver and potential innovation can be changed by income level, education, labour, farm size and age of the farmers. The farm size of the farmer also can contribute in influencing the farmer to want to get information from the channels concerning the SWM practices and use its effectiveness likeability to understand the message, frequency of use, informativeness) to make the decision. Age and education level also may contribute to the types of channels the individual farmers prefer to use for information on SWM practices. The labour needed in the application of the innovation also may influence the farmer's decision.

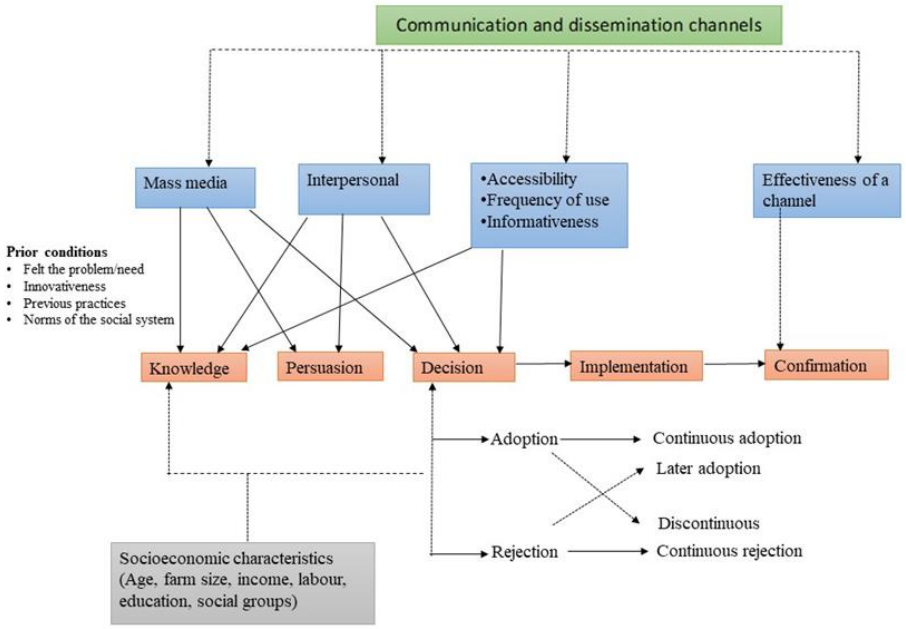

Figure 2.2: Conceptual framework for the relationship between communication channels and adoption. Source: Adolwa et al. (2012) as modified from Namulondo (2016)

This study refers to the theories found in the literature to investigate the communication channels used and their effectiveness in disseminating SWM practices; whether they influence the adoption of the innovation to support sustainable agriculture. Akinbile and Otitolaye (2008) note that various communications are used to disseminate agricultural innovation and other channels can be appropriate to disseminate a specific innovation.

2.4.2. Interactive model of communicative intervention

The interactive model of communication intervention is explained to be a participatory form of communication as it contributes to the social processes like social learning, network building and negotiation (Leeuwis, 2004). In this approach the role of communication is not to sell or implement the pre-defined goals, innovation or policies but to help to design and create appropriate goals, policies and innovations in close interaction with societal stakeholders (Van Woerkum et al.,1999; as cited in Leeuwis, 2004). Leeuwis (2004) explains that communication becomes a crucial part of facilitation strategies that aim to improve learning and negotiation towards change.

Richards et al. (2001) refer to interactive communication more as participatory communication. According to the authors, the participatory model emphasises the importance of cultural identity

of local communities, democratisation and participation at all level including individual, local, national and international.

Participatory communication stresses a two-way communication processes, distinguishing them from one-way communication approaches that involve disseminating messages, transmitting information, or persuade people to change their behaviour (Srampickal, 2006). Furthermore, participatory communication gives preference to horizontal approaches that encourage dialogue focused on searching for solutions and analysis of the problem, as well as bottom-up approaches that aim to raise the awareness of decision-makers (Otsyina and Rosenberg, 1997). Chauhan (2007) adds that participatory communication means moving from a focus on informing and persuading people to change their behaviour or attitudes, to a focus on facilitating exchanges between different stakeholders to address common problems.

Leeuwis and Aarts (2011) explicitly note that nowadays innovations are not one-dimensional and that the thinking about innovation as a process has also changed. The innovation processes are conceptualised as conflictive and dependent on dynamics in networks. Also, they note that previous focus on diffusing a tangible product is currently unhelpful because outscaling of meaning innovation depends on spreading of collective process that happen form one network to another (Leeuwis and Aarts, 2011). This applies to SWM practices, for the practices to be adopted and sustainable there should be connection between all agricultural stakeholders and can only happen if there is effective communication between them.

Due to the change in the innovation process from the linear model to the complex interdependency of the system, the role of communication in innovation has also changed from diffusing a ready-made innovation. Leeuwis and Aarts (2011) emphasise that communication in innovation cannot only be focused on the contributions of professional change agents and intermediaries or the likes, but innovation is performed by interdependent societal agents who interact with each other in several settings and networks. These actors are more likely to communicate with each other about change-related issues during everyday activities and occasions than during the meetings and interventions prepared professionally (Leeuwis and Aarts, 2011)

Moreover, Scrampickal (2006) explains that communication plays an essential role in development because, without the proper two-way flow of information and dialogue between stakeholders, development is unlikely to happen. Communication can connect individuals and communities or governments and citizens in participatory and shared decision-making. Communication might also lead to common development initiatives to experiment with possible solutions and to identify the needs to support the initiative in terms of partnerships, knowledge and material conditions (Chauhan, 2007)

2.5. Research Gap

From personal observation, it has been observed that much has been written on factors affecting the communication or adoption of Good Agricultural Practices like improved varieties or fertilisers in Africa. However, little has been written about the communication channels in disseminating SWM practices that could be effective in bringing about sustainable smallholder farmers specifically in Tanzania. Since climate change is further affecting the agricultural sector, it is urgent to know the appropriate channels for communication strategies with the farmers. This is the overarching gap that the research aimed to fill. This work is a case study under a project implementing activities in Kongwa and Babati districts of Tanzania.

CHAPTER THREE

3.0. Materials and methods

3.1. Description of the study area.

3.1.1. Geographical Location

The study was conducted in two regions namely Manyara and Dodoma. Manyara is located in northern part of Tanzania, from the 2012 national census Manyara had 198,513 agricultural households out of which 132,677 (67%) were involved in crops as well as livestock production, 60,611 (30%) involved in growing crops only, and 5,224 (3%) were involved in rearing livestock only (National Sample Census of Agriculture 2012). 608,088 hectares (ha) was the total area of land was available to smallholders for agriculture. Annual crop production (maize, paddy, oilseeds) activity provided most of the household's income followed by livestock keeping. The area was reported to have 2% of the total area under irrigation with 22% of agricultural households with soil erosion and water harvesting facilities in the region (National Sample Census of Agriculture 2012), The numbers are likely to have changed by the time the study was implemented. Manyara region is divided into five districts namely; Babati, Kiteto, Hanang, Mbulu and Simanjiro. Annual average rainfall is extremely variable, ranging from 500 – 1,200 mm. The area experiences bi-modal rains; long rains that starts from February to May and short rains from November to December (Löfstrand 2005). Soil types are sandy to clay loams that are dominated mostly by the red colours of sesquioxides – secondary clay minerals and black colours in low lands (Löfstrand, 2005; Timler et al., 2014).The communication channel assets owned by most rural agricultural households in Manyara region are 30% radios/cassette/music system, mobile phones (20%), television/video (1%) and landline phone (1%) while the remaining percentages are other household assets including bicycle (29%), pressing iron (12%), wheelbarrow (4%), refrigerator (1%) and vehicle (2%) (National Sample Census of Agriculture 2012).

Dodoma is located at latitude 6˚S and longitude 35˚E, in the centre of the country, covering an area of 41,311 square kilometres (Kahimba et al., 2014; www.dodoma.go.tz/profile). The climate of Dodoma is mostly semi-arid with relatively warm temperature throughout the year (Kihamba et al., 2014), characterised by a marked seasonal rainfall distribution with a long dry and short wet season, an average annual rainfall of about 550 – 600mm per year, which falls between December

and April each year. Generally, the rains fall in heavy storms resulting in flash floods causing 60% of the precipitation to become run-off rather than penetrating the soil for crop growth. (www.dodoma.go.tz/profile). Dodoma has seven subdivision districts namely; Bahi, Chamwino, Chemba, Dodoma urban, Kondoa, Kongwa and Mpwapwa. The communication channel assets owned by most rural agricultural households in Dodoma region were not identified from previous literatures for this study.

The researcher mainly selected these two regions because the Africa RISING programme was implementing its activities but also due to their different ecological zones of semi-arid in Kongwa and sub-humid in Babati. Moreover, both regions grow some similar crops like maize and sunflower, and they are both involved in agricultural and livestock farming as main activities. (www.domestictourismsafaris.co.tz; wwwodoma.go.tz/profile)

3.1.2. Study site

The study was conducted in five villages where the Africa RISING programme activities are implemented to have the beneficiaries and non-beneficiaries' groups. Africa RISING is the name of the programme operating in three East and Southern Africa (ESA) regions including Tanzania. The programme is funded by USAID under the Feed the Future initiatives, implemented in the maize-dominated cereal-legume farming systems of Tanzania. The activities aim at establishing best-bet technologies that could deliver adoptable development solutions to smallholder farm families and drive wider adoption at scale through effective partnerships with able and willing development institutions (www.africa-rising-wiki.net). The researcher also worked in five villages where the project's activities are not implemented to have respondents as control farmers. Project's sites selected were two villages in Babati district, Manyara region and three villages in Kongwa district, Dodoma region. For control sites, two villages were selected in Babati district and three villages in Kongwa district. A total of 10 villages were selected for this study.

Table 3.1: Names of villages and types of farmers included in the study

Districts - Regions	Beneficiary groups villages	Non-beneficiary groups villages	Control groups villages
Babati, Manyara	1. Seloto 2. Orngadida	1. Seloto 2. Orngadida	1. Loto 2. Endanoga
Kongwa, Dodoma	1. Sagara 2. Laikala 3. Mlali	1. Sagara 2. Laikala 3. Mlali	1. Suguta 2. Iduo 3. Ijaka

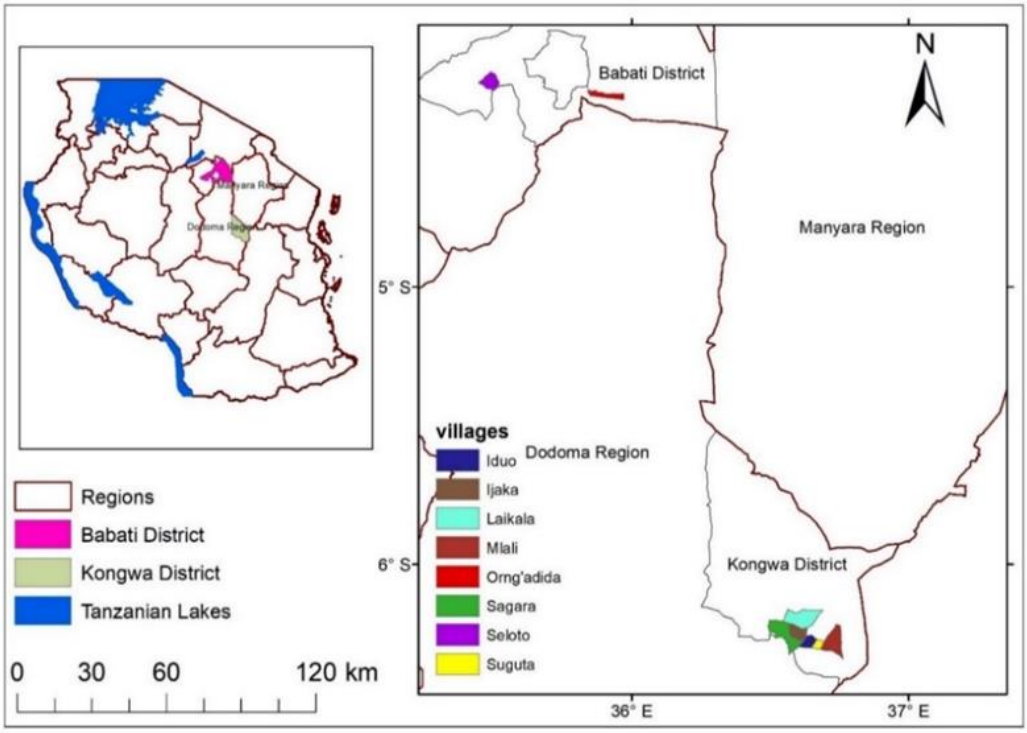

Figure 3.1: A map showing the study sites in Dodoma and Manyara regions.
Source: Exavery Kigosi IITA/Africa RISING
Note: Some villages are not mapped because they were split from other villages and the responsible authority has not released the new version of village map layers

3.2. Research design

The study employed a survey research design. The survey was conducted using a short questionnaire that collected socioeconomic information from respondents during Focus Group Discussions (FGD) and semi- structured interview with key informants. The questionnaires and the net-map tool used for FGDs were piloted before using them in the field. Data collection was conducted during January and February,2019.

3.3. Determination of the sample

A total of 91 respondents, both smallholder farmers and key informants participated in the study in Manyara and Dodoma regions. The regions were purposively selected based on the districts that the Africa RISING programme works on disseminating SWM technologies. To identify the sample, the project's SWM researchers assisted the researcher to get the lists of sites where SWM practices specifically ripping, 'Fanya juu' and 'Fanya chini' terraces and tied ridges were implemented in Babati and Kongwa districts. A purposive selection of 10 members was made from each farmer's groups which are beneficiaries of the programme in the selected sites because the each beneficiary groups have around 20 members and it could be difficult to conduct FGD with all members . In Babati sites, there were no farmers groups; therefore, the researcher decided to put individual farmers who are beneficiaries of the project into two groups from two sites. Five individual farmers who were non-beneficiaries from the same project's villages and five individual farmers from five villages where the project's activities were not implemented were selected. All individual farmers were put in groups to form an FGD in each study site. Five key informants were selected to complete semi structured interviews with, depending on their positions related to dissemination of the SWM practices in the selected sites, with the aim of capturing the additional information on how they disseminate SWM practices.

The sampling based on criteria of selection of sites where project implemented SWM practices activities, farmers awareness on SWM practices and specific preferred number of beneficiary respondents was 10 members in each site, while non beneficiaries and control groups included five members in each site. The sampling did not include the criteria whether the respondents implement or does not implement the practices because it focused on awareness of SWM practices, channels used to get information and what farmers do with knowledge transferred to them.

3.4. Data collection

Prior to conducting semi structured interviews and net-map Focus Group Discussions (FGDs), the lists of beneficiaries, non-beneficiaries and control farmers and sites were identified. The interview guidelines were prepared. The net-map tool was piloted with four colleagues during January, 2019 in Arusha to look into possible content and flow of the questions for the full run of the FGDs.

At the start of the FGDs, the consent of respondents was requested by reading out the consent form content, giving clarifications that participation was voluntary and other clarifications on to issues that respondents wanted to understand. All respondents agreed and selected one of the respondents who signed the consent form on their behalf. The short questionnaire survey was conducted with the 86 respondents who participated in the FGDs to collect socioeconomic characteristics of the respondents. The characteristics collected were age, gender, education level, source of income, types of SWM practice they implement, family size and farm size and the farm area under cultivation. This descriptive data was collected to better understand the sample population. All discussions and interviews were conducted in Swahili language with all farmers and three key respondents, the consent forms were written in Swahili. The two remaining key informants were interviewed in English because they were not fluent with Swahili.

Since the study focuses on how communication channels can be made more effective in disseminating SWM practices, special care was put in getting farmers from three categories (beneficiaries, non-beneficiaries and control) and key informants on SWM practices to get balanced insight. The project used the participatory approach in conducting its activities; therefore, the farmers that were directly working with the project were identified as *'beneficiaries'* while those who were not directly working with the project were identified as '*non-beneficiaries'* within the project's sites. The '*control'* groups were the farmers who wre in villages where project's activities were not implemented. Data was collected on the types of stakeholders and communication channels used.

Although the sites have different ecological zones, they are all characterized by land degradation, with the areas exhibiting the high levels of soil loss. The soils in the regions are also inherently poor in terms of fertility making this a leading biophysical cause of low agricultural productivity. Therefore, the researcher of this study focused on SWM practices, stakeholders and communication channels because she wanted to investigate the effective dissemination of the

Fanya juu and Fanya chini terraces, tied ridges and ripping as technologies that would help to prevent soil and water loss. Stakeholders and communication channels are important variables to be considered when looking at the effective communication in disseminating SWM practices.

15 net-map FGDs and five semi- structured interviews were conducted with a total of 91 respondents. Interviews were recorded with consent from the respondents. Whereas, FGDs were based on the net-map method (Schiffer,2007), the researcher adapted the tool in a way that would fit the study. In a first step, the respondents were presented with a flip chart with the names of the stakeholders and communication channels stickers on it, and explanations were given concerning the relationship between the stakeholders and communication channels stickers that were on flip charts. The researcher purposively prepared the flipcharts with the generally known stakeholders and channels due to time constrains, farmers cautioned the team to observe time because they were expecting rains and they were spending much time in farms The respondents were asked to identify if there were information flow between stakeholders, and which channels were used to transfer the messages. Some of the stakeholders were used as communication channels of which SWM information was passed through. These stakeholders and communication channels were as explained in the next paragraph

In a second step, the information flow about SWM practices were characterised between stakeholders and channels as identified in step 1. This was done by successively evaluating the presence of each relationship among actors based on previously defined questions, while simultaneously drawing a diverse network in a collaborative and interactive way. To visualize the network, arrows were drawn for every connection between stakeholders and channels on the flip chart. The third step of the net-map FGDs consisted in assessing the communication channels attributes needed for the exploration of common communication channels and preferred channels. Perceived motivations were assessed by asking respondents the reason for using or preferring the communication channels discussed and selected. In all motivations mentioned, six motivations appeared to be repetitive in all discussions and the researcher used them as the main motivations for this study. Communication channels were allowed to have multiple motivations, and motivations were marked as word next to the channel's name on the chart.

The actors' perceived common communication channel was assessed by each respondent to stack bottle tops and construct towers of different heights for each communication channels. The

'*common communication channel'* in this study means the usual channel. Each respondent was given fives bottle tops to indicate the five common channels that are used to disseminate SWM practices. In a similar step, the respondents were asked to construct towers representing the communication channel that they considered to be farmer's preference in disseminating the SWM practices, the use of bottle tops was a bit different in this round of constructing towers. Each respondent was given three bottle tops of different colors representing preference ranking; blue representing first choice, yellow second choice and red a third choice. The height of both towers was restricted, as one respondent could not stack the tops more than once on the channel they choose, but other respondents with similar perceptions on the channels would place their bottle tops on already chosen channel. The heights of both towers were marked as numbers on the charts and the net-map procedure completed with this step.

Due to physical unavailability and time constraints of key informants normal semi-structured interviews were conducted to get the required information. This resulted in the failure of conducting net-map interviews which was the main tool used in this study. However, the information for communication channels and preferred channels was collected through sending a short excel form for the key informants to respond. Only two out of five key informants filled and returned the forms; they were also used in common and preferred channels results. The recordings also included the key informants and were used to support the discussions on the results and were found during the study.

3.5. Data presentation and analysis

Questionnaires, recordings and notes from interviews and net-map FGD were kept confidential following the privacy rights protocol. Data were analysed using the IBM Statistical Packages for Social Science (SPSS) 24 to analyse the questionnaires to get quantitative figures of variables based on the socio-economic characteristics influencing the respondents' access of sources and channels and implementing of the SWM practices. The frequency of the variables was analysed.

The recordings were listened and used to analyse data for RQ 4 and also to clarify quantitative findings. The information from recordings and notes helped to clarify the motivations for using and prefer communication channels. Moreover, suggestions on how to improve the communication in disseminating SWM practices were identified.

Information obtained from 15 FGDs net-maps from beneficiaries, non-beneficiaries and control respondents in Kongwa and Babati district showing the flow of information between stakeholders through communication channels were used to create graphs, the charts were converted into separate adjacency matrices as individual sites. An adjacency matrix as defined by Wasserman and Faust (1994) 'is a two-way matrix used to represent network data in Social Network Analysis (SNA). Its two dimensions are composed by sending actors located in the rows and receiving actors located in the columns of the matrix'. In these binary matrices, information on the existence of a tie is coded with 1, and information on the non-existence of a tie is coded with 0, respectively. The information flow is assessed between stakeholders through directed communication, meaning that ties connecting two stakeholders and channels are either incoming or outgoing. Connections between stakeholders are not always considered to be reciprocal. Information flow between stakeholders through channels is interesting because many of them specifically seem to like to use interactive channels in sharing SWM information. There is incoming and outgoing information between stakeholders and even in the channels they commonly use and prefer. The 15-individual net-maps from the 10 sites were represented into 15 adjacency matrices separately. The similar groups (beneficiaries, non-beneficiaries and control) were summed up to get one adjacency matrix for each group in each district (*see appendix 5*). Finally, a total of six adjacency matrices were produced and used to generate network graphs showing the flow of information between stakeholders through channels in Babati and Kongwa. The SNA measures were calculated and networks of the information flow were evaluated using Gephi 0.9.2 software, while network graphs were visualized using NetDraw/net-map from the same software (Cherven, 2015). As there were 17 networks showing the flow of information concerning SWM practice, the stakeholders and communication channels were grouped into two subgroups for connection assessment. The connections were grouped into stakeholders and communication channels whereas channels were again based on their criteria mass media including ICT and interpersonal. Each group was differentiated using a different color in the network graph and presented as '*nodes'*

Gephi 0.9.2 was also used to calculate the in-degree centrality, out-degree centrality and betweenness centrality of stakeholders and communication channels in the network of flow of information about SWM practices. The indegree centrality measures the ties where the stakeholders and channels receive information; the outdegree centrality measures the ties where

the stakeholders and channels provide information and the betweenness indicates the stakeholder and channel's potential to control the information flow (Delgadillo et al.,2016; Cherven, 2015).

Information about 1) common 2) preferred communication channels and 3) motivations for using the communication channels was recorded in 45 attribute tables, three for each FDG network from each respondent group. The attributes for common channels and preferred channels were clustered by district for easy visualization. Therefore, there are four graphs presenting common communication channels and preferred communication channels in Babati and Kongwa sites.

For each of the 14 communication channels motivations, data was coded in the form of values ranging from 0 for a motivation not present in any individual network, to 11 for a motivation present in all of the 14 individual networks. 11 was the highest some farmers groups especially the beneficiary exceeded the required number of 10. Data on the common and preferred channels ranges from 0 if no tower was constructed for a channel in any individual network, to 11 if the tower constructed for the channel was the highest (whereas 11 was mostly for beneficiary group and 5 for non-beneficiary and control); and therefore took a value of 1 in all individual networks.

As the restriction was on choosing five common channels and three preferred channels for each respondent the height of the towers varied on selection of the channel by the respondents. To make them easy to compare standardization was made on the common communication channels including 0 – not used, 1 to 2 – less used, 3 to 4 – medium used and 5 and above – mostly used. Preferred communication channels were standardized by different bottle top colours; blue represented the first most preferred, yellow represented the second best preferred and red represented the third best preferred. Motivation for this section refers to the reasons that influence a farmer to prefer a certain communication channel. The motivations were captured after the construction of the common and preferred communication channels. The farmers were asked the reasons for preferring the channels they chose. The reasons that were said were noted beside the channel on the flip charts. During the analysis and sorting of data, the researcher selected motivations that appeared to be mentioned mostly by the farmers groups. Six motivations from the sorting became the main farmers motivations that the researcher used for this study including informativeness, accessibility, flexibility, frequency of use, reference and feedback.

CHAPTER FOUR

4.0. Results

This section lays out the results obtained in the analysis. The information presented is based on the questionnaires, the net-map charts as well as the recording and notes obtained from the net-map FGD and the semi structured interviews. The results are presented to respond to the specific problems and research questions. In order to avoid repetition of information, results of RQ 4 is presented together with discussion in chapter five.

1.1. Response rate

86 questionnaires were filled by respondents who participated in the FGDs with assistance from the research enumerators in Babati and Kongwa. All questionnaires were filled in and returned making a 100% rate of response. The 86 responses were considered to be valid for this study.

1.2. Socio-economic characteristics of the respondents.

1.2.1. Gender and education level

The study FGDs were conducted with 44 male respondents and 42 female respondents. The education level acquired by male respondents was 81.8% primary education, 15.9% secondary education and 2.3% higher education. Whereas, for female respondents 14.3% were illiterate and 85.7% attained primary education (Table 4.1). The study shows that the education level of the respondents is one of the factors that make farmers use or prefer certain communication channel. Most female respondents noted use and preference for interpersonal channels in sourcing information over mass media especially poster and flyers because they cannot read.

Table 4.1: Education level attained by respondents in Babati and Kongwa districts

Education level	Male		Female	
	Frequency	Percent	Frequency	Percent
Illiterate	0	0	6	14.3
Primary	36	81.8	36	85.7
Secondary	7	15.9	0	0
Bachelor	1	2.3	0	0
Total	44	100.0	42	100.0

1.2.2. Gender and SWM practices implementation

Table 4.2 shows that (40.5%) of female farmers implement the SWM practices under the study compared to the male farmers. However, still 28.6% of female farmers do not implement the SWM practices while male farmers who are do not implement the practices are 22.7%. The number of women implementing the SWM practices is higher than that of men because they are the ones who are mostly working in the farms. Men as heads of households get information and share with their wives and children to implement. Moreover, men have decision power of whether certain practices can be implemented in the farms due to land ownership and authority they have as heads of households. It was indicated in Babati district that women can implement information they get, only if they are able to communicate well and convince the husbands on the topic or if men give them the permission to decide certain issues in the family. The female headed households were also noted to source for information and implement when they have access to land. Women explained that they are ready to implement the practices but labour intensity and access to land are major challenges. Men were concerned with high productivity but time investment, cost and what they call '*reducing farm size'* through measuring and digging terraces cause them not to implement the practices. Cost implications and lack of technical knowledge on the practices, especially the importance of measurements and the technical know-how of measures were general challenge.

Table 4.2:Types of SWM practices implemented by male and female respondents in Babati and Kongwa districts

Types of practices	Male		Female	
	Frequency	Percent	Frequency	Percent
None	10	22.7	12	28.6
Ripping	1	2.3	0	0
Fanya juu and fanya chini terraces	1	2.3	5	11.9
Tied ridges	1	2.3	5	11.9
Fanya juu terraces	0	0	1	2.4
Mixed practices under study	13	29.5	6	14.3
Conventional tillage	6	13.6	7	16.7
Other practices	7	15.9	2	4.8
Other mixed practices	5	11.4	4	9.5
Total	44	100.0	42	100.0

1.2.3. Farmers groups and SWM practices implementation

Table 4.3 reveals that 60% of non-beneficiary farmers group does not implement SWM practices compared to 25% of control farmers. The observation shows that farmers in control groups look for information to solve the SWM challenges from various sources outside their villages. While the non-beneficiary groups who despite having the information, had different reasons for not adopting the technologies available citing reasons like labour intensity, cost, time, being used to conventional practices. 97.3% of the beneficiary groups implement the SWM practices, they noted that interaction with researchers and networking with other successful farmers have enlightened, exposed and motivated them to want to experience new knowledge.

Table 4.3: Types of SWM practices implemented by the farmers groups respondents in Babati and Kongwa districts.

Types of practices	Control		Beneficiary		Non-beneficiar
	Frequency	Percent	Frequency	Percent	Frequency Perc
None	6	25.0	1	2.7	15
Ripping	1	4.2	0	0	0
Fanya juu and fanya chini terraces	1	4.2	4	10.8	1
Tied ridges	1	4.2	5	13.5	0
Fanya juu terraces	0	0	0	0	1
Mixed practices under study	5	20.8	13	35.1	1
Conventional tillage	5	20.8	3	8.1	5
Other practices	4	16.7	3	8.1	2
Other mixed practices	1	4.2	8	21.6	0
Total	24	100.0	37	100.0	25

1.2.4. Respondents age groups

Table 4. 4 shows 60.5% of population are in a middle-aged adult group and 23.3% are in older adult group. Only 16.3% of young adults are doing agriculture. This can be the reason for SWM practices to not be adopted at high rate as the population with high labour power is not participating in agricultural activities. Furthermore, this can lead to different choice of channels used to get SWM practices information.

Table 4.4: Respondents age groups in Babati and Kongwa districts

	Frequency	Percent
Below 35 years	14	16.3
Between 35 and 55 years	52	60.5
Above 56 year	20	23.3
Total	86	100.0

1.3. Flow of information between stakeholders

1.3.1. Strength of networks

The results represent the networks on flow of information about the SWM practices among the stakeholders through communication channels in both Kongwa and Babati sites. They also show that sometimes stakeholders act as communication channels to disseminate SWM practices to others which can be explained as face-to-face interpersonal communication. Each group is explained by independent net-maps respectively. The net-map centralities are explained for each group in the districts. Later, the explanations for the common communication channels, preferred channels and motivations for farmers to use the channels are reported.

Six categories of stakeholders were identified including farmers, Non-Governmental Organisations (NGO), researchers, extension officers, fellow farmers and government. The researcher identified the types of communication channels including the interpersonal communication (exchange visits, exhibitions, farmer field days, fellow farmers, researchers, extension officers), mass media (TV, radio, newspapers, flyers, posters, internet and mobile phones) and *'others'*; the *'others'* category gave the respondents the chance to add the channels that they use apart from those mentioned by the researcher during the study. All these categories are presented as *nodes* in the net-maps.

In total, 17 nodes were identified on 15 net-map charts. In the '*other'* node the respondents mentioned the channels including seminars, trainings, workshops, village meetings, demonstration plots, village drum announcements, farmers groups. Other stakeholders that were mentioned in NGO nodes that disseminate SWM practices were Farm Africa, LAMP, HADO, LVIA, local environmental committees.

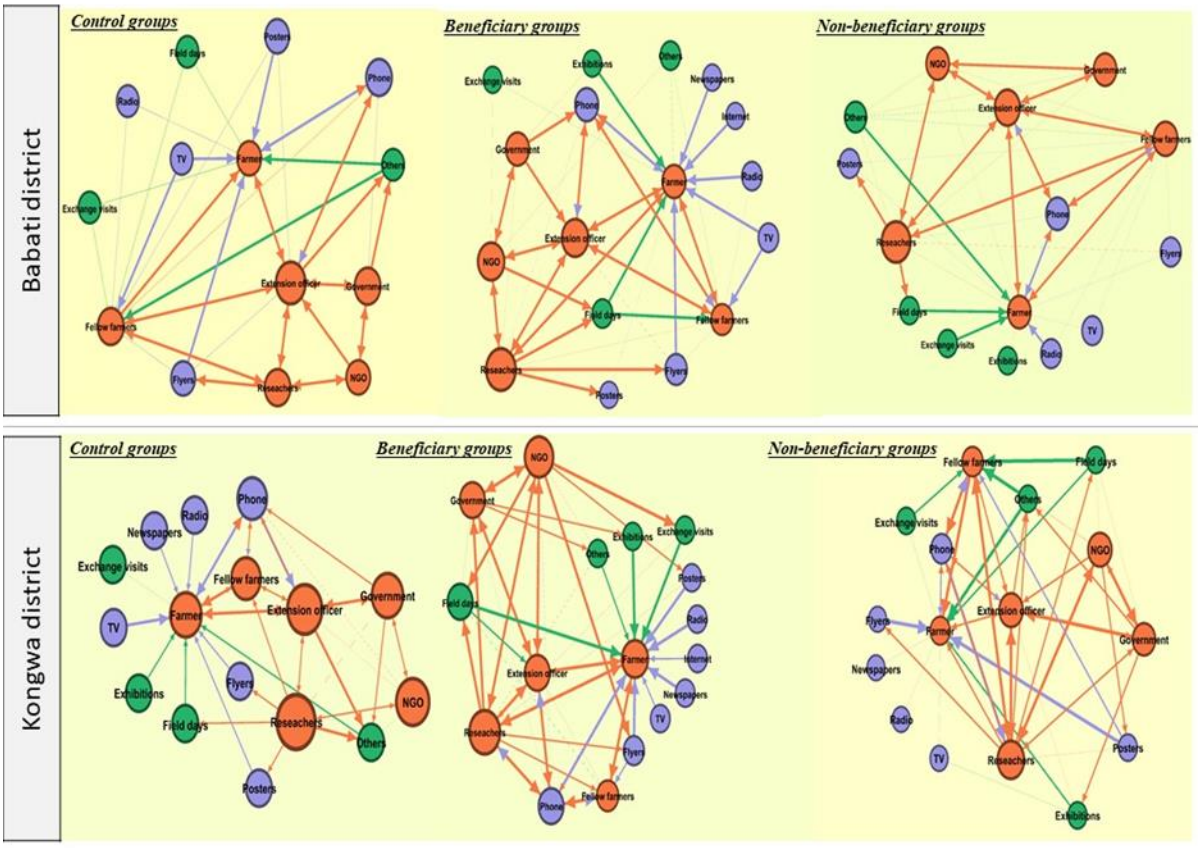

Figure 4.1: The net-maps showing the flow of information about SWM practices among stakeholders in Babati and Kongwa districts.

The sizes of nodes reflect the stakeholder/channel with high out-degree centrality of flow information within the network. The nodes are clustered by colours at three different levels; green – interpersonal channels, purple - mass media/ICT and oranges- stakeholders. The arrows reflect where the information is directed, while the thickness of the edges shows how the farmers groups perceive the flow of information between networks. The dotted edges = less flow of information (1), thin edge = medium flow (2), thick edge = high flow of information (3). These indicate whether the same flow occur in all villages for the same farmers groups or partially occurring to some villages

All net-map figures show differences in the flow of information concerning SWM practice between stakeholders through channels in groups of respondents, this depends on the exposure of the individuals in the groups, the social economic characteristics including age, gender and education level. These differences can also be determined by the challenges they face in using certain channels due to their proximity to the sources of information, geographical location or education level. For example, in the Kongwa district women in all groups were observed to be

informed about SWM practices information as they have opportunities to access sources of information like meetings, field days and working with researchers, many noted that they have opportunity to implement them due to the decision-making chance they have in the households. In the Babati district, men had more interaction with sources of information *'Women do not come to meetings like this, they stay home and we take the information to them'* a male respondent noted. *'The head of the household has to decide if we implement the technology, because he has the final say'*. Moreover, education level was also noted to be the reason for difference in channels use and preference *'I like demo plots and practical learning because I don't know how to read, and I tried to apply one of the practices from what I have been hearing from the radio and fellow farmers, but I did it wrongly because I lacked practical knowledge and the technology didn't work'* a control respondent from Kongwa noted. *'I suggest for more flyers because one can keep and refer to it for future use, even for years to come'* a beneficiary respondent from another village in Kongwa district.

1.3.2. Networks positions

Table 4.5: Top five list of the highest centrality measures in flow of information among stakeholders through channels in disseminating SWM practices in Babati district.

The indegree centrality measures the ties where the node receives information; the outdegree centrality measures the ties where the node provides information and the betweenness indicates the node's potential to control the information flow (Delgadillo et al.,2016; Cherven, 2015)

Groups centralities		Fellow farmers	Farmers	Extension officers	Researchers	Phones	NGOs	Government	Flyers	Field days	Exchange visits	Radio	TV	*Others*	Posters
Indegree	Control	11	10	8	3	4		3							
	Beneficiary	9	14	7	4	4	3	3							
	Non-beneficiary	9	11	7	5		4								
Outdegree	Control	4	3	6	4	4	3	4	3		2	2	2	2	3
	Beneficiary	3	4	6	8	4	6	4	3	2		2	2	2	
	Non-beneficiary	5	3	6	9	4	3	4							
Betweenness	Control	30.41	10.16	26.5	20.83	4.41									
	Beneficiary		91.8	45.7	65.2		33.1	15.8							
	Non-beneficiary	41.5	34.3	24.6	48.6	5.6									

Table 4.6: Top five list of the highest centrality measures in flow of information among stakeholders through channels in disseminating SWM practices in Kongwa district.

The indegree centrality measures the ties where the node receives information; the outdegree centrality measures the ties where the node provides information and the betweenness indicates the node's potential to control the information flow (Delgadillo et al.,2016; Cherven, 2015)

Group centralities		Fellow farmers	Farmers	Extension officers	Researchers	Phones	NGOs	Government	*Others*	Field days	Agricultural exhibitions
Indegree	Control	4	12	6		5		3	4		
	Beneficiary	6	14	7	5	6	5	5	4	4	
	Non-beneficiary	8	13	6	6	4		3	4	3	
Outdegree	Control	3	4	6	8		5	4			
	Beneficiary	3	9	6	11	6	9	6		6	
	Non-beneficiary	4	3	7	10	4	7	6			
Betweenness	Control		100.0	84.75	48.83		2.25	6.75			
	Beneficiary		106.15	11.41	31.94	11.24		16.42			
	Non-beneficiary	21	76.5	37.9	65.4						14.2

Tables 4.5 and 4.6 illustrate the nodes with high centrality measures in the flow of information about SWM practices in Babati and Kongwa. In control groups in Babati (Table 4.5), the fellow farmers node has high indegree centrality because the respondents noted that there are fellow farmers who previously used to work with projects which have phased out like Farm Africa and LAMP so they received much information on SWM practices, some contributed to dissemination of SWM practices in their villages by sharing information and mentoring others. They also noted to be getting information from distant fellow farmers who are informed about the practices through mobile phones. Whereas in Kongwa (Table 4.6), the non-beneficiary respondents noted that some villages have not had long existing projects working on SWM practices apart from HADO that existed the 1970's, this led many fellow farmers to have less information about the practice and depend on information shared from external fellow farmers or other sources. In these villages, interactive information on SWM practices is rare unless through extension officers or a farmer being a member of a farmers group. In both districts, farmers groups were identified to be the easy access to information for farmers from all levels of stakeholders than individual farmers. The

information observed from the respondents in two districts can be evidently seen in the out-degree centrality measures where the fellow farmers node in control groups in Babati (Table 4.5) seems to be the second node with high out-degree centrality after the extension officers node while fellow farmers node of control groups in Kongwa (Table 4.6) are the fifth in the list of nodes that disseminate information to other stakeholders. This means the control farmers in Babati district are aware about SWM practices and communicate in dialogues since various programmes concerning land management worked in the district compared to control village farmers who have not heard much about SWM practices and thus dialogue is limited. Moreover, for control groups in Babati the extension officer's node has high out-degree centrality measures while in Kongwa, the researcher's node is considered to have the high out-degree centrality. All farmers from both districts recognised that researchers are the ones originating the information from their research finding. However, the farmers in Babati (Table 4.5) noted that they have been working and receiving much of the information on SWM practices from the extension officers who have been interactive and efficient. While in Kongwa (Kongwa 4.6), the farmers noted that most of the times information is disseminated by the researchers through demo plots and field days that they get the chances to attend in neighboring villages and information from other sources like mass media. It was also noted that there is limited interaction between farmers and extension officers in Kongwa control villages. It can be observed that there is a big difference in betweenness centrality measures of the control groups from the two districts. Control group in Babati, fellow farmers is a node with high betweenness centrality measure of 30.41 (Table 4.5) while in control groups from Kongwa the farmer node seems to have high betweenness of 100.0 (Table 4.6). As it has been elaborated before that fellow farmers nodes in the control groups from Babati was the one more exposed to sources of information, this leads it to be the potential node in controlling the information flow, meaning the node can make the flow of SWM information successful or a failure through sharing the information with other nodes In Kongwa, the farmer node is a potential node because it has the power to act on sourcing for information from other nodes, it also decides whether the information it receives or knows about SWM practices reach other nodes specifically the fellow farmers node.

In beneficiary groups, it is revealed that both groups from Babati and Kongwa district receive the information about SWM practices equally (Table 4.5 and 4.6). It can be said that the implementing project is equally communicating and disseminating the research findings to the beneficiaries. Moreover, all beneficiary groups are noted to use similar communication channels (*see Figure*

4.1). The researcher's nodes from both districts seem to have high out-degree centrality measures in the beneficiary groups (Tables 4.5 and 4.6). The beneficiary farmers noted that they have much and direct interaction with the researchers, they noted that the interaction with researchers have equipped them with technical knowledge that help not only on SWM situation but also agricultural improvement at whole. Farmers also noted that the interaction and participatory approach that researchers use in bringing the intervention give them a sense of belonging and that they are free to share their opinion and a chance to use the technologies that best fit their situations. This keep motivating them to disseminate the information and also implement them despite the challenges that practices come with. Many farmers from the three categorised groups also noted that most researchers have good approach of inclusiveness of the farmers in their activities compared to how other stakeholders specifically government introduce the intervention which was noted to be instrumental approach including fines, coercion. However, they recognised the subsidies efforts that are given by the government. Again in both districts, the farmers nodes are revealed to have high betweenness centrality measures in beneficiary groups (Tables 4.5 and 4.6),this is because they have access to more sources of information on SWM practices especially the interpersonal channels compared to control and non-beneficiary groups thus making them to have more opportunity to get the knowledge in the districts. They are potential nodes who can also act as intermediaries between the fellow farmers node and other nodes, and their control over information can contribute in the adoption and implementation of the technologies in action. For example, it has been noted by farmers from control and non-beneficiary groups that some of the beneficiary groups are training and helping other farmers within and outside their villages in technical measures of some SWM practices. They also noted to be informed about and observing the practices form the beneficiary farmers.

Furthermore, in Babati and Kongwa districts the non-beneficiary farmers nodes seem to be receiving more information about SWM practices compared to the control farmers (Tables 4.5 and 4.6). This is due to the opportunity they have to also interact with nodes that have knowledge concerning the practices including their extension officers, fellow farmers within their communities and even researchers while control group farmers' nodes have chances to interact mostly with extension officers and by chances with fellow farmers in case of villages that had SWM projects before. However, the out-degree centrality measures of the non-beneficiary farmers nodes are lower. This means many non-beneficiary farmers do not communicate and disseminate

the SWM practice information, this can be the reason for the low adoption rate of innovation (Table 4.6).

Interestingly, mobile phones node seems to be an essential mass media node that nodes use to communicate and disseminate SWM information. Control groups in Babati district, mobile phones node seems to have in-degree centrality of 4 (Table 4.5) while it gets in-degree centrality of 5 in Kongwa (Table 4.6) taking the third and fourth place in ranking of centrality. This shows that nodes use the channel in giving and receiving information about SWM practice and the phone act as a receiver that gets the message through. However, in Kongwa district the phones node does not appear in the control group's top five list of high centralities but is still used while in Babati district the phones node appear the second in high centrality list. This means that control farmers in Babati use phones in both receiving and giving information about the innovation while the control farmers in Kongwa use it mostly in receiving information. The phones node also has high betweenness for control groups in Babati district, making it to be a potential node that controls the flow of information between nodes. Moreover, mobile phones node seems to have high in-degree centrality and out-degree centrality both measuring with 4 in beneficiary groups in Babati district (Table 4.5) and in control groups in Kongwa district, the beneficiary groups in Kongwa also happen to measure with a 6 in in-degree centrality and out-degree centrality (Table 4.6). Other nodes like field days and '*others'* namely demo plots and village meetings seem to have high in-degree and out-degree centrality measures in Kongwa district (Table 4.6). While nodes like radio, posters, flyers and TV and some nodes like field exchanges, field days and meeting have high out-degree centrality measures in Babati district. The differences show that although the two districts have similar channels, they also have their differences in types of channels they use and prefer in communicating and disseminating SWM practice information. It shown in Table 4.4 that farmers groups in Babati district also get information from mass media as the stakeholders use these channels to communicate the information. The Babati key informants noted that apart from the government using extension officers more and field days, demo plot, seminars by projects; many development projects use mass media especially print media like flyers and posters to disseminate SWM practices information. In contract, Kongwa district stakeholders use more interpersonal channels as explained by the Kongwa key informants who mention environmental committees, extension officers, village meetings, field days, exchange visits, fellow farmers and demo plots.

The farmer node seems to be a node with the high in-degree centrality of receiving the information in all groups; control, beneficiaries and non-beneficiaries. The reason for the farmers to have high in-degree centrality in all sites is that all other stakeholders and channels target the farmer as the stakeholder who needs information and knowledge that would help to support in solving the existing problem in the smallholder communities as they are important stakeholders for changes to occur.

The very high betweenness of the farmer nodes in all groups in the network of information flow infers the potential of this node to control the flow. Meaning, the more or less the node shares and acts on information concerning the SWM practice might increase or decrease the adoption of the technologies and bring about sustainability. This will make a farmer be in a decision stage when the farmer gets in activities that would lead to adoption of rejection of innovation. Researchers are acknowledged for the generation and dissemination of information about SWM practices interventions by beneficiaries and non-beneficiaries' groups; the same has been noted by control group although not directly within their sites. Extension officers' nodes are important for all groups, they represent the bridge for disseminating the SWM practices at the grassroots level, while also linking the top level and grassroot stakeholders concerning the SWM practice interventions. Moreover, mobile phones nodes have high potential to control the information flow to the beneficiaries' group as it is considered to be the node that can directly connect farmers node with other nodes.

Generally, extension officers, researchers, farmers, fellow farmers, mobile phones, government and NGO nodes identified as the key networks for flow of SWM practices information in both Kongwa and Babati district.

1.4. Common and preferred communication channels

1.4.1. Common communication channels

Common communication channels indicated by farmers are presented in Figure 4.2 for Babati and Figure 4.3 for Kongwa. Evidently displayed in Figure 4.2, the extension officers are considered to be the most common channel used to disseminate SWM practices in all villages compared other channels. This is because the government and development stakeholders use them more in reaching out to the farmers. The same applies to Kongwa ((Figure 4.3), where extension officer is also used by all villages and farmers groups. The researchers seem to be a common channel used

more by beneficiary groups in Kongwa district (Figure 4.3) compared to Babati district where all farmers' groups use researchers as a common channel to get SWM practices information. The control group noted that they get the information about SWM practices through their fellow farmers or during exchange visits in the villages where the projects are implemented. Moreover, mobile phones are more used as common channels in Kongwa (Figure 4.3) than in Babati district (Figure 4.2). The beneficiary groups in Kongwa noted that they use phones to frequently communicate with other stakeholders concerning SWM practices, while other groups noted to be receiving information from fellow farmers or asking for information on SWM practices using the phones. Fellow farmers also are identified as common channels used by all farmers groups in both districts to get information about SWM practices, but the intensity of use differ between the villages depending on several reasons like availability, trust, informativeness, feedback, acceptance of the person giving the information.

In Babati district (Figure 4.2), the control groups noted to use radio as a common channel to get information about agriculture including SWM practices. Loto village farmers specifically noted that the radio stations they mostly listen to are aired from the neighbouring country. Other farmers groups both in Babati and Kongwa districts noted to also get information through radio but they identified the challenge on reception of FM stations that air the agricultural programmes and convenient programmes schedules. Moreover, flyers are print media channel that seem to be used in Babati and Kongwa districts. This is because many development stakeholders find them to be a convenient channel to communicate the information they have to the farmers, due to their flexibility and reference that enable farmers to keep and use the flyers for future use. Newspapers seem not to be commonly used as a channel to disseminate SWM practices because of villages being distant from the cities. Farmers noted that information from the newspapers are not news for them but rather storytelling due to the delay of reaching the audience. Farmer field days, exchange visits and agricultural exhibitions are also noted to be used in disseminating SWM practice in both district (Figures 4.2 and 4.3)

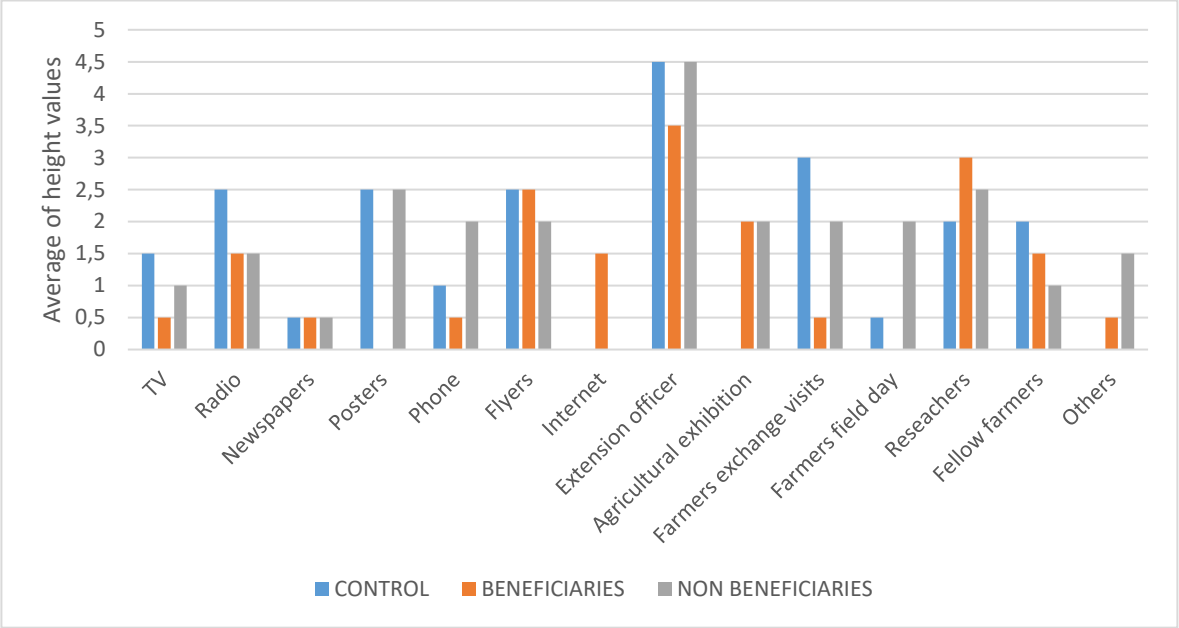

Figure 4.2: Common communication channels used to disseminate SWM practices in Babati district as reported in net-map FGDs.
Height values are total number the channel was selected by respondents while constructing towers for the channels

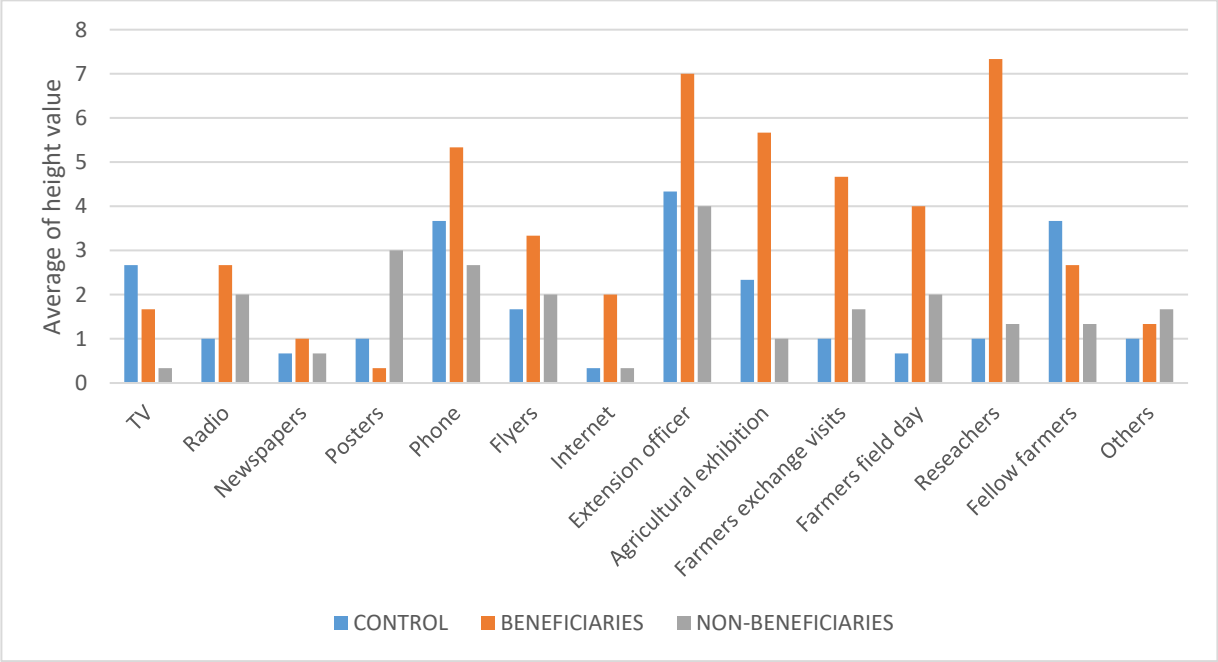

Figure 4.3: Common communication channels used to disseminate SWM practice in Kongwa district as reported in net-map FGDs
Height values are total number the channel was selected by respondents while constructing towers for the channels

1.4.2. Preferred communication channels

It is clear in both Figure 4.4 and 4.5 that there is variation in preference of communication channels amongst the sites and the farmers groups. It can evidently be noted from both districts that extension officers, researchers and mobile phones are mostly preferred by the farmers groups (Figures 4.4 and 4.5). However, the preferences on extension officers and researchers vary within farmers groups and villages (Figures 4.4 and 4.5). Researchers are preferred more by beneficiary groups because they are the ones who interact more often and more directly with the researchers than others. Whereas the extension officers seem to be preferred by control and non-beneficiary groups in both districts. However, some groups in Kongwa much preference did not occur (Figure 4.5) due to different reasons concerning the stakeholders that were noted by the farmers.

Moreover, the farmers preferred fellow farmers too as a channel that can be used to disseminate SWM practices (Figures 4.4 and 4.5). However, their reasons varied per district and site. For instance, some farmers groups preferred fellow farmers because they noted to get information about SWM practices through them and even be trained on how to implement the technologies.

The flyers were more preferred by control groups in Kongwa (Figure 4.5) because they noted flyers to be helpful to transfer information from the researchers since they don't have opportunity to interact with them. Whereas, the farmers groups in Babati (Figure 4.4) preferred TV and radio because they have easy access to them. Moreover, most farmers groups preferred the '*others*' channels including village meeting and demonstration plots because of the practical learning and interaction benefits that offered in those channels. Agricultural exhibitions and newspapers were less preferred due to their availability and accessibility challenges in the villages. Internet was not preferred due to its access complexities.

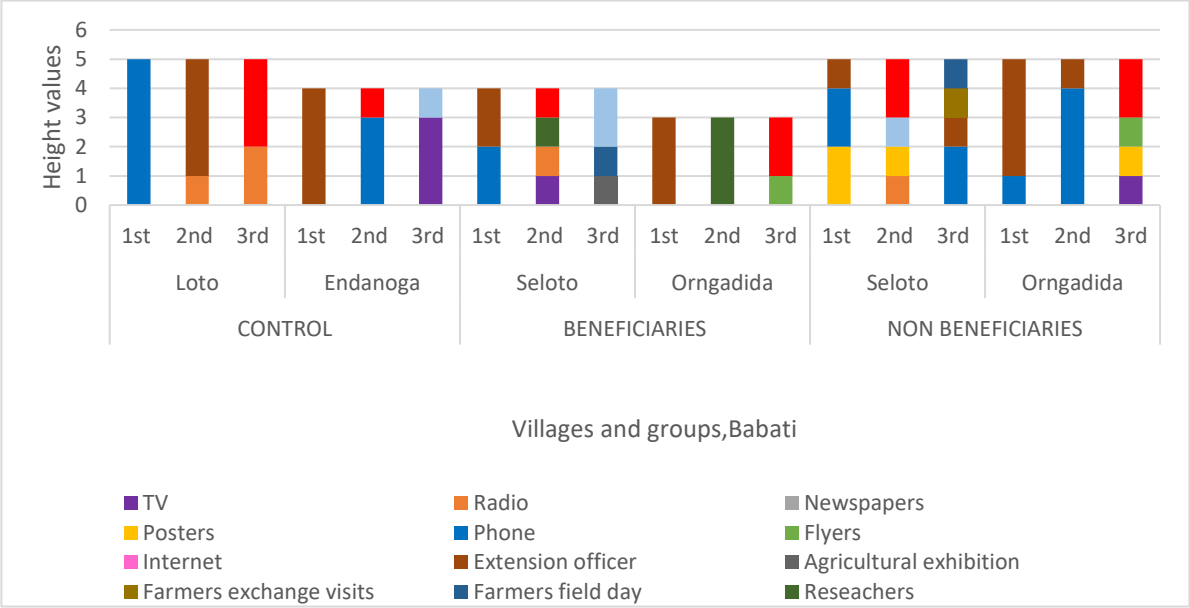

Figure 4.4: Preferred communication channels to disseminate SWM practices in Babati district as reported in net-map FGDs.
Height values are total number the channel was selected by respondents while ranking preference of channels

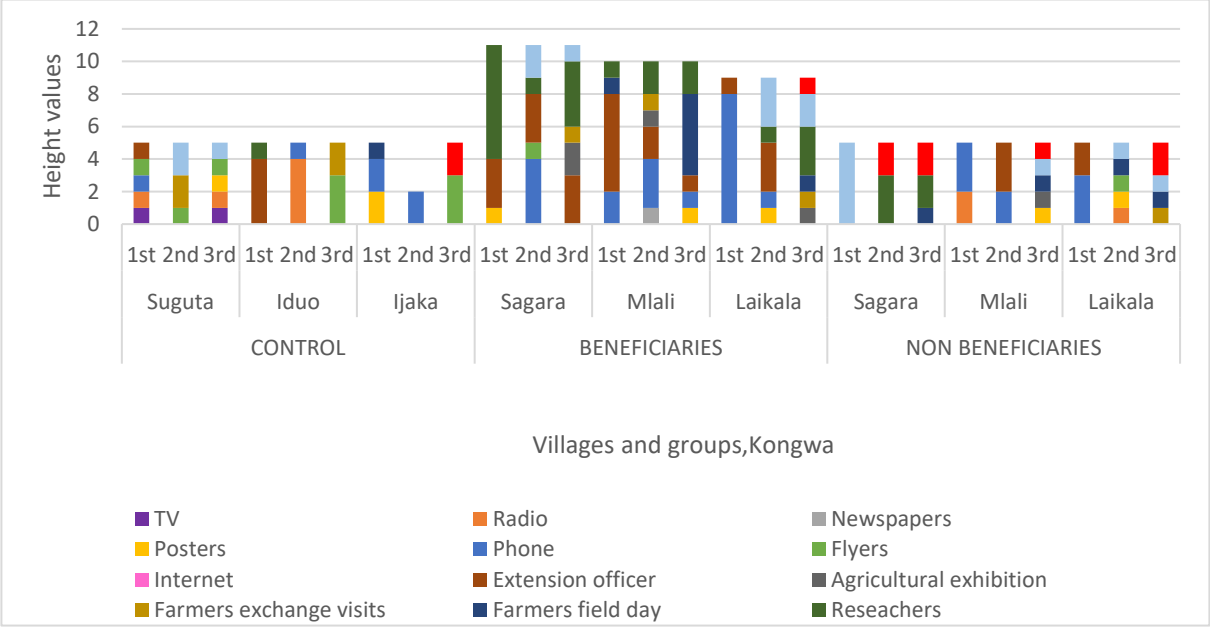

Figure 4.5: Communication channels preferred to be used to disseminate SWM practices in Kongwa district as reported in net-map FGDs.
Height values are total number the channel was selected by respondents while ranking preference of channels

1.5. Motivations for using the communication channels

Figure 4.6 and Figure 4.7 present the motivation for using certain communication channel over other channels. In both districts, it is shown that farmers use or prefer either mass media or interpersonal channels because of its accessibility, frequency of use and informativeness (Figures 4.6 and 4.7). Moreover, feedback motivation was what makes farmers use or prefer fellow farmers, extension officers, researchers, *'others',* mobile phones, exchange visits and farmers' field days over the other channels in both Babati and Kongwa district. The farmers noted that the interpersonal channels and mobile phones give them more opportunity to interact through feedback and allow their opinions to be included in communication of the SWM practices than when mass media is used as they only become receivers with no room for clarifications when the need for more knowledge is needed. Interesting is that internet seems to have feedback, flexibility, informativeness and accessibility motivations in Kongwa (Figure 4.7) compared to Babati whose motivation is only accessibility. This is because in Kongwa had young farmers who noted to be aware of internet use.

In addition, the flexibility of a certain channel was the motivation that farmers considered in using or preferring the channel in both districts (Figures 4.6 and 4.7). They noted that extension officers, radio, posters and flyers to be flexible as extension officers could visit the farmers or meet where would be appropriate to inform farmers. The radio and flyers were flexible channels and farmers could carry them around. While posters can be displayed in open spaces where they can be visible to all audience. When farmers explained about flexibility of farmer field days, exchange visits and '*other*s' channels, they specifically noted about time that the activities would be conducted. They noted that researchers always communicate and organise the activities dates when it is convenient for farmers schedules. The same applies to the village meeting and exchange visits that agricultural stakeholders intend to communicate or disseminate the information concerning SWM practices.

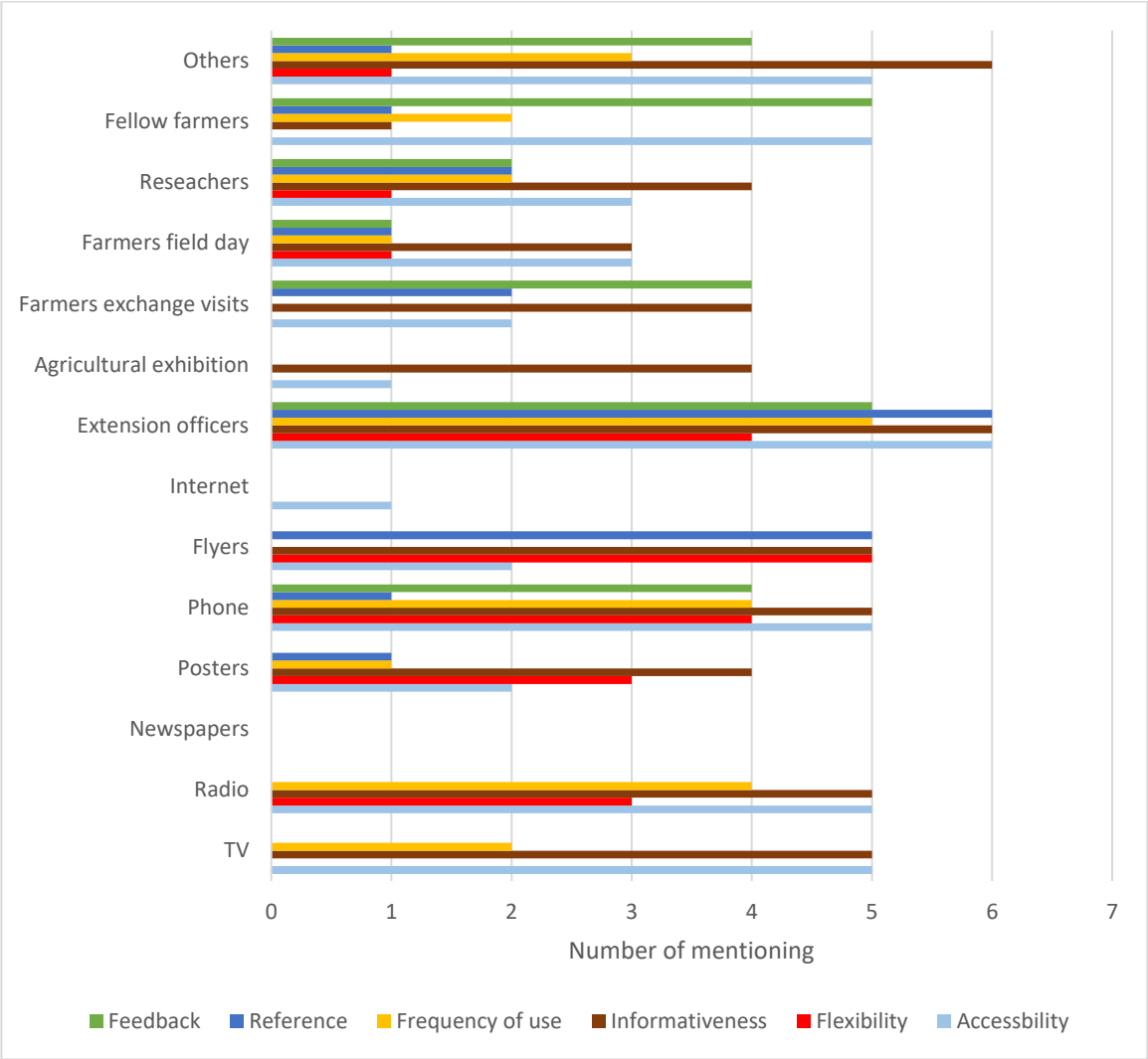

Figure 4.6: Farmers' motivations for using communication channels to disseminate SWM practices in Babati district as reported in net-map FGDs

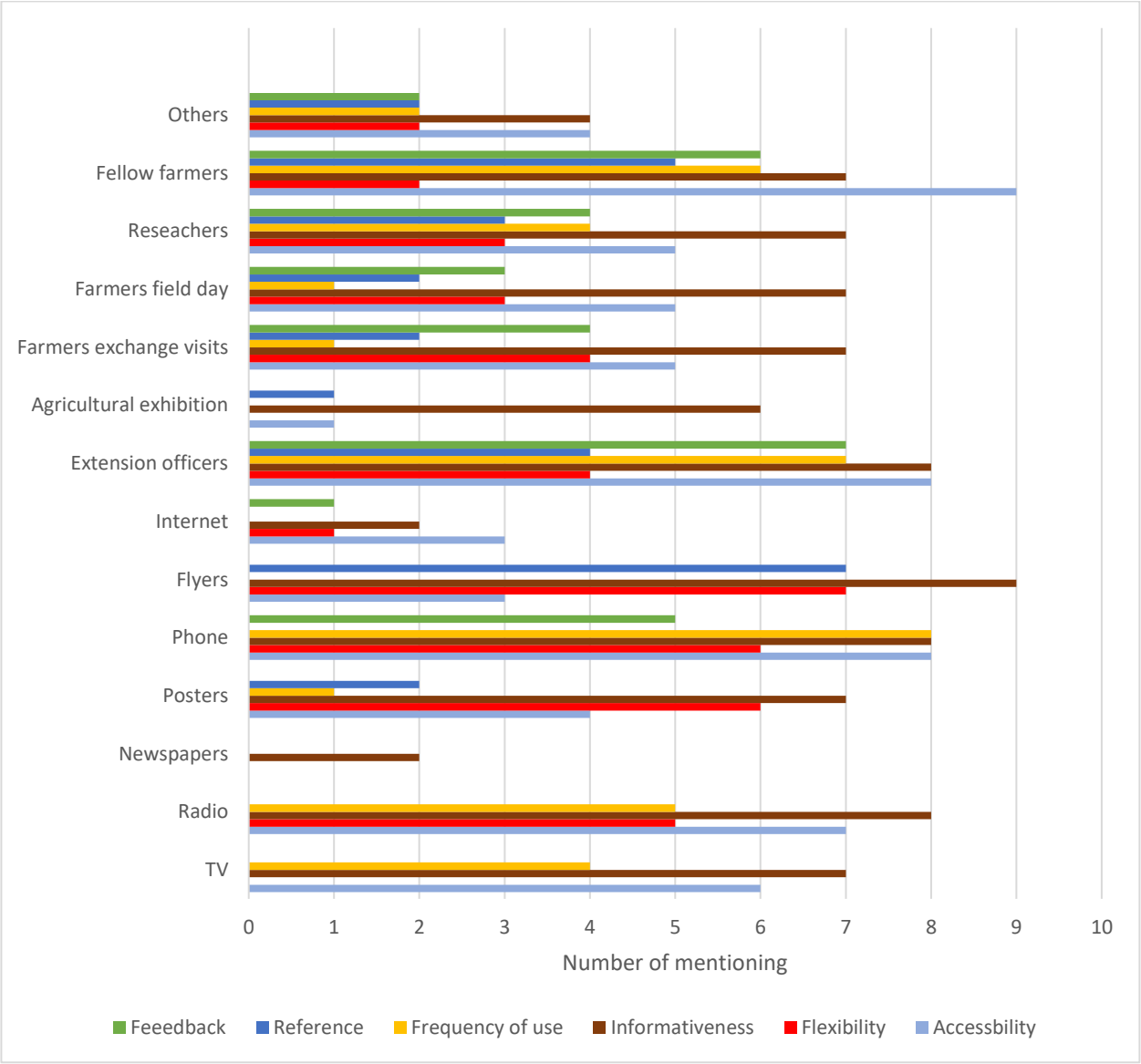

Figure 4.7: Farmers' motivations for using communication channels to disseminate SWM practices in Kongwa district as reported in net-map FGDs.

CHAPTER FIVE

5.0. Discussion

The results show that there is a higher flow of SWM practices information to the beneficiary farmers groups when compared to the control and non-beneficiary farmers groups. The beneficiary groups have many sources of information about SWM practices which can be effective leading to the adoption of the SWM practices (Figure 4.1). In addition, the beneficiary groups seem to receive more information than other groups (Tables 4.5 and Table 4.6). The finding shows that beneficiary groups have more access to information and knowledge that leads to adoption of SWM practices than other groups supports Namulondo's (2016) argument that the knowledge gained or persuasion from either mass media or interpersonal communication can influence the farmer's decision making, but also the accessibility of information. The beneficiary groups also have direct interaction with the researchers who are identified as the people originating the knowledge and disseminate to other stakeholders. The opportunity to interact with the experts motivates the farmers to implement the SWM practices due to the training and technical support they get compared to control and non-beneficiary groups, who do not have the opportunity to interact with the researchers. This agrees with Adolwa et al. (2012) who noted that the moment the farmer implements the new ideas, he/she has already validated it, and it is the task of researchers and other stakeholders to provide technical support.

In both control and non-beneficiary groups, fellow farmers and extension officers prove to be essential stakeholders in disseminating SWM practices to the intended farmers (Tables 4.5 and 4.6). The farmers from these groups acknowledged that their primary source of information about SWM practices are extension officers whom they noted as a knowledge store of information from other sources; and fellow farmers who are beneficiaries of projects that deal with SWM interventions within or outside the villages (Figure 4.1). The reason is that these stakeholders interact with each other in several settings and are always likely to share information concerning agricultural technologies. This finding confirms the point by Leeuwis and Aarts (2011) that innovation is not only contributed by professional change agents but also by interdependent societal agents who interact with each other in several settings and networks, where actors are likely to communicate with each other about change-related issues during everyday activities than during the professional interventions' meetings. The high outdegree and betweenness centrality

measures that the researchers hold in all the groups reflect the importance they have in the knowledge flow of SWM practices (Tables 4.5 and 4.6). The study found out that the interaction between farmers, extension officers and researchers bring about the motivation for farmers to want to perform well and implement the SWM practices as they noted 'feeling recognised and included' in giving their reasoned opinions and experiences concerning the circumstance in their communities. This finding is contrary to Delgadillo et al.'s (2016) finding that the presence of researchers makes groups to some extent more dependent on the researchers´ knowledge input. Moreover, the result is similar to Delgadillo et al. (2016) study that the researcher's high outdegree and betweenness measures show the importance in the knowledge flow of innovation.

As revealed in the network results, researchers, extension officers, fellow farmers and mobile phones are essential in disseminating SWM practices in Babati and Kongwa districts. The same finding can be demonstrated in figure 4.2 and figure 4.3, where farmers perceived those channels to be common communication channels used in disseminating SWM practices information. Moreover, the use of farmer fields days, farmer exchange visits and agricultural exhibitions in Kongwa (figure 4.3). Using interpersonal communication channels showed importance in the dissemination of SWM practices and adoption. This finding concurs with the findings by Namulondo (2016) that interpersonal channels specifically extension officers and demonstration plots were crucial when it came to adoption of innovations.

Most farmers do not use posters and flyers as a source of information about SWM practices because the language used in most posters and some flyers is English, while the farmers are competent in Swahili. This study agrees with Namulondo (2016) who found that farmers did not use posters due to language constraints. The second reason was that the information that was communicated in Swahili used scientific jargon that made it difficult for the farmers to understand the message clearly. The findings support the definition by Vinod and Marcia (1974) that effective communication is an art of understanding and being understood by the targeted audience. Moreover, some farmers noted that many literate farmers also do not have a reading culture, this leads to only a few of them reading the flyers despite their availability. They also noted that most farmers have primary education and others are illiterate which leads to failures to access complex information from the printed media. This reason can be justified by the findings from the respondents' survey that shows 14.3% of the female population was illiterate, 85.7% of the female

and 81.8% of the male population had primary education level (Table 4.1). The finding agrees with Jirgi et al. (2009) that print media have low audience due to low education level. The finding also agrees with Adolwa et al. (2012) that print-based channels are not preferable by the farmers.

Moreover, the findings concur with Adolwa et al. (2012) that farmers do not prefer the use of mass media specifically TV when it comes to dissemination of SWM practices because of its of lack of flexibility and frequency of use. Many farmers explained that they do not frequently watch TV due to insufficient luxury time and those who watch noted a lack of fixed schedule for agricultural programmes that is convenient to the farmers. However, they acknowledged that visualisation helps them to understand more the information disseminated. In contrast, farmers prefer radio to be used to disseminate SWM practices, but it is difficult to access national radio stations that have some agricultural information due to the weak connection of FM in some areas. Also, there are no fixed agricultural programmes in local stations which leads farmers to listen to other programmes. The farmers who frequently listen to agricultural radio programmes access the neighbouring country radio stations like 'Shamba Shaper programme' aired by a radio station in Kenya. The finding supports Jirgi et al. (2009) that most farmers have access to the radio but face difficulties in being able to listen to farming programmes. Furthermore, the findings of the study partially agree and disagree with findings from Adolwa et al. (2012) that ICTs are not preferable for farmers. Although internet is identified as the less used ICT channel use to disseminate SWM practices, farmers did not perceive it as a preferred channel. Farmers explained that use of internet needs smartphones that are expensive to afford and operating the phone to access the required information to seem complicated to many farmers especially due to their age and the education level (Tables 4.1 and 4.4).

On the other hand, the finding contradicts Adolwa et al. (2012) because mobile phones seem to be a commonly used channel and preferred channel by farmers to communicate and disseminate information about SWM practices. They noted that calling and texting options are convenient for them. Moreover, it is a smooth and fast channel to get the message through and an opportunity to provide feedback. Farmers noted that many farmers could afford to buy ordinary mobile phones and there are affordable credits that provide the right amount of texts and calling bundles per week. The difficulties mentioned in the use of mobile phones included poor mobile phone network in

some areas within the villages. A limitation in Adolwa et al., (2012) study is that no breakdown of ICT channels was noted which makes it difficult to make a direct comparison.

Extension officers seem to be the preference for most farmers in Kongwa and Babati districts. The preference is due to their accessibility, informativeness, frequency of use and feedback motivations on disseminating SWM practices. The motivation findings are consistent with Okwu (2011) that the type of channel used is measured by various means indicating whether the farmers always uses or never uses the specific channel. Equally Adolwa et al. (2012) indicated that accessibility and informativeness or understanding of the message through a specific channel are indicators which can be measured for the appropriateness of the existing channels. In many areas, extension officers are the community-based specialist that farmers consult on issues related to agriculture especially information related to new practices. In some areas where intervention projects are not implemented, they noted that extension officers are the ones informing them about SWM practices and others even work with them in the farms to show how different types of practices are being constructed. They acknowledged extension officers' efforts to practically teach them because besides hearing the information from mass media it is important to know how SWM practices are implemented since they need technical knowledge too. They further explained that since the extension officers work with researchers and other agricultural stakeholders from different levels, they act as a bridge to bring information about SWM practices to farmers who do not have opportunities to interact with other stakeholders. This finding agrees with study finding by Adeniji, (2007) which showed that the extension officers were the primary channel through which farmers receive information on improved practices.

Farmers prefer researchers, fellow farmers, extension officers, mobile phones and '*others'* channels like seminars, training, demonstration plots, village meetings and village leaders because of not only the informativeness the channels but also the interactive way which fill the gap for feedback and sense of inclusiveness. This finding agrees with Otsyina and Rosenberg, (1997) that participatory communication gives preference to horizontal approaches that encourage dialogue focused on searching for solutions and analysis of the problem, as well as bottom-up approaches that aim to raise the awareness of decision-makers where Leeuwis (2004) explained that communication becomes a crucial part of facilitation strategies that aim to improve learning and negotiation towards change These help the farmers not only to get information thought to be

appropriate but also an opportunity to interact and get the needed clarification for their decision-making and implementation of SWM practices. Farmers also noted that extension officers, fellow farmers and researchers contribute to their decision or implementation stage, whereas mobile phones also lead them to knowledge and implementation stage depending on the frequency of times the sender and receiver interact concerning the topic. This finding agrees with Namulondo's (2016) finding that showed the adoption rate was also confirmed with time innovation messages spread through multiple information sources such as researcher to farmer, farmer-farmer and radio (interpersonal and mass media) in more villages.

The demonstration plots and field days facilitate most farmers to get knowledge, to be persuaded and to implement the SWM practices. Most farmers noted that farmers field days, exchange visits and demonstrations plots help them to have evidence of the results from the practices and interact with other stakeholders on the importance of implementing the technologies. However, many still do not implement because of labour intensity, familiarity with conventional practices, lack of technical know-how and cost implications hence leading to low adoption. This result supports Chauhan (2007) that participatory communication should move from a focus on informing and persuading people to change their behaviour to focus on facilitating exchange between various stakeholders to address common problems. Beneficiary groups noted that working with researchers has given them the opportunity to learn the importance of SWM practices through different dialogues, they also added that researchers expose them to different practices and farmers are free to choose one that fits their circumstances. On the other hands, farmers from all groups stated that in most cases the information from the government is more instrumental in approach using fines or coercion, where intervention is put without considering its feasibilities in the areas introduced. Most farmers noted not be infavour of approach at the start of intervention but rather suggested for it to be used later for sustainability of the innovation being introduced.

Furthermore, the study agrees with Akinbile and Otitolaye (2008) claim that various communication channels are used to disseminate agricultural innovation and other channels can be appropriate to disseminate a specific innovation. The study noted that SWM practices information requires practical and visualisation rather abstract information for farmers to understand how to implement them. Therefore, interpersonal communication is more appropriate than mass media like radio or printed media with texts.

In addition, the key informants mentioned to use the channels that were identified by farmers as common channels, also they were able to have some correct perceptions of the communication channels that are preferred by the farmers including researchers, fellow farmers, radio and '*others'* (demonstration plots). This study has revealed that the project's researchers are communicating their results about SWM practices to the end users through grassroots channels like farmers field days, demonstration plots, extension officers, fellow farmers, phones, posters and researchers. The finding is contrary to Mowo (2009) who pointed out that most researchers lean towards disseminating their research results in recognisable journals. The researcher of this study thinks that researchers' publications seem to be a measurement for performance and career success and not because they find them more important than communicating them in other channels. However, the finding on language barriers like complicated jargons supports Rees et al.'s (2000) suggestion that poor communication has been a significant restriction to information flow between researchers and farmers.

Although Namulondo (2016) noted that communication channels and effectiveness of communication channels lead to adoption of innovation. This study found there is another implication beyond the communication aspect. The communication channels can be improved for effective communication but the adoption rate remains low because there are other factors that hinder adoption. The identified factors are labour intensity, time consumption, access to land, cost implications, lack of technical knowledge about the practices like measurement and misperception of measurements that reduce farm sizes. Farmers explained that many farmers do not implement the practices because of the mentioned reasons and not because they are not informed.

This study also confirms Leeuwis (2004) interrelated features that characterise the instrumental model of communicative intervention where communication is used intentionally as a policy instrument to direct human behaviour is thought of being mostly predictable. The respondents noted that communication mostly done by the local governments are done through compulsory behaviours of regulations, fines and restrictive provisions of some inputs to make the farmers to adopt the technology. This seems not to be most effective approach as farmers tend to implement at a low rate or intentionally implement the innovation wrongly to please the authority but there will be no positive impact nor sustainability at a long term. Thus, leading to failure or dysfunction of the social system as members do not cooperate to seek to solve common problem (Roger, 1981).

As Rogers (2003) recommends diversity of communication channels with different functions along the five stages like knowledge, persuasion, decision, implementation and confirmation for adoption or rejection of innovation. This study identifies the links between communication channels and social inclusion. For example the study shows that not everyone can read printed media, has time to watch TV, has opportunity to interact with extension officer or researcher. There is a social stratification along age, gender, education level, geographical location, income, et cetera that needs to be considered when disseminating or communicating innovation for adoption.

Rogers (1981) notes that there is a trade-off between the effectiveness of mass media in transmitting knowledge and the interactive qualities of interpersonal communication in influencing adoption. The results of this study suggest that the trade-off between effective knowledge transmission and effective interaction do not exist in the study sites. Although the figures 4.4, 4.5, 4.6 and 4.7 show that interpersonal communication channels are valued and preferred because of its interactive qualities, they are also seen to be effective in knowledge transmission as mass media. The reasons being that mass media are not accessible for smallholder farmers in Tanzania due to different challenges like illiteracy, time, connectivity. Also, interpersonal communication transmits contextualized know-how like demonstration plots. Field days to the farmer of different socio-economic features like education levels, age, gender, et cetra.

5.1. Improving communication on disseminating of SWM practices to bring about sustainable agriculture

In this section the respondents have given their perspective on how to improve communication in disseminating SWM practices in the study sites. The results are from the FGDs recordings and notes. The suggestions noted are the ones that arose repeatedly in many discussions.

Timely delivery of information

Information about SWM practices communicated to farmers is usually delayed. The beneficiary farmers explained that researchers most of times communicate timely with them about the SWM practices information and activities before the start of the cropping seasons through village sensitization meetings and trainings. Moreover, they noted researchers to communicate with farmers through mobile phones to remind them on when to start preparing the technologies so as

they become effective. However, other stakeholders like extension officers or local government officials communicate the information in short notice in village meetings or calling through mobile phones. The extension officers delay information because they work in more than one village and reaching all farmers is impossible. This leads to most farmers to neglect taking measures as farmers work in accordance to the rains. Therefore, the stakeholders are advised to give information before rainy seasons so that farmers can have time to prepare and work on the information. Overall, it was noted that all the communication channels being used to disseminate information seem ineffective being the message is delivered on an inappropriate time. *'In brief we can conclude that all the channels used most of the information is delayed'*

Use simple language and infographics to communicate

Communication does not end once the information is taken out to farmers. The use of simple language especially related to the terminologies is important to be considered. It was explained that although many farmers have attained their primary education (Table 4.1), many still cannot read and those who can read, cannot read English information which is presented in most posters and flyers. This is supports Vinod and Marcia (1974) finding that effective communication is an art of understanding and being understood by targeted audience. Also, Jirgi et al. (2009) and Adolwa (2012) found that print media have low audience due to low education level and that they are not preferred by farmers. *'I cannot read printed information because I did not go to school but if I see pictures I can understand!'*. Although most flyers are printed in Swahili language, the terminologies that are used to explain the information make it difficult for farmers to capture the message intended. Infographics were suggested as they help not only the illiterate but increase interest for those who do not have a reading culture as pictures are considered attractive than words. Infographics also help farmers to understand the messages intended as words only can lead to wrong message interpretation especially when SWM (technologies instructions are more abstract) are put in words alone. Also, the concern was to increase the font sizes of texts on most flyers, many were noted to be small which hindered readability. The use of simple language was also emphasized in other communication channels like radio and interpersonal communication channels.

Government support and cooperation at grassroot level

Researchers are closely working with farmers; this is said to motivate and inspire those farmers engaged in interaction. Farmers explained that the close interaction they have with researchers make them feel included in the team of finding solution rather than people who only wait to do what has been decided for them, they get a feeling of belonging and responsibility to solve the problem facing their community. A good collaboration between the government and the development stakeholders, like researchers who are working to disseminate knowledge on SWM practices was also recognised. However, it was considered important that the high government officials responsible for agricultural activities cooperate and work with the teams at the grassroot levels. This will help to facilitate the activities and prepare strategies that would help the work to continue be implemented at wide range when the projects end. *'Researchers come and go with projects, the government officials have the chance to work with us for long terms, so they have to get out their offices and interact with stakeholders at grassroot level.'*

Organization of agricultural events at village level

These events are occasions when farmers get opportunities to interact with agricultural stakeholders and learn new knowledge about agricultural practices including SWM practices information through personal demonstrations. Unfortunately, information from these events including the DWM practices fail to reach the targeted audience at the required rate. *'Currently, the events are celebrated by people who are not farmers while many farmers still do not know the importance of these days.* The reason being, most of the big agricultural exhibitions are organised and hosted in big cities where many farmers cannot afford to attend due to expenses involved. The events will be meaningful when they are organised and hosted at village levels where experts who participate in those events deliver the information to farmers. This will help the farmers to have access to knowledge and learn without the costs associated with those special days, meant to recognise farmers' good work for the nation.

Frequent and consistent scheduled agricultural programmes

The information on SWM practices need to be communicated through-out the channels for farmers to understand their importance in agricultural activities. The local radio and TV stations can have special agricultural programmes that are aired frequently and consistently considering the time that

is appropriate to farmers availability. The topics about SWM practices should be aired often as it is done with the use of improved seed varieties for better yields. When the programmes broadcast often about the SWM practices, this will raise awareness and create dialogue between farmers. Currently, SWM practices are portrayed as optional practices that farmers can choose compared to the improved seeds that farmers see to be important. The value for improved seeds has been promoted by mass media and became part of the public dialogue among farming communities and stakeholders. Programmes broadcasted on TV would be appreciated if they are not aired in series, as most farmers do not frequently watch TV, a programme that has continuous topics might might cause farmers to miss the entire message intended for them. *'If there would be agricultural programme scheduled, we as farmers would sit together to listen. This will be a way for us to relax after farming but also learn together'*

Rewarding the VBAAs

Village Based Agricultural Advisors (VBAAs) are farmers who are trained by researchers through projects with the purpose of helping to train other farmers on agricultural issues within their villages. These farmers are doing much work to communicate and disseminate information on SWM practices. It was explained that they also help farmers who want to implement the technologies with measurements and other technical steps within and out of their villages. Fellow farmers suggested for initiatives to reward and make VBAAs accepted in the community as agricultural experts can be made by the government or NGOs. Farmers noted that these VBAAs are making efforts in promoting and scaling out SWM practices through interaction and action within their community. *'You can find a way to reward them, I don't know how but honestly they sacrifice a lot of their time to teach others' 'Some farmers, the VBAA are very dedicated they even go to other villages to help other farmers on measurements of terraces and tied ridges. They need to be rewarded!!'*

Sufficient and interactive extension officers

Extension officers are the store of information for the farmers, and most of the SWM practices information is disseminated through them. However, there is an urgency to increase the numbers of extension officers, as currently they are overwhelmed with activities due to high number of villages where they are working. One extension officer serves three villages or at a ward level, this

also leads to a delay of SWM practices information and service that need to reach out to the farmers especially in villages where the projects are not operating. Moreover, extension officers are urged to be interactive with farmers so that they can be able to disseminate SWM practices. Some extension officers are reported not to be known by farmers as their interactions with farmers are limited, they are seen when important stakeholders visit the villages. The extension officers' presence and interaction with farmers help the farmers who are ready to implement technologies to correctly implement them in their fields. *'Most farmers know the deceased extension officer because he used to work with us daily, and he is the one who taught us SWM practices, the current one appears on special occasions. Most farmers still refer to the deceased when asked about the extension officer because we don't know the new guy!'*

Develop direct text messaging system on SWM practices

Most farmers have access to mobile phones and use them as a channel to source agricultural information including SWM practices. Since they still have a challenge to afford to purchase phone credits daily, developing and improving more direct text messaging concerning SWM practices information can improve communication of the technologies between stakeholders. The direct text messaging should not only be one-way communication but rather give room for feedback from farmers on the information disseminated to them. Moreover, the connectivity strength for the mobile phones' networks need to be improved to ensure prompt delivery of messages so that farmers can be able to act the information on time. This will enable the effective communication among stakeholders through the use of mobile phones which seem to be a handy channel for farmers than other channels. *'Sometime we are working with the phones as toys because we cannot use them either because we don't have credit or there is no connection' 'A phone is like an empty tin if does not have credit, I can't call neither text. I just wait for people to reach out to me and if they do through text then I will not give feedback.'*

CHAPTER SIX

Conclusion

The study concludes that effectiveness of communication channels varies depending on the type of the stakeholders involved, and that more attention should be paid to the end users of the information in selecting the type of communication channel. The senders should mostly consider the fact on what would be the effective and convenient channel for the one receiving the information if at all they want the messages to be impactful and worked upon. Interpersonal and mass media communication channels are suitable in disseminating SWM practices and knowledge to farmers (Adolwa 2012). However, the stakeholders have to bear in mind that not all channels are equally fit for every farmer and different geographical areas have different preferences in communication channels and this is crucial when stakeholders want to disseminate SWM practices.

Moreover, the study also notes that interpersonal channels including extension officers, researchers, fellow farmers together with ICT channel specifically mobile phones are mostly preferred because of the informativeness, feedback and inclusiveness factors. Use of the interpersonal channels provide opportunity for interaction and fill the feedback loop that is in most mass media channels. Since communication that are effective are the ones that happen in everyday discourse rather than those are professionally prepared to be communicated (Leeuwis and Aarts,2011).

Also, it will be good if the agricultural exhibitions events are organised at village or wards levels so that the experts can participate and deliver their information and knowledge to farmers. This also will also give opportunities to farmers to learn and get access to knowledge without cost associated to those events that are currently hindering farmers to get information.

However, the mass media channels like flyers, poster, TV and radio that have been used largely by institutions have their advantages and should continuously be promoted in dissemination of SWM practice information with some improvements like language, time, layout of printed materials into considerations. Also, farmers' gender, education level and age were the factors that influence access to information and knowledge concerning SWM practices and subsequently the

adoption of SWM whereas Adolwa noted farmer's assess endowment as a factor the influence for ISFM (Adolwa 2012)

This study raised the implication that the trade-off of effective knowledge transmission and effective interaction do not exist in the study sites which is in contrast to Rogers' (1983) claim. The study concludes that both mass media and interpersonal communication can integrate in transmitting knowledge and effective interaction to influence adoption. Since the interpersonal channels have been identified to be effective in transmitting knowledge in this study, mass media can also be improved to accommodate and facilitate interactive qualities in communication through the use of ICT channel specific mobile phones in agricultural discussions aired on radio and TV.

The study also revealed that there are spillover communication effects about SWM practices but still the farmers are not implementing the practices because of factors that are raised from the practices like time investment needed for the practices, cost implications, labour intensity, lack of technical knowledge. As Leeuwis (2004), noted that the interactive model of communication intervention is a participatory form of communication as it contributes to the social processes like social learning, network building and negotiation. This study suggests that researchers and other change agents are supposed to learn from the farmers the reasons that slow the adoption of the practices and find ways to negotiate and facilitate exchanges between different stakeholders to address the mentioned hindrances.

Recommendations

1. The study identifies extension officers to be the main bridging between stakeholders and dissemination of SWM practices information. Therefore, it is recommended that the number of extension officers to be increased so that they can be able to effectively serve the farmers in each village.
2. The high government officers responsible for agricultural activities should cooperate and work at grassroots levels so that they can facilitate and continue the activities introduced by the projects for SWM practices to have sustainability impacts.
3. Institutions and government should liaise with mobile service providers to offer information services to farmers (Adolwa et., 2012) especially about SWM practices to areas with drought and erosions problems. Moreover, they should give room for feedback

where farmers can share their inquiries about the information provided through either free direct texting or voice messages. Moreover, the government and network providers should work to improve the mobile network infrastructure for stable connectivity as the study identified mobile phones to be handle and quick communication channels for most farmers. Also, the providers and government can subside the mobile credits and make them affordable for farmers and ease their communication.

4. Infographics and simple language should be used in print media like flyers and posters to be able to reach wide audience including the illiterate and literate who do not have reading culture through pictures that will be attractive and comprehensive. Moreover, researchers should also use simple language that will be easy for farmers to understand during the interpersonal interaction or through mass media like TV, radio.
5. The local government need to recognise the VBAAs who are performing well in disseminating SWM practices through awarding of certificates and public meetings so that they gain acceptance from the communities and assist the extension officers who are currently overwhelmed with serving many villages.
6. This study also noted that communication is a very important aspect in supporting SWM practices sustainability, therefore the government and institutions should have well defined communication strategies that will consider the characteristics of farmers they want to communicate with so that the channels used can be effective.

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APPENDICES

Appendix 1: Consent form

FOMU YA IDHINI, RUHUSA, KIBALI, MSAMAHA NA KUACHIA KUSIKO NA KIKOMO AU YENYE MIPAKA KWA AJILI YA VYOMBO VYA HABARI

"Ruhusa ya Kutoa Picha na/au Nakili ya Kimaandishi"

RUHUSA ---

Mimi _____, nikiwa na miaka kumi na minane na kuendelea, ninaruhusu IITA, pamoja na chuo cha Wageningen, makandarasi, wadhaminiwa, washirika, wafanyakazi na mawakala wake pamoja na hao walioteuliwa nao kutayarisha kumbukumbu ya kimaandishi ya simulizi yangu, pamoja na/au kutayarisha picha, video, sinema, au nakala ya sauti yangu au mfano wangu, pamoja na familia yangu, wanyama wangu wa kufuga, wanyama, mali, sauti, jina na wasifu wangu kwenye utafiti wao kwa muundo wowote ule na kutumia hayo kwa sababu zozote zilizo halali.

RIDHAA ---

Zaidi ya hapo, ninatoa idhini yangu ili kumbukumbu ya kimaandishi ya simulizi yangu, pamoja na picha na nakili zangu ziweze kutolewa nakala, kufupishwa, kuchapishwa, kuchapwa, kutolewa kwenye matangazo ya luninga na matangazo ya redio au kutangazwa kwa njia yeyote inakayokubalika au ya elektroniki kwa mara zozote zitakazotakiwa pamoja na maelezo yake na matamko ya kihariri ambayo huenda sijayaona.

MSAMAHA ---

Zaidi ya hapo, ninasamehe na kuachilia haki yangu ya kupokea faida ya kibiashara, muda wa matangazo, kipato cha fedha, faida, kubadilishana vitu kibiashara, sifa, kujulikana, masharti yeyote yanayotakiwa kabla ya makubaliano haya, fidia, na kwa ujumla kupokea "uhalali unaoweza kuleta faida ya kibiashara", madhara au hasara, au malipo yanayotokana na hayo.

KUACHIA ---

Zaidi ya hapo hivi sasa ninaiachilia IITA, taasisi, makandarasi, wadhamini, wadhaminiwa, washirika, wafanyakazi na mawakala wake pamoja na hao walioteuliwa nao ili kuwaepusha na madhara au hasara au kudaiwa kwa vyovyote vile kunakotokana na matayarishi ya kumbukumbu hiyo ya kimaandishi, picha na kunakili kwa mambo yote yaliyoelezewa hapo juu.

MIPAKA ---

Ruhusa, ridhaa, msamaha na kuachia kulikotajwa hakutabadilika hapo juu kamwe, ni kwa moja kwa moja na kwa kudumu isipokuwa kama mambo yafuatayo yatatokea:

_____.

SAHIHI

TAREHE: _____ YA MUHUSIKA: _____

WAKALA: _____ JINA KWA HERUFI KUBWA_____

TUKIO: _____ ANWANI: _____

SIMU:_____

Appendix 2: Interview guidelines for farmers and key informants

Appendix 2A: Farmers

1. Je unafahamu kuhusu teknolojia za uhifadhi wa udongo na maji shambani katika shughuli zako za kilimo?

2. Teknolojia gani unazifahamu, kwa majina?

3. Je teknolojia gani kati ya hizo mnazitekeleza mashambani?

4. Je teknolojia hizi zina faida zozote shambani kwako?

5. Je wadau wa kilimo wanatumia njia gani za mawasiliano kufikisha taarifa kuhusu teknolojia za uhifadhi wa udongo na maji?

6. Je ni njia gani kuu unatumia kupata taarifa kuhusu teknolojia za kilimo hasa za uhifadi wa udongo na maji?

7. Na hizi njia za mawasiliano unazotumia, taarifa zake unazopata zinakusaidiaje? (kuelewa (K), ushawishi (P), kuamua (D), kutekeleza(I), kuthibitisha (C)

8. Je katika vyombo mlivyovitaja, ni vipi mnapendelea vitumike katika kufikisha taarifa juu ya uhifadhi udongo na maji shambani?

9. Sababu gani zinakufanya wewe utumie njia fulani za mawasiliano katika kupata taarifa juu ya teknolojia za uhifadhi wa udongo na maji ?

10. Nini kifanyike katika kuboresha njia za mawasiliano zinazotumika ili kusambaza zaidi taarifa kuhusu uhifadhi wa udongo na maji?

11. Je ni sababu gani zinazofanya wakulima watekeleze teknolojia za uhifadhi za udongo na maji?

12. Je ni sababu zinazofanya wakulima washindwe kutekeleza teknolojia za uhifadhi za udongo na maji?

Appendix 2B: Key informants

I. DAICOs

1. Je serikali ina mikakati au kampeni zinazohusu kutoa taarifa kwa wakulima juu ya teknolojia za uhifadhi wa udongo na maji katika mashamba?

2. Je teknolojia za kuhifadhi udongo na maji zina umuhimu katika kuleta kilimo chenye tija kwenye mkoahuu?

3. Je mnawasilisha vipi umuhimu huu kwa wakulima?

4. Ni kwa kiasi gani serikali inasamabza taarifa kuhusu teknolojia za uhifadhi udongo na maji kwa wakulima?

5. Ni njia gani kuu za mawasiliano mnazotumia kama serikali katika kusambaza taarifa juu ya teknolojia za uhifadhi udongo na maji kwa wakulima?

6. Kwanini mnatumia nja hizo ulizozitaja katika kusambaza taarifa za teknolojia za uhifadhi wa udongo na maji?

7. Je unafadhani wakulima wana njia za mawasiliano wanazozipendelea zitumike katika kusambaza taarifa za teknolojia za uhifadhi udongo na maji? Unaweza kuzitaja njia hizo kwa majina?

8. Je ni changamoto zipi zinakabili njia za mawasiliano mnazotumia?

9. Je njia hizi za mawasiliano ziboreshwe vipi ili ziweze kusaidia kilimo chenye tija?

II. Researchers

1. What are the communication strategies for disseminating SWM technologies?
2. What are the key communication channels that are used to disseminate SWM practices to farmers?
3. Which criteria do you consider for the communication channel to be effective?
4. Which communication channels you think are preferred by farmers?
5. How can communication be improved in disseminating SWM practices support sustainable agriculture?

Appendix 3: Socioeconomic questionnaire

General Information

Questionnaire No : _____

Interview date : _____

Enumerator Name : _____

Respondent Name : _____

Basic Demographic information

Region

- o Manyara
- o Dodoma

District

- o Babati
- o Kongwa

Village

- o Seloto
- o Halu
- o Gallapo
- o Sabilo
- o Long
- o Mlali
- o Sagara
- o Laikala
- o Unknown/missing

Respondent?

- o Household head
- o Wife of household head
- o Husband of household head
- o Grown up child
- o Parent of household head
- o Other (if other, please specify)

- o Unknown/missing

Household type?

- o Nuclear
- o Extended
- o De jure female headed (widow, never married, divorced)
- o De facto female headed (husband absent)
- o not yet married males
- o unknown/missing

Other household type

_____

Household size - total number

_____

Household size - adult male members

_____

Household size - adult female members

_____

Household size - children (under 18 years)

_____

Sex of household head?

- o Male
- o Female
- o unknown/missing

Educational Level of respondent?

_____

Educational level of spouse?

_____

Marital status of respondent?

- o Married
- o Single
- o Divorced
- o Separated
- o Widowed
- o unknown/missing

Age of respondent?

_____

Age of spouse?

_____

Source of income of the respondent?

_____

General Farm System Description

What is the total firm size?

_____

What is the size under cultivation?

_____

Do you implement soil and water management technology in your fam?

- o Yes
- o No

What type of soil and water management technology practiced in the farm?

- o Tied ridges
- o Ripping
- o Fanya juu
- o Fanya chini
- o None
- o Other (please specify)

Appendix 4: Field photos

Figure 1: Non-beneficiary farmers group putting towers to common communication channels used for disseminating SWM practice information in Seloto village. (Photo by Benjamin Ngulu)

Figure2: The research stud introducing the study to the farm before the start of the study. (Photo field team)

Figure 3: A farmer's hand in Sagara village demonstrating the communication flow of information about SWM practices between stakeholders (Photo by Benjamin Ngulu

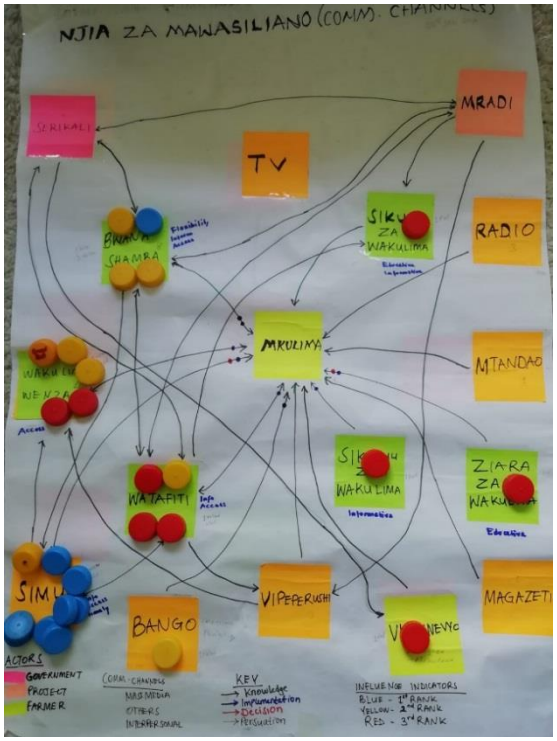

Figure 4: Net-map chart showing the flow of information between stakeholders and the preference tower of communication channels of beneficiary group in Laikala village (Photo by Gloriana Ndibalema)

Figure 5: A farmer's farm implementing tied ridges as SWM practice in Sagara village (Photo by Gloriana Ndibalema)

Figure 6: A farmer's farm that is doing conventional agriculture in Sagara Photo village (Photo by Gloriana Ndibalema)

Appendix 5: Adjacency matrices

The adjacency matrices presented below are representative samples to show how data analysis was conducted in getting NetDraws of the entire study.

	Government	NGO	Farmer	TV	Radio	Newspapers	Posters	Phones	Flyers	Internet	Extension officers	Agricultural Exhibitions	Exchange visits	Farmers field days	Reseachers	Fellow farmers	Others
Government	0	3	0	0	0	0	0	1	0	0	3	2	0	1	3	0	2
NGO	3	0	0	0	0	0	2	1	3	0	3	0	3	3	3	0	1
Farmer	0	0	0	0	0	0	0	2	0	0	2	0	1	1	3	3	0
TV	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Radio	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
News Paper	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Posters	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phones	1	1	3	0	0	0	0	0	0	0	3	0	0	0	3	3	0
Flyers	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Internet	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Extension officers	3	3	3	0	0	0	0	3	0	0	0	0	0	1	2	1	0
Agricultural exhibitions	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Farmers exchange visits	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Farmers field days	1	1	3	0	0	0	0	0	0	0	2	0	0	0	1	1	0
Reseachers	3	3	3	0	0	0	1	3	2	0	3	0	1	3	0	2	1
Fellow farmers	0	0	3	0	0	0	0	3	0	0	1	0	0	0	0	0	0
Others	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 7: The sum of adjacency matrices for beneficiary farmers groups in Kongwa district

	Government	NGO	Farmer	TV	Radio	Newspapers	Posters	Phones	Flyers	Internet	Extension officers	Agricultural exhibition	Exchange visits	Farmers field days	Reseachers	Fellow farmers	Others
Government	0	2	0	0	0	0	0	0	0	0	2	1	0	0	0	0	2
NGO	2	0	0	0	0	0	0	0	0	0	2	0	1	2	2	0	1
Farmer	0	0	0	0	0	0	0	2	0	0	2	0	0	0	2	1	0
TV	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Radio	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Newspapers	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Posters	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Phones	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0
Flyers	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Internet	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Extension officers	1	1	2	0	0	0	0	2	0	0	0	0	0	0	2	2	2
Agricultural exhibitions	0	0	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Exchange visits	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Farmers field days	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Reseachers	1	2	2	0	0	0	2	0	2	0	2	0	0	0	0	1	0
Fellow farmers	0	0	2	0	0	0	0	1	0	0	2	0	0	0	0	0	0
Others	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Figure 8: The sum of adjacency matrices for beneficiary farmer groups in Babati district