COMMUNICATION TOOLS FOR IMPROVED KNOWLEDGE SHARING IN RAINWATER MANAGEMENT: A CASE STUDY OF THE NILE BASIN DEVELOPMENT CHALLENGE

M.Sc. Thesis

Elias Damtew Assefa

April 2012

Haramaya University

COMMUNICATION TOOLS FOR IMPROVED KNOWLEDGE SHARING IN RAINWATER MANAGEMENT: A CASE STUDY OF THE NILE BASIN DEVELOPMENT CHALLENGE

A Thesis Submitted to the Department of Rural Development and Agricultural Extension, School of Graduate Studies, Haramaya University

In Partial Fulfillment of the Requirements for the Degree of MASTER OF SCIENCE IN AGRICULTURAL INFORMATION and COMMUNICATION MANAGEMENT

By

Elias Damtew

April 2012

Haramaya University

SCHOOL OF GRADUATE STUDIES
HARAMAYA UNIVERSITY

As *Thesis* research advisors, we hereby certify that we have read and evaluated this *Thesis* prepared under, our guide, by **Elias Damtew** Entitled**: "Communication Tools for Improved Knowledge Sharing in Rainwater Management: A Case Study of the Nile Basin Development Challenge"**. We recommend that it be accepted as fulfilling the *Thesis* requirement.

Prof. Ranjan S. Karippai	_____	_____
Major Advisor	Signature	Date
Dr Tilahun Amede	_____	_____
Co-advisor	Signature	Date

As member of the *Board of examiners* of the M.Sc. *Thesis Open Defense Examination,* we certify that we have read, evaluated the thesis prepared by **Elias Damtew** and examined the candidate. We recommended that the *Thesis* be accepted as fulfilling the *Thesis* requirement for the degree of *Master of Science* in Agricultural Information and Communication Management.

_____	_____	_____
Chairman	Signature	Date
_____	_____	_____
Internal Examiner	Signature	Date
_____	_____	_____
External Examiner	Signature	Date

DEDICATION

I dedicate this thesis manuscript to all my loved ones and the poorer farmers in the study area.

STATEMENT OF THE AUTHOR

I declare that this thesis is my authentic work and that all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements of M. Sc. degree at the Haramaya University and is deposited at the University Library to be made available to borrowers under rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

Brief quotations from this thesis are allowable without special permission provided that accurate acknowledgement of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the School of Graduate Studies when in his or her judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

Name: Elias Damtew Assefa Signature: ……

Place: Haramaya University, Haramaya

Date of Submission: ……

BIOGRAPHICAL SKETCH

The author was born in Addis Ababa on September 11, 1983. He completed his primary education in Mekane Eyesus primary and junior high school. He attended his secondary education at Bole Senior Secondary School. He then joined the then Alemaya University in November 2001 and graduated with B.Sc. degree in Agriculture/ Animal Science/ in July 2005.

After his graduation, he had worked as a self contained teacher in a private school before he joined Addis Ababa Trade and Industry Bureau as Livestock Products Marketing Development Officer. During the same time, He had worked in LINKS (Livestock Information Network and Knowledge System) and ELMIS (Ethiopian Livestock Marketing Information System) projects that were engaged in collecting, processing and disseminating livestock marketing information in Ethiopia and East Africa. He then joined Haramaya University for his postgraduate study in June 2010.

ACKNOWLEDGEMENTS

Above all, my heartiest thank goes to the gracious God for filling me with courage and stamina. My special gratitude extends to my beloved family for their unconditional love, care and support throughout my life.

I most sincerely appreciate the support and guidance I got from my major advisor, Professor Ranjan S. Karippai, in the course of the proposal and thesis manuscript development. Dr Tilahun Amede, my advisor from ILRI, I thank you very much for your kind and generous support and valuable comments from the very outset. My deepest gratitude to my adviser and mentor from ILRI, Mr. Peter Ballantyne, your warm heart and helpful intuition was not only a key to realize my dream but also gave me a valuable lesson what helping others does really mean. Thank you seem very feeble for connecting me with the NBDC.

I thankfully acknowledge NBDC project and ILRI/IWMI for recruiting me as a graduate fellow and funding my research project. Working on the project has been inspirational and quite an experience.

I am equally grateful to Woreda administrators, experts, DAs and the farming community in the study area which without your assistance the field work would have been a formidable task. I am indebted to my dear and near friends. You certainly added greatly to my success.

ABBREVIATIONS

BBM	Broad Bed Maker
CGIAR	Consultative Group on International Agricultur Research
CPWF	CGIAR Challenge Program for Water and Food
CTA	Technical Centre for Agricultural and Rural Cooperation
DA	Development Agent
FAO	Food and Agricultural Organization
FTC	Farmer Training Center
GO	Governmental Organization
GIZ	Gesellschaft für Internationale Zusammenarbeit
GWP	Global Water Partnership
ICT	Information Communication Technology
ILRI	International Livestock Research Institute
INBO	International Network of Basin Organizations
IWA	International Water Association
IWM	Integrated Watershed Management
IWMI	International Water Management Institute
IWRM	Integrated Water Resource Management
KA	Kebele Administration
MoA	Ministry of Agriculture
MoWR	Ministry of Water Resources
NBDC	Nile Basin Development Challenge
NGOs	Non Governmental Organizations
RAAKS	Rapid Appraisal of Agricultural Knowledge Systems
RHM	Rainwater Harvesting and Management
RMS	Rainwater Management System
RWM	Rainwater Management
SG 2000	Sasakawa Global 2000
SWC	Soil and Water Conservation
UNICEF	United Nations International Children's Emergency Fund

TABLE OF CONTENTS

TABLE OF CONTENTS (*Continued*)

TABLE OF CONTENTS (*Continued*)

LIST OF TABLES

LIST OF FIGURES

COMMUNICATION TOOLS FOR IMPROVED KNOWLEDGE SHARING IN RAINWATER MANAGEMENT: A CASE STUDY OF THE NILE BASIN DEVELOPMENT CHALLENGE

ABSTRACT

Communication and knowledge sharing among stakeholders working in rainwater management has a paramount importance to create shared understanding and to narrow the gap between research and action. Even though various rainwater management initiatives have been undertaken in Ethiopia in the last thirty years, there has been limited opportunity to share experience, to take valuable lessons and avoid duplication of efforts. This paper attempted to describe NBDC stakeholders' understanding on concepts and practices of RWM. It then assessed knowledge sharing challenges in RWM and finally went to identifying and evaluating communication and knowledge sharing tools for stakeholders in NBDC. By stratifying stakeholders as Policy Makers, Development Actors, Research Institutes and farmers, multi-stage sampling was used at organizational and individual levels to draw 129 respondents from selected stakeholders which were MoA, GIZ, Holleta Research Center and Farmers in Juldu Woreda. Both probabilistic and non probabilistic sampling techniques were used in the process. More of qualitative and some quantitative data were collected using interview schedule, FGD and key informant interviews. Narrative Analysis and RAAKS tools for qualitative analysis and simple descriptive statistics for quantitative analysis were employed. The result showed that there were different perceptions and understanding on basic concepts and practices of RWM. Farmers were found to have limited knowledge and practical know-how on scientific RWM concepts and practices whereas; professionals focused more on technological aspects of RWM than on enabling institutional innovation. knowledge sharing difficulty with model farmers, lack of constant follow up and resources to translate knowledge into practice among farmers and lack of commitment, different professional approaches, varying interest, lack of strong network and lack of enabling technologies and knowledge management professionals were among the major challenges for improved knowledge sharing in rainwater management among other stakeholders. The study revealed that communication and knowledge sharing tools used by training facilitators were not suitable to the majority of farmers. Farmers preferred a more practical oriented training sessions with demonstrations and field visits and with audio-visual tools like video, films and radio programs as teaching aids. Ease of understanding and permanence of acquired knowledge were among the major reasons for farmers' preference. Professionals from Holleta research Center preferred tools and methods that allow both face-to-face and virtual communications justifying the importance at different levels of engagements. Respondents from GIZ have shown more interest to virtual communication through web-based applications whereas, experts from MoA voted for face-to-face communications and knowledge sharing through workshops, conferences, seminars and trainings as these provide a better opportunity to deal with ambiguous and unstructured tasks as policy makers.

1. INTRODUCTION

1.1. Background of the Study

Nile Basin Development Challenge is funded by the CGIAR Challenge Program on Water and Food (CPWF). It aims to improve the resilience of rural livelihoods in the Ethiopian highlands through a landscape approach to rainwater management. It comprises five linked projects examining: 1) Learning from the past; 2) developing integrated rainwater management strategies; 3) targeting and scaling out of rainwater management innovations; 4) assessing and anticipating the consequences of innovation in rainwater management systems; and 5) catalyzing innovation platforms for learning, communication and coordination across the projects (CPWF, 2011a).

CPWF (2011c) stated that an innovation platform is a network of different stakeholders who come together to exchange knowledge and develop joint action to bring about change in livelihoods and natural resource management. The growing interest in innovation platforms recognizes that improvements to farmer livelihoods and environmental integrity depend not just on on-farm technologies but on wider institutions, markets and policies. Improved land and water management practices can often be more readily and sustainably achieved by addressing these wider issues than by a narrow focus on changing farmer behavior, but addressing them requires the involvement of a wide variety of stakeholders from communities, government, NGOs, research and private sector. Although this approach may require more patience the results are likely to be more sustained and far-reaching.

It is emphasized by Merrey and Gebreselassie (2011) on catalyzing the importance of knowledge sharing that the coordination project will ensure synergies, lessons and interactions between other Nile basin projects are fully exploited so that the whole is greater than the sum of the parts; and communication and linkages among the wider Nile BDC actors are strengthened, and successful ‘significant changes’ are promoted and integrated into current and emerging initiatives. To achieve this, the coordination project is organized around three major outputs:1) Development, use, monitoring and adaptation of the impact pathways

(Outcome Logic Models); 2) innovative approaches to foster change by mapping networks of present and desired actors and their interactions and developing plans for engaging and influencing them; and 3) communication among RWM actors and between policymakers and development actors, and among all partners within the five projects as well as other local and national initiatives. Bessette (2006) asserts that effective learning and communication mechanisms improve the capacity of stakeholders to adjust their decisions and behaviors to adapt to future changes in water resource availability.

Lotfy (2007) asserts that efforts should be geared towards enhancing mutual understanding among stakeholders which can be created through interaction around local situations. So, communication and knowledge sharing among multiple stakeholders are expected to be efficient for creating common understanding on basic concepts and practices of rainwater management. Effective communication and knowledge sharing through different tools and methods that suit the nature and complexity of information and knowledge to be exchanged or shared, and that take into account the ground realities within which the target groups exist is important. In other words, relevant information and knowledge concerning integrated rainwater management should be available and, delivered and scaled out in a form that is appropriate to all participants.

To emphasize the importance of taking into account social aspects of knowledge sharing in designing appropriate tools, Sydney *et al*. (2005) stated that knowledge sharing is a social activity and so the social implications of knowledge sharing systems need to be considered and used to help design processes and tools that are actually useful. In a complete knowledge sharing system, tools to support finding the right person or group of people are required.

So, a systematic investigation in the communication and knowledge sharing aspect to identify and evaluate different communication and knowledge sharing tools that are suitable for different types of stakeholders, with due consideration of the situation they are in, is imperative for creating common understanding on the issue and for effective outreach of the target groups in particular and the wider public in general.

1.2. Statement of the Problem

Different literatures pinpoint concepts on water resource management tend to be understood differently by different stakeholders. There is also a limited awareness on how these concepts can be communicated with multiple stakeholders, but for the success of any water resource development initiative a common understanding on the issue is important (FAO, 2001; Debora and Brian, 2009). Roland (2007) pinpoints that underlying the whole issue of knowledge sharing in the water sector are the driving factors for change in the natural and social environments. Lotfy (2007) stated that building of common views, the desire to resolve a resource dilemma must be shared by the stakeholders. Stakeholders must agree on a common understanding of shared basin management and see advantages in a joint approach. The need for better knowledge sharing and knowledge generation remains acute. APWF (2009) also asserts new challenges of water security in the 21st century addressed knowledge on key water topics must be better leveraged and communicated among individuals, groups, organizations, and countries.

Knowledge sharing is becoming increasingly important to ensure that practice and policy are based on sound evidence. For this to happen, the gaps among research, practice, and policy must be bridged. Knowledge sharing is a tool that can be used to promote evidence-based practice and decision making, and also to promote exchange and dialogue among researchers, policymakers, and service providers. Lack of arrangements for knowledge sharing limits collaboration and shared understanding (Lily *et al.,* 2006). Various national and regional organizations in Ethiopia are engaged in natural resource management, particularly in land and water, but for the last 30 years there has been limited opportunity for them to share experiences, identify gaps and feed key insights to policy makers (Adane, 2011).

CapNet (2004) stressed that a proper communication system within the network is central for its efficiency and to facilitate knowledge mapping and knowledge sharing. Networks are about people and their interactions, and thus communication is critical. Technology offers a tool to facilitate this process.

The means of communicating knowledge in a learning environment is highly varied. Web based tools combined with face-to-face methods offer new opportunities for better knowledge sharing across disciplines, languages and borders (Simon *et al.,* 2010). Open or restricted access websites are common tools for basin managers and stakeholders to share and access information. For those without internet connections, the same sets of information can be shared on CD-ROMs. Although the Internet is effective for information sharing, it may not be the most suitable tool for information sharing in basins where rural and poor communities do not have access to such technology. Basin organizations thus need to consider different options including newsletters in local languages, radio programs and face-to-face meetings (GWP and INBO, 2009).

A number of action researches have been undertaken on scientific and technical aspects of rainwater management. However, identifying and evaluating suitable tools and methods is expected to contribute in materializing effective information and knowledge sharing and creating shared understanding on basic rainwater management concepts and practices. So far, no systematic investigation has been conducted on the communication and knowledge sharing aspect of relevant stakeholders including the beneficiary community in the project research sites in general and in the study area in particular, and hence this research is expected to contribute in filling this knowledge gap.

1.3. Objectives of the Study

The general objective of the study is to investigate knowledge sharing practices, challenges and communication and knowledge sharing tools for different stakeholders in Nile Basin Development Challenge for improved knowledge sharing in rainwater management in Juldu wereda.

The specific objectives of the study are:

- to analyze understanding of different stakeholders on basic concepts and practices of rainwater management;

- to assess knowledge sharing practices and challenges in rainwater management for different stakeholders; and

- to identify and evaluate communication and knowledge sharing tools of different stakeholder categories.

.

1.4. Scope of the Study

The scope of the study is delineated to describe and analyze how different stakeholders understand the concept of rainwater management. It then moved to identifying and evaluating what communication and knowledge sharing tools and techniques are being used and would be appropriate for each type of stakeholder in the Nile Basin Development Challenge which in the process existing knowledge sharing practices and challenges are assessed.

The principal focus of the study was to investigate knowledge sharing practices, challenges and tools for the rural communities which have implications for other water stakeholders in the area for materializing effective interaction with the farmers. However, as communication and knowledge sharing processes and practices in a co-learning scenario are meant to involve different actors, it was necessary to include other important stakeholders that are active in the study area.

1.5. Significance of the Study

Elucidating conception and understanding of different stakeholders on rainwater management would have implications for water stakeholders in analyzing entry points for effective communication. Evaluating currently used tools and identifying best bet communication and knowledge sharing tools for different actors will be imperative in setting a platform for effective knowledge flow among the different stakeholders. Therefore, the findings of this research can be used as an input by policy makers, researchers and development actors in their effort to materialize improved knowledge sharing through appropriate tools and methods among themselves and with the local community.

Even though, a number of researches were conducted on the technical aspects of land and water resource management in the country, the researcher was unable to find a full-fledged research done on communication and knowledge sharing aspects of water stakeholders. Hence, as the study attempted to look from a different perspective in RWM, it can also be used as a relevant resource for further academic research in the area.

1.6. Organization of the Thesis

The thesis is organized into five chapters. The first chapter is devoted to the introduction part that includes background of the study, statement of the problem, objective of the study, scope of the study, significance of the study and organization of the thesis. In the second chapter, relevant literature on definitions and basic concepts of rainwater management, water stakeholders, knowledge and knowledge sharing, communication and knowledge sharing tools and empirical studies on the area are reviewed. Chapter three dwells on the research methodology. In Chapter four main findings of the study are presented and illustrated. It is structured into four sections based on the objective of the study where the content of each subsection is explicitly described at the beginning of the chapter. Finally, chapter five presents the summary, conclusions and recommendations of the study.

2. LITERATURE REVIEW

This section of the study attempts to overview stakeholders and their understanding on issues of water resource management in rainfed agriculture. It then goes through communication and knowledge sharing practices on the issue and communication tools suitable for different stakeholders. So emphatic reviewed literature will be divided in six parts as:

2.1. Concepts of Integrated Rainwater Management.
2.2. Stakeholders in Water Resource Management in Rainfed Agriculture.
2.3. Concepts of Knowledge and Knowledge sharing.
2.4. Communication and Knowledge Sharing for Integrated Rainwater Management.
2.5. Communication and knowledge sharing Tools for Integrated Rainwater Management.
2.6. Empirical Studies on Communication and Knowledge Sharing.

2.1. Concepts of Integrated Rainwater Management

Rockström (2003) explains a broad approach to water productivity in land management that covers both irrigated and rainfed agriculture has implications for water resources management. Partitioning of rainfall in rain-fed agriculture and the biophysical dynamics of green-water flow at plant and production system level has recently been studied. However, relatively less attention (compared with irrigation efficiency) has been paid to the opportunities at hand to improve agricultural water productivity within the large (relative to blue-water flow) component of green-water flow in the on-farm water balance and the hydrological cycle at catchment, basin and global levels. He then states, integrated rainwater harvesting and management (RHM) systems and complementary technologies can help smallholder farmers to increase and diversify crop production, and hence shift from subsistence to commercial agriculture.

Water management to upgrade rain-fed agriculture encompasses a wide spectrum, from water conservation practices for improving rainwater management on the farmer's field to managing runoff water (surface and subsurface) for supplying supplemental irrigation water to rainfed

food production. There is no clear demarcation between rainfed and irrigated systems (Hatibu *et al.,* 2007).

With regard to the concept of rainwater management, Amede *et al.* (2011) describe it as an integrated strategy that enables crop-livestock systems to systematically capture, store and efficiently use water and nutrient resources on farms and watersheds in a sustainable way for both agricultural and domestic purposes. It focuses more on the institutions and policies than on the technologies and advocates increased water storage and water productivity at various scales; in the soils, farms, landscapes, reservoirs and basins. Rainwater management is an effective strategy to manage the consequences of climate change (e.g. floods and drought) by combining water management with land and vegetation management.

To emphasize the concept of rainwater management is beyond technical innovations Merrey and Gebresilasie (2011) argues that rainwater management system (RWMS) includes technologies and practices for managing land and water for production, and the policy, institutional and social dynamics and support systems necessary to optimize the benefits of such technologies and practices.

Stephens (2011) also elucidates rainwater management as a holistic, landscape-based which seeks to capture rain where it falls, and is guided by a 'design with nature' philosophy. With respect to landscape-based rainwater management, an Integrated Rainwater Management Plan is a vehicle for local government to strategically connect the dots between land use planning, development and infrastructure standards, and asset management.

Rainwater Management System (RMS) by CPWF (2011b) is comprehensively explained as interventions (technical, institutional, policy) that enable water to be captured, stored and efficiently utilized. This broadly includes soil and water conservation, sustainable land management, rainwater harvesting, conservation farming and micro irrigation management of water for crops, livestock, agro forestry and fish productivity. It is based on two broad concepts: The first is a 'landscape approach to rainwater management.' Like 'integrated watershed management' (IWM), it shares a systematic integrated systems paradigm.

‘Integrated Watershed Management’, however, emphasizes hydrological boundaries while the landscape perspective considers broad social, economic and institutional networks that cut across hydrological boundaries. In the landscape approach, the aim of research is not necessarily to maximize the output of one element of the system, but to optimize the range of services of the entire watershed resource system. The second is an ‘innovation system’ paradigm. Based around the notion of a ‘learning platform,’ the underlying idea is that to optimize the relevance and uptake of research results, research must be carried out from the beginning as a partnership of multiple stakeholders learning together.

Apparently, the underlying principles of a landscape approach to rainwater management is as holistic as that of integrated watershed management perspective, yet it conceives all social, economic and institutional networks from local to landscape and basin level without being confined within hydrological boundaries. On the watershed paradigm German *et al.* (2006) stated that without having a fixed idea about the nature of issues to be addressed within the watershed management umbrella, understanding of what constitutes a ‘watershed issue’ remains elusive.

The watershed context provides the natural framework for investigation into the complex and reciprocal linkage among land use, soil and water resources, and the interdependence of people in their resource use practices. Because of this physical significance, watersheds are also considered to be the logical spatial constructs for the sustainable and integrated management of resources with the direct involvement of local populations and the practice is what popularly known as integrated watershed management (Brooks *et al*., 1997 ; Sharma, 1999; Rhoades, 2000, as cited in Woldeamlak, 2003).

According to Sally (2002), there are two ways of meeting increased demand for agricultural water use: developing additional water supplies (e.g. reservoir construction, trans-basin diversions), or making effective use of existing facilities. The essential function of storage, whether in reservoirs, tanks, farm ponds, or Ground water aquifers, is to help meet water demand in the face of spatial and temporal variations in natural water supply, whereas, in areas where water rather than land is the limiting resource, the focus should shift to increasing

the productivity of water. That is, to identify and adopt agricultural and water management practices that achieve more output per unit of water consumed, thereby easing the strains of water scarcity and reducing the need for additional storage.

From the aforementioned paragraphs it can be emphasized that, rainwater management is a broad concept incorporating a wide range of issues along with community's vision for socio-economic benefits working without hydrological boundaries. Apart from equitable and efficient capture, storage and use of rainwater for agricultural and domestic purpose, the concept of rainwater management, whether at micro or macro level, treats environmental issues as one of its main concerns for sustained ecosystem services.

2.2. Stakeholders in Water Resource Management in Rainfed Agriculture

2.2.1. Overview of stakeholders

Stakeholders are individuals, groups or institutions that are concerned with, or have an interest in the water resources and their management. They include all those who affect and/or are affected by the policies, decisions, and actions of the system. That means not only direct water users but those affected by (waste) water management. They include those involved in water resource development, management and planning, including public-sector agencies, private sector organizations and NGOs and external (such as donor) agencies (Warner, 2005).

On a study at benchmark watershed sites of 'Eastern African highlands' German *et al.* (2006) define water stakeholders specifically as local actors with different interests or "stakes" as defined with respect to the particular issue at hand (trans-boundary, CPR or other). Non-local stakeholders are only involved if the issue involves them directly, including the management of public lands, governance issues or public services (water, etc.).

Dixit *et al. (*2003) explain management of natural resources on watershed basis is a complex process involving several disciplines and institutions. It has been long debated about how to achieve convergence of various disciplines and institutions at watershed level. It is indeed

challenging to bring together various agencies that have their own strengths, limitations, and styles of functioning, and form a consortium to deliver goods to the rural poor.

2.2.2. Stakeholders understanding of water resource management in rainfed agriculture

Lack of shared understanding has hindered the collaboration of efforts and resources among actors, but rather, it has promoted implementation of uncoordinated and conflicting approaches of rainwater management. It is found that breaking the dilemma between alternative solution options among stakeholders is part of a solution to the current crisis of rainwater use, management and promotion (Mogus, 2006).

To emphasize the difference in perception among stakeholders Mogus (2006) stated that recently, in Ethiopia, RWH as an alternative water supply option has received a lot of attention as development actors and scholars, has increasingly recognized the importance to mitigate the problem of physical as well as economic water scarcity. This has resulted in widespread agreement to work towards the promotion of RWH technologies and efficient use of rainwater resources. However, the attraction of many actors, on the other hand, resulted in varied perceptions over the use, management and promotion of rainwater. This in turn has resulted in a heated debate about the solution to the crisis of rainwater management among stakeholders.

The importance of having common understanding on rainwater management is also emphasized by the NBDC project. The technical partner meeting report by Pfeiffer (2011) explained that “one of the objectives of meeting stakeholders in Nile 3 project is to reach a common understanding of what a ‘landscape approach to rainwater management’ is”. Even though integrated rainwater management practices take into account local contexts with their landscape component, one can realize understanding of basic concepts and proposed intervention practices tend to be perceived differently by stakeholders.

IWA (2007) stressed that at many levels in the process even at the governmental level stakeholders lack the necessary knowledge and skills for full application of IWRM.

Community stakeholders may not be familiar with the concept of water resource management, catchment management, corporate governance, and their role in these. Many, even in developed countries, do not even know what a catchment or watershed is. The water stakeholders must, therefore, collaborate in designing and implementing strategic elements of capacity building as part of the evolving IWRM process. Early dissemination of information, available information on basin should be made available to all stakeholders when project is initiated, to give a base-line for the development of a common understanding, which provides for effective stakeholders participation (Lotfy, 2007).

2.3. Concepts of Knowledge and Knowledge Sharing

2.3.1. Concepts of knowledge

Davenport *et al.* (1998) define knowledge as a high-value form of information that is ready to apply to decisions and actions. Serrat (2008) states that knowledge is created and organized by flows of information and shaped by their holder. It is tacit or explicit. Tacit knowledge is non verbalized, intuitive, and unarticulated knowledge that people carry in their heads. It is hard to formalize and communicate because it is rooted in skills, experiences, insight, intuition, and judgment, but it can be shared in discussion, storytelling, and personal interactions. It has a technical dimension, which encompasses skills and capabilities referred to as know-how. It has a cognitive dimension, which consists of beliefs, ideals, values, schemata, or mental models.

According to Servin (2005), tacit knowledge is the knowledge that people carry in their heads. It is much less concrete than explicit knowledge. It is more of an “unspoken understanding” about something. He further explained that most people are not aware of the knowledge they themselves possess or of its value to others. Tacit knowledge is considered more valuable because it provides context for people, places, ideas and experiences. It generally requires extensive personal contact and trust to share effectively.

Serrat (2008) described explicit knowledge as a codified knowledge that can be expressed in writing, drawings, or computer programs and can be transmitted in various forms. He also emphasized that explicit knowledge and tacit knowledge are mutually complementary forms of meaning. GDN (2007) identified the explicit knowledge as; 'what is captured in documents, databases, web sites and other knowledge resources versus tacit knowledge that is not primarily captured, but exists in people's heads and is reflected as insight, judgment, craftsmanship and creativity. While, explicit knowledge can be readily transmitted to others. For Davice (2001) explicit knowledge is knowledge that the knower can make explicit by means of a verbal statement, readily available to the users in many codified forms such as books, journals, reports and Internet.

Explicit knowledge can be categorized as either structured or unstructured. Documents, databases, and spreadsheets are examples of structured knowledge, because the data or information in them is organized in a particular way for future retrieval. In contrast, e-mails, images, training courses, and audio and video selections are examples of unstructured knowledge because the information they contain is not referenced for retrieval (Servin, 2005). Knowledge has a characteristic which is the same as the currency, i.e. people can't find its value unless it is used or transmitted. The knowledge is useful only when it becomes social sharing. In other words, knowledge develops in the communication and value-added in the use (Lingling *et al.*, 2008).

2.3.2. Concepts of knowledge sharing

According to Roland (2007), knowledge sharing is a means to an end. As such, it describes the process by which individuals and groups communicate their knowledge unconsciously or deliberately to their mutual benefit. To point out the roots of knowledge sharing Jeffrey (2003) stated that it has emerged as a key research area from a broad and deep field of study on technology transfer and innovation, and more recently from the field of strategic management. Increasingly, knowledge-sharing research has moved to an organizational learning perspective.

Knowledge sharing presumes a relation between at least two parties, one that possesses knowledge and the other that acquires knowledge. The first party should communicate its knowledge (Hendriks, 1999). Hansen (2005) stressed that knowledge sharing can be understood as the behavior by which an individual voluntarily provides other social actors, both within and outside an organization, with access to his or her unique knowledge and experiences. While emphasizing the importance of social presence in knowledge sharing, he further argued that if the understanding of knowledge is based on action and tacit elements, then knowledge sharing behavior is more likely to entail offering one's time and skills for face to-face interaction or other forms of direct discussion. Mentorship programs or communities of practice would be characteristic of such a tacit knowledge focus. Sally (2007) explains that knowledge sharing processes are optimized when there is clarity, with regard to what knowledge to exchange based upon the objectives, who is involved in the exchange process and which technology is the most appropriate to use.

Fostering knowledge sharing is more than simply putting people together in a conference room or sending them on experiential learning programs. It is about creating an environment in which people are able to discern whether their colleagues are both knowledgeable and willing to extend their knowledge to the benefit of others (Daniel *et al*., 2003).

2.4. Knowledge Sharing and Communication for Integrated Rainwater management

2.4.1. Communication for integrated rainwater management

Planning and implementing a sound communication strategy that facilitates knowledge sharing and multi-directional dialogue in the issues of water resource management is indispensible. Laban *et al.* (2005) underscored that in the broad arena of Integrated Water Resource Management, networking and dialogue can lead to different forms of social organization. This can range from loose communication networks for sharing and learning to strategic alignments and resource coalitions of different stakeholders where resources and capacities are pooled to come to joint planning, decision-making and action.

Effective communication aims to increase public understanding of the problem whilst better informing local decision making and public acceptance of strategies which might be imposed in future to manage scarce water resources. As this problem is inherently complex, effective risk communication is problematic both for those developing management strategies and those who may have such strategies imposed upon them. (Sawah, 2009)

Communication may be a vehicle for information/knowledge exchange, knowledge building and dissemination. Free-riding, opportunism and double agendas however are obvious pitfalls. While there are known cases where the stakeholders themselves collect, manage and interpret the information, it is hard to predict and prove however that any joint learning (rather than individual learning, or learning at delegation level) happens as a result of participation. While no doubt people learn by doing, i.e. acquire new information and ways of thinking due to their participation (Warner, 2005).

With regard to the importance of communication for effective innovation outreach Mast, (2005) pinpoints that the information about and communication of new ideas, technologies, products, and services play a crucial role. For the diffusion of innovations it is essential to make them popular both among the specialist community and within broader parts of society. It is thus of crucial importance for scientists and managers to reconsider their attitude towards an active communication of innovative ideas and inventions. Without this, any effort by politics to create a suitable general framework and by media to facilitate a public innovation discourse are in vain. It also does not support people's understanding of the ways in which a society is made productive, which reform measures are necessary accordingly, and which innovative products and processes are acceptable.

People have the most direct influence on our behaviors, either directly or when the mass media demonstrate other people like us practicing recommended behaviors. This may seem obvious, and it is. The question is: why don't we use the obvious in development interventions? Humankind is influenced by friends, neighbors, people we admire, the groups we join. Therefore, these are valuable and more important available resources that should be used to encourage people to develop recommended behaviors. This is why the most

successful efforts to develop sustained recommended behaviors have been those that have enlisted satisfied acceptors, local networks, local influential people, community training programs and, the most important factor of all; that which has encouraged communities to participate in planning, implementing, monitoring and improving their own interventions (UNICEF, 1999).

Attempts at capacity building without some consideration of communication methods, tools and skills cannot in the end succeed. Especially in these days of project based funding, where capacity building attempts have failed and money has been wasted because project goals and potential have been "inflicted" in a top down fashion: the communication was all one way, and usually originated from outside the community. But communication that fosters growth is a two-way street, and so ultimately, the most important thing communities can do to build capacity is to engage in multidirectional dialogue with all community stakeholders. Only then does sustainable development have a chance (Romanow, 2006).

2.4.2. Knowledge sharing for integrated rainwater management

Knowledge and perception play a vital role in shaping human practice. This implies at the same time that innovation and development (i.e. modification of human practice) require and/or go along with changes in knowledge and perception. Communication, then, is an important process that people use to exchange experiences and ideas, and hence a vital trigger for altering knowledge and perception (Leeuwis, 2004).

One of the main challenges for researchers in natural resources management is to turn knowledge into action to achieve tangible results and outcomes to improve livelihoods of the smallholder farmers. Enhanced knowledge sharing ensures that research findings are well communicated to key stakeholders in order to achieve improved livelihoods and influence decision-making and utilization of improved technologies (CTA, 2010).

Almost everyone in the water sector could benefit from sharing knowledge and data with peers in other countries and sectors. Knowledge to be shared includes technical data and

technical information as well as institutional and financial information (GWP, 2003). Information and knowledge management are increasingly recognized as important features in effective and efficient work in the water sector. However this essential knowledge is not easily available and is often spread among various stakeholders worldwide. In addition, its enhancement is impeded by a lack of sharing and exchanges within either the "water community" in general or thematic communities (Dondeynaz *et al.*, 2009).

In the framework of the 'Integrated Water Resources Management' approach, the development of the water sector in developing countries implies the involvement of an important number of stakeholders at different decision levels. This implies the generation of complex information, data and knowledge that are often unstructured and fragmented in different working groups and projects. There is an urgent need for an information system which should federate this information, one promising approach is adaptive co-management between local communities and knowledge agents, in which knowledge sharing and transformation occur as an iterative process. Important tools for adaptive co-management include participatory approaches, farmer field schools, and action research methods (Hatibu, 2007).

2.5. Communication and Knowledge Sharing Tools for Rainwater Management

On the nature of services tools provide with regard to timeframe of connection, communication experts broadly classify communication tools as synchronous and asynchronous tools.

2.5.1. Synchronous communication tools

According to Kaplan and Ashley (2003), Synchronous tools enable real-time communication and collaboration in a "same time-different place" mode. These tools allow people to connect at a single point in time, at the same time. Synchronous tools possess the advantage of being able to engage people instantly and at the same point in time. The primary drawback of synchronous tools is that, by definition, they require same-time participation -different time

zones and conflicting schedules can create communication challenges. In addition, they tend to be costly and may require significant bandwidth to be efficient. Synchronous communication can save travel time and money, and a range of both licensed and free communication tools for this purpose have been developed throughout the past years. Examples of synchronous are shown in Table.

Table 1. Synchronous communication tools

Tool	**Useful for**	**Drawbacks**
Audio conferencing	Discussions and dialogue	Cost, especially when international participation is involved
Web conferencing	Sharing presentations and information	Cost, bandwidth; may also require audio conferencing to be useful
Video conferencing	In-depth discussions with higher-touch interactions	Cost, limited availability of video conferencing systems
Chat	Information sharing of low-complexity issues	Usually requires typing, "lower touch" experience
Instant messaging	Ad hoc quick communications	All users must use compatible system, usually best for 1:1 interactions
White boarding	Co-development of ideas	Cost, bandwidth; may also require audio conferencing to be useful
Application sharing	Co-development of documents	Cost, bandwidth; may also require audio conferencing to be useful

Source: Executive update online (http://www.centeronline.org).

2.5.2. Asynchronous communication tools

Asynchronous tools enable communication and collaboration over a period of time through a "different time-different place" mode. These tools allow people to connect together at each person's own convenience and own schedule. Asynchronous tools are useful for sustaining dialogue and collaboration over a period of time and providing people with resources and

information that are instantly accessible, day or night. Asynchronous tools possess the advantage of being able to involve people from multiple time zones. In addition, asynchronous tools are helpful in capturing the history of the interactions of a group, allowing for collective knowledge to be more easily shared and distributed. The primary drawback of asynchronous technologies is that they require some discipline to use when used for ongoing communities of practice (e.g., people typically must take the initiative to "login" to participate) and they may feel "impersonal" to those who prefer higher-touch synchronous technologies (Kaplan and Ashley, 2003). Communication is expanded over a longer time period and thus prolonged, compared to synchronous communication. Speaking technically, synchronous communication tools usually require high bandwidth and an often more complex software, when compared to asynchronous communication. Examples of synchronous are shown in table.

Table 2. Asynchronous communication tools

Tool	**Useful for**	**Drawbacks**
Discussion boards	Dialogue that takes place over a period of time	May take longer to arrive at decisions or conclusions
Web logs (Blogs)	Sharing ideas and comments	May take longer to arrive at decisions or conclusions
Messaging (e-mail)	One-to-one or one-to-many communications	May be misused as a "collaboration tool" and become overwhelming
Streaming audio/Video	Communicating or teaching	Static and does not provide option to answer questions or expand on ideas
Narrated slideshows	Communicating or teaching	Static and does not provide option to answer questions or expand on ideas
"Learning objects" (Web-based training)	Teaching and training	Typically does not provide option to answer questions or expand on ideas in detail
Document libraries	Managing resources	Version control can be an issue unless check-in /-out functionality is enabled
Databases	Managing information and knowledge	Requires clear definition and skillful administration
Web books	Teaching and training	Not dynamic & may lose interest of users

Source: Executive update online (http://www.centeronline.org).

2.5.3. Suitable communication tools for integrated rainwater management

In Ethiopia, the major problems associated with the generation of reliable data and information on water resources management consists of a lack of consolidated strategy, including institutional linkages, processes of collection, storage, analysis, and dissemination (Awulachew, 2007). The proper selection of media is fundamental and should be done carefully. Each medium has its own specific technical features that make it more or less suitable for specific objectives, target groups, situations, cultures, messages, levels of intervention and also budget. Essential to success of media in rural development are a precise analysis of the situation, the objective and the actors, pre-testing and impact monitoring (GTZ 2003).

The emergence of Information and Communication Technologies (ICTs) has opened new venues for communication and knowledge sharing that can efficiently be used in water resource management initiatives. FAO (2003) explains the revolution in information and communication technologies is profound. The Internet, e-mail, mobile phones, satellite and wireless, have all opened up communications in ways not thought possible even a few years ago. Countries with collapsing telecommunications infrastructures can utilize cell phones; microwave and satellite technologies to upgrade and more affordably replace old systems, and provide phone and Internet service to isolated rural areas.

On the other hand, communication thinking must also reflect the environment it works in. In developing countries like Ethiopia easy access to state-of-the-art ICT technologies, especially in rural areas, is far-fetched at least in the short term. Traditional communication media still seems one of the best options for the purpose of communication and transfer of knowledge. Based on his study conducted in India Kumar (2006) asserts “Even when modern media have penetrated isolated areas, the older forms maintain their validity, particularly when used to influence attitudes, instigate action and promote change. Extensive experience shown that traditional forms of communication can be effective in dispelling the superstitions, archaic perceptions and unscientific that people have inherited as part of traditions and which are difficult to modify if the benefits of change are hard to demonstrate

One of the traditional communication tools, Radio, is still the most accessible, affordable and most widely used mass medium in Ethiopia. It is Often the only mass medium in rural areas. Myers (2008) emphasizing the importance of mass communications in Africa stated that Radio seems to have proven itself as a developmental tool, particularly with the rise of community and local radios, which have facilitated a far more participatory and horizontal type of communication than was possible with the older, centralized broadcasting model of the 1960s and 70s. There seems also to have been a re-discovery of radio in the context of new ICTs, a realization that technology has made radio into a more two-way medium and that it can help bridge the digital divide by providing a powerful tool for information dissemination and access, especially for hard-to-reach rural audiences.

In Ethiopia apart from centralized radio broadcasting, a number of small FM radio stations with mostly specific local context and audience are mushrooming. These radio stations can foster communication and empower communities to participate in dialogue and decision making concerning issues on integrated rainwater management.

In line with the argument, GTZ (2003) reported that print media work well with participatory approaches. They include newspapers, posters, photo albums, wrappers, folders, stickers, calendars etc. Compared to other media, print has the advantage of being relatively cheap, as well as better to memorize because of the fact that written words or pictures stick better in mind. This medium is comparatively low-priced and available for a wide range of people.

When it comes to farmers a hand-on practical teaching is important. Trainings, field visits and practical demonstrations are important knowledge sharing tools as knowledge is mostly embedded in farmers' practices. Robert (2003) explained that farmers and their families are taught in informal settings; such as in a field, under a tree in a village, or in a meeting room. Teaching materials should be in terminology farmers use and understand, with illustrations. Most importantly, they need to be in language farmers use and understand. Method and result demonstrations on fields are needed.

Bohmann (2004) identified important communication and knowledge sharing tools that could be applied at the micro level.

Table 3. Media Overview

I. Print Media • To read: Information booklets, brochures, books • To look at: Posters, calendars • For group work: Flip charts, flash cards The non-verbal media can also be designed with and for illiterate target group members. They can be used to transmit information quickly and efficiently, reaching many people. Brochures and books are used at the meso and macro levels in information and advocacy work, the other media mainly at the micro level.
II. (Audio-) Visual Media • Videos ; Films; Slide series These media are usually used in group work to arouse interest in a topic, to transfer certain information, and as a didactic instrument at the micro level.
III. Grass-roots and Small-scale Media • Theatre, puppet shows, role-plays • Songs, drumming, dances, poems, storytelling, street processions • Fabrics, T-shirts, peaked caps, burlap bags with printed slogans • Large flip-boards, flannel boards, flyers, leaflets • Stickers, badges, postcards These are particularly suitable for arousing interest, promoting awareness, and encouraging people to think about or discuss a certain theme. They are useful for work at the micro level; the non-verbal media are particularly apt for work with illiterate target groups.
IV. Mass Media • Daily newspapers and magazines: News, reports, columns, interviews, advertisements, appeals, announcements • Radio and TV: News, reports, radio plays or films, soap operas, radio / TV spots, interviews, talk shows, appeals, announcements

These are suitable for information and education work, especially in campaigns. Simple messages and a range of background information can be efficiently disseminated and new themes placed on the agenda at the local, regional and national levels.
V. New Information and Communication Technologies (ICTs) • Internet and computers: Knowledge databases, e-mails, websites, PowerPoint presentations, CDROMs • Digital cameras • Mobile phones, faxes These are used to transfer information quickly for remote training courses, to support seminars, to promote economic activity, to support advocacy work and for networks at all levels of intervention. The first positive experiences with mobile phones have been gathered at regional level in the marketing of small commodities. Digital photos, for instance, taken on tours of firms, can be a didactic instrument for profitable environmental management.
VI. Media Mix Depending on the media use behavior and the size of the target groups, different media can be used for specific segments of the group using several media.

Source: Bohmann (2004)

2.6. Empirical Studies on Communication and Knowledge Sharing

Previous empirical studies that are done on communication and knowledge sharing aspect of stakeholders working in water resource management in Ethiopia are almost non-existent. However, some important findings as part of other studies were established by researchers which can give some insight for this study.

With regard to stakeholders understanding, a study conducted on Berki catchment in Tigray by Dibora and Brian (2009) reveals that stakeholders perceived ‘content’ in IWRM as one of the limits of communication, stating that it is often unclear. To understand how stakeholders perceive ‘integrated water resource management’, the authors asked respondents if water should be managed at basin level or not and what social and political constraints they could foresee if water resources were managed at basin level. At federal and regional levels most

stakeholders (80%) recognize the difficulty of harmonizing administrative and hydro-geological boundaries, and the rest mentioned lack of expertise, lack of baseline data on water resources and lack of financial resources. At Woreda and Tabia levels, during focused group discussion, different stakeholders from the regional technical committee said the community does not understand the concept of a catchment area, even with pictures. So one basic concept of IWRM is too difficult to be understood locally; how does it affect the communication process?

A study by Kebebe *et al.* (2010) explored that how effective engagement of different communication and knowledge sharing tools for different stakeholders have facilitated joint learning and collaboration. It was stated training and on-farm demonstrations, farmers' field days, stakeholder planning meetings, farmers' experience sharing visits, debriefing conferences and fodder roundtables shaped the process of shared learning and increased trust and mutual understanding among the actors. The stakeholder platform began to break the institutional barriers, bridging system failures in the pilot districts. More interactions and institutional learning intensified among actors including farmers. The partners began to discharge responsibilities agreed upon in the joint planning sessions. The platform has become a suitable venue to raise and discuss common issues of concern among actors.

When it comes to assessing different tools as source of information and knowledge for farmers, Daniel (2008) in his study at Metema Woreda revealed that amongst different mass media, radio, television, leaflets and newsletter (reading material), and posters contribute to the dissemination of agricultural information with different degrees. Out of the total respondents of the study, 48.8%, 27.5%, 12.5% and 5% of farmers obtained information from radio, television, leaflet and news letter, and posters respectively. As the result shows, most of respondents obtain information from radio, due to the high number of radio ownership. Regarding the information obtained through leaflet and posters, they are found to be of a relatively lower proportion, due to the poor availability and high illiteracy level, even though the utility level for those who have access to the reading materials is found to be higher in the study (87.5 %). He argued further that mass media play a great role in provision of information and creating awareness in shortest time possible over large area of coverage. As

far as awareness is a prerequisite for behavioral change, its role cannot be underestimated. Furthermore, its influence can be expressed through other effects like enhancing favorable attitude and overall good perception about new innovations.

2.7. Conceptual Framework

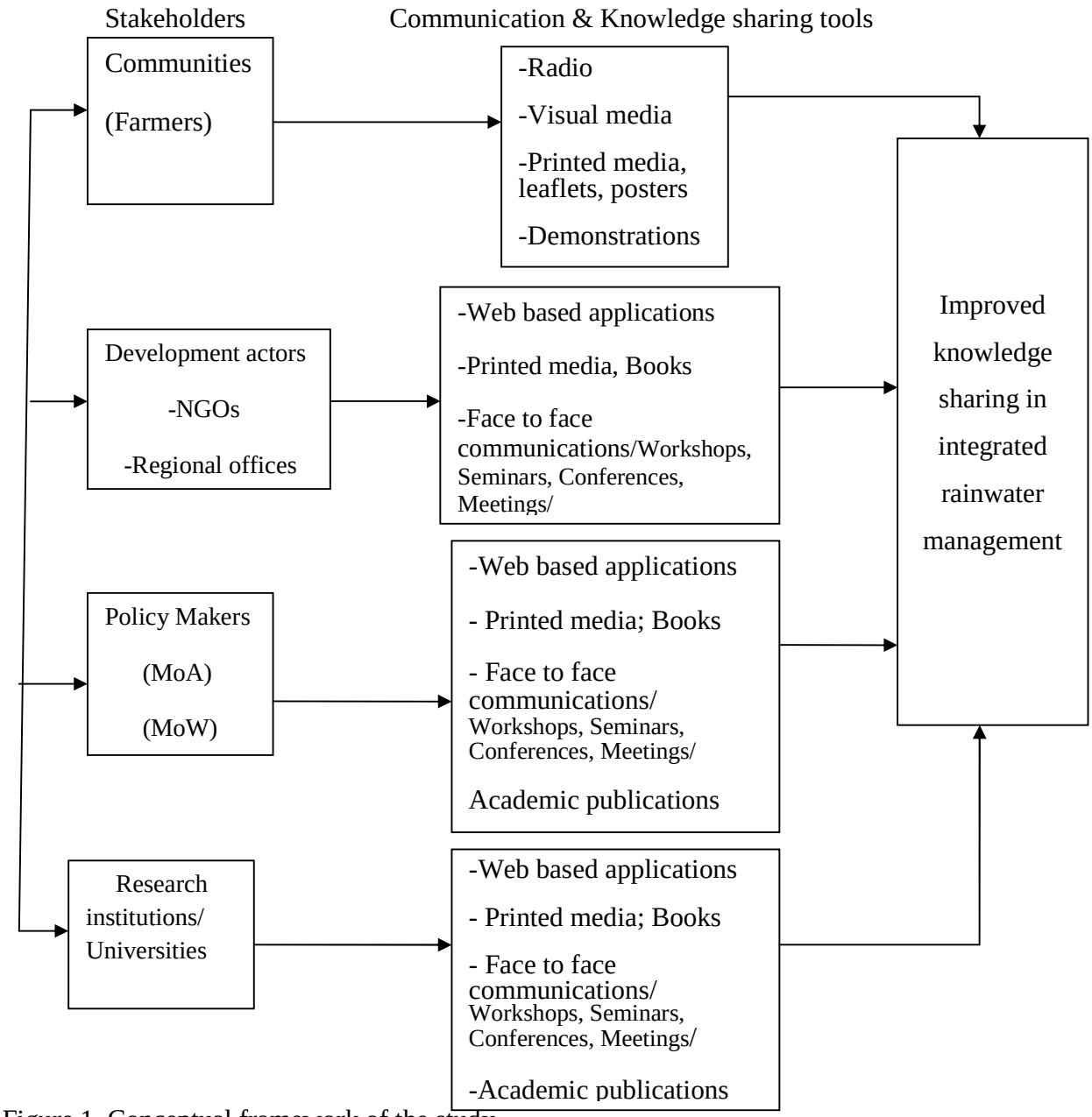


Figure 1. Conceptual framework of the study

Source: Own design

The conceptual framework illustrates how water stakeholders can communicate one another by using different tools and approaches to improve knowledge sharing in rainwater management. Accordingly, it hypothesizes that different categories of stakeholders need to interact through different communication and knowledge sharing tools to enhance knowledge sharing success in concepts and practices of rainwater management. The communication and knowledge sharing tools range from different kinds of micro-level and conventional electronic and printed media to emerging Information Communication Technologies and other practical tools.

Different tools can be used to different degrees for having effective communication and knowledge sharing among stakeholders but use of appropriate tools is expected to be a vehicle for improved communication and knowledge sharing. This eventually leads to the creation of shared understanding on concepts of rainwater management which paves the way for collective action to improve the livelihood of the local people.

3. METHODOLOGY

The first section of this chapter attempts to give some highlights about the Nile Basin Development Challenge and describes the study area in which the research is undertaken. The sampling techniques that will be employed are discussed in section two. In section three data types, sources and collection methods, and in section four methods of data analysis are discussed.

3.1. Description of the Study Area

The NBDC is implemented by a consortium comprising the International Livestock Research Institute, International Water Management Institute, World Agro-forestry Centre, Oversees Development Institute, Nile Basin Initiative, Stockholm Environment Institute, Ethiopian Economic Policy Research Institute, Catholic Relief Services – Ethiopia, Oromia Regional Agricultural Research Institute, Amhara Agricultural Research Institute, Bahir Dar University, Ambo University, Wollega University, the Ministry of Agriculture and the Ministry of Water and Energy (CPWF, 2011b).

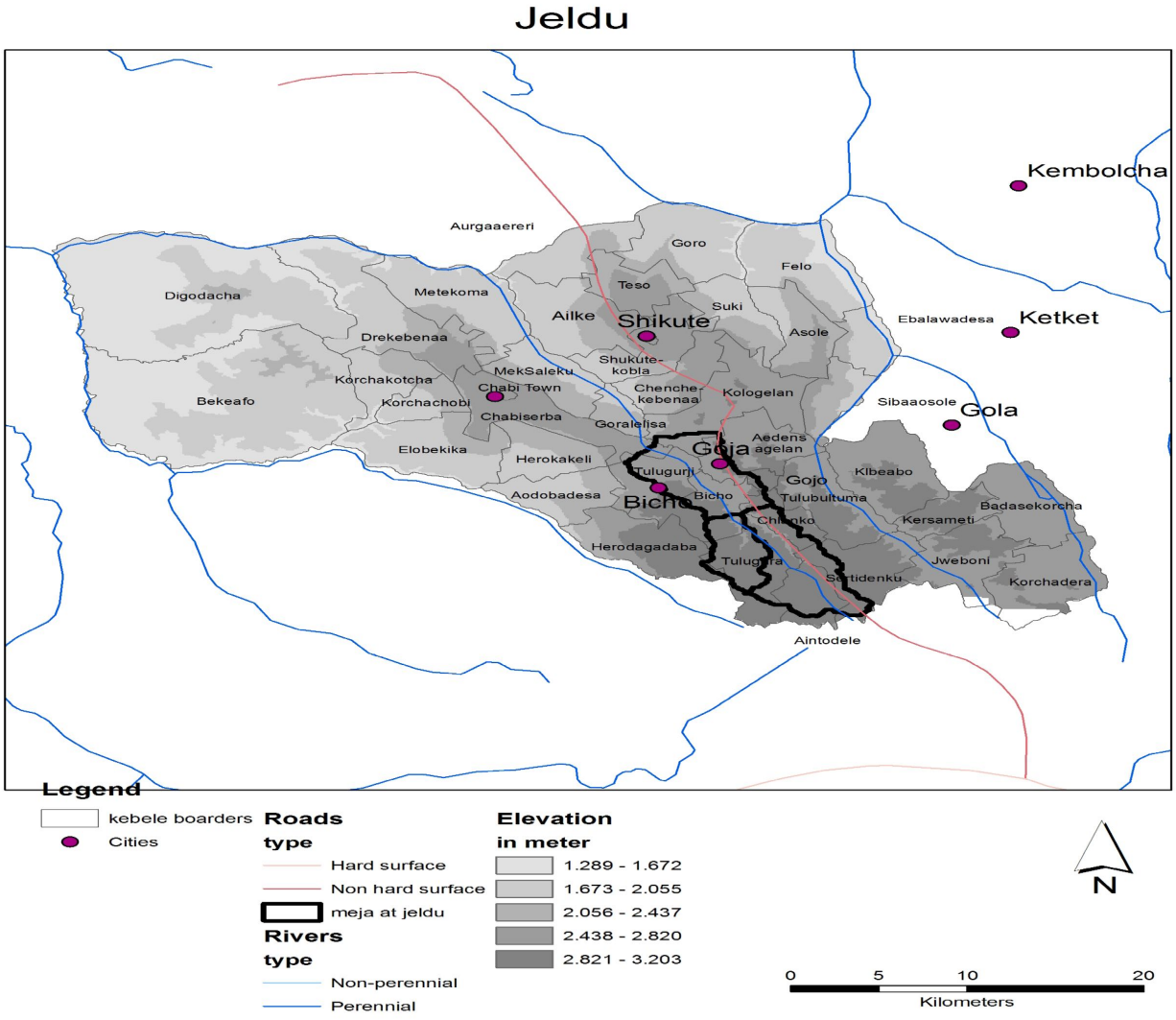
Based on inputs from inception workshop of the project, consideration of a set of criteria from stakeholders, and seeking to represent the variability in Ethiopian highland landscapes, the following three landscapes/action research sites have been selected:

1. Nekemte; includes Gimbi and Diga weredas. The predominant farming system in the area is ‘mixed crop-livestock system’. In the lowland area maize and sorghum based agriculture (mono-cropping) with 3-4 year crop rotation is a practice. In the midland, teff, millet and maize are important. The place has an annual rainfall between 1,376 and 2037 in mm.

2. Fogera; includes Fogera and Farta weredas. The landscape has ‘mixed crop-livestock system’ as a predominant farming system. Rice is the major crop followed by maize, millet, teff and barley. The area has a mean annual rainfall ranging between 974 and 1,576 in mm.

3. Jeldu in The State of Oromia is located in Ethiopia - roughly 113 kms West of Addis Ababa. It is one of the 180 woredas in the Oromia Region of Ethiopia. Part of the West Shewa Zone, bordered on the south by Dendi, on the southwest by Ambo, on the north by Ginde Beret, on the northeast by Meta Robi, and on the southeast by Ejerie. Based on figures published by the Central Statistical Agency in 2005, this woreda has an estimated total population of 202,024 persons. The woreda has predominantly a 'mixed crop-livestock system' and it grows potato as a dominant crop. Barley and teff are also common in the area. The place has an annual rainfall between 900 and 1,350 in mm (CPWF, 2010b).

Figure 2. Areal map of Jeldu Woreda



3.2. Sampling Procedure

This research has given more emphasis on qualitative data due to the nature of the study objectives. Different stakeholders for the Nile Basin Development Challenge were units of analysis. Individuals within the stakeholder organizations and the beneficiary community in the study site were respondents for the study; consequently, multi-stage sampling was implemented at organizational and individual levels.

3.2.1. Stakeholder sampling

Because of heterogeneous nature of unit of analysis, stakeholders were stratified into four groups as: Community/Farmers, Policy Makers, Development Actors, and Research institutions/Universities. From each stratum, a sample stakeholder was selected purposefully based on geographical proximity to selected stakeholders in other strata. This was not only important to deal with time and budget constraints but most importantly, at the local level, it is those stakeholders close to the study site that are expected to be more active in the area. It was assumed that stakeholders within the same stratum are more homogenous for the role they are entitled to in the basin development challenge; hence, taking one sample stakeholder from each stratum was thought to be practical considering the difficulty of incorporating all stakeholders in this study. Accordingly, Ministry of Agriculture from policy makers; GIZ from Development actors and Holleta Agricultural Research center from research institutes were selected as organizational sample stakeholders.

Three key informant respondents who have a better understanding of the NBDC and who delegate their organization on the innovation platform were selected purposefully from each selected sample stakeholder in the strata of Policy makers, Development actors and Research institutions. Dolores (2007) states purposive sampling technique, also called judgment sampling, is the deliberate choice of an informant due to the qualities the informant possesses. Purposive sampling is especially exemplified through the key informant technique.

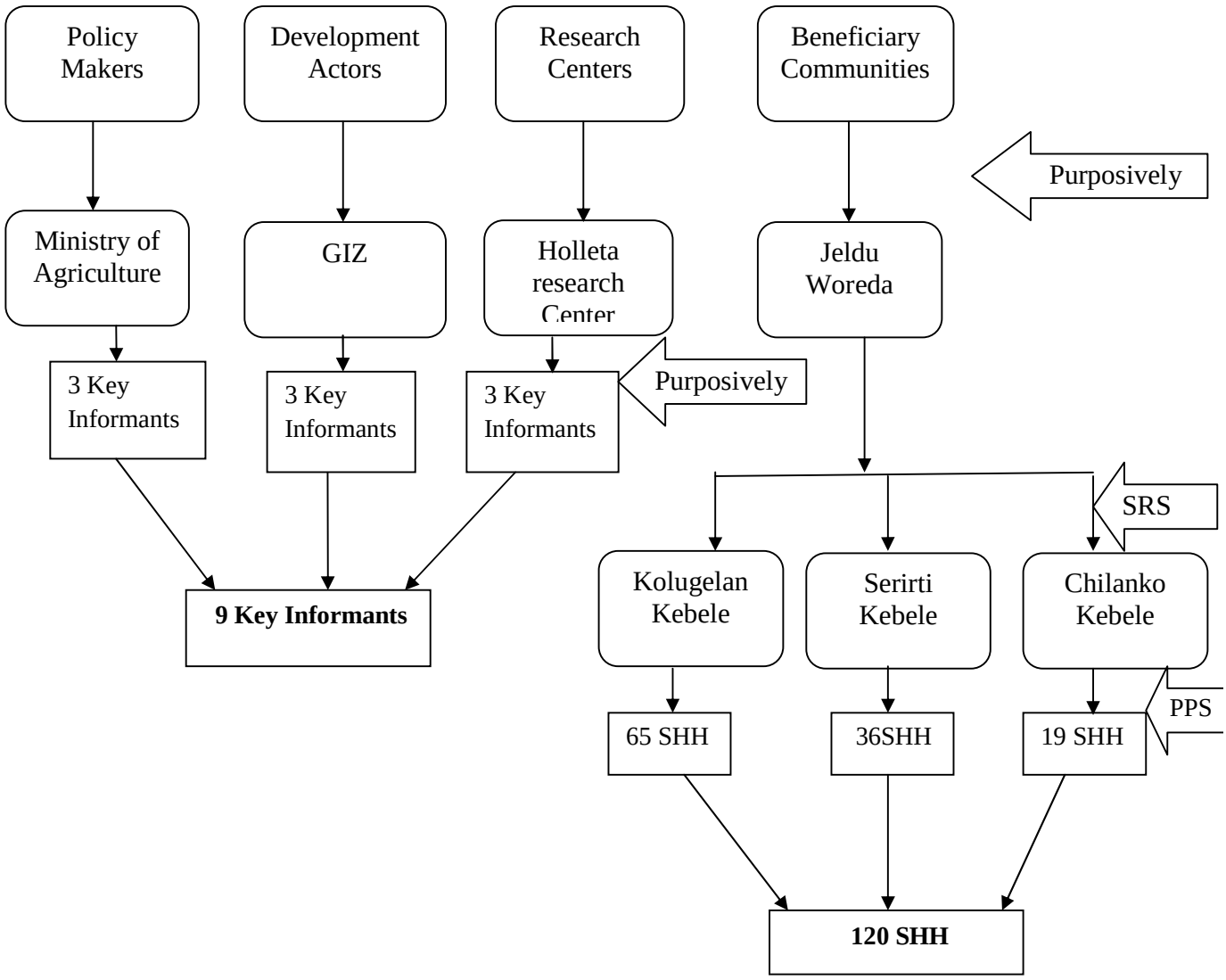
The selected respondents from the sample organizations were officials and experts that are engaged on land and water management programs and initiatives and that have direct or indirect involvement on behalf of their host organization in the challenge program and other natural resource management initiatives in the study area.

In the same manner, from the three research sites of the challenge program Juldu Woreda was selected purposively due to its institutional and geographical closeness to the other stakeholders. Out of thirty eight KAs in Jeldu Woreda, the challenge program is researching in eight KAs that are found in the Meja catchment. Three KAs, namely, Seriti, Chilanko and Kolugelan, were selected randomly from which individual respondents were drawn.

3.2.2. Household sampling

For the beneficiary communities that reside in the three randomly selected KAs in Jeldu Woreda, sampling frame of 2441 was taken from all KAs and 120 household respondents, representing 5% of the population, were distributed among the three Kebeles using Probability Proportional to size random sampling technique. These 120 household heads were respondents in the study area that are included in the interview schedule.

Figure 3. Sampling Procedure



PPS- Probability Proportional to Size

SRS- Simple Random Sampling

3.3. Methods of Data Collection

In order to address the objectives of the research, both qualitative and quantitative data were collected using different data collection techniques from both primary and secondary sources.

3.3.1. Primary data collection

Primary data were collected using structured interview schedule, focus group discussions, key informant interviews, informal discussions and field observations.

3.3.1.1. Quantitative data

Structured Interview Schedule was used for the household survey in the beneficiary community to collect data of quantitative nature. Enumerators were trained on the content of the schedule and methods of interviewing before pre test was made on six non sample respondents to check for any modifications needed for the actual survey.

A total of 120 farmer households were included in the survey. For the data collection, 10 enumerators who can speak the local language were employed. DAs in the three sample Kebeles were used with the assumption of their relatively better technical knowledge on land and water resource management practices. But as there were some sensitive questions on the knowledge sharing and communication part of the schedule that could possibly bias respondent farmers to give honest reply for DAs respondents are familiar with, DAs were deployed to do the survey out of their respective Kebeles and they are advised to keep their profession anonymous as much as possible.

3.3.1.2. Qualitative data

Three Focus Group Discussions with six farmers each were held in all the three KAs with individuals selected with the assistance of the DAs who were thought to have a better understanding on socio-economic and biophysical context of the study area. After a brief

introduction about the purpose and scope of the discussion, the FGDs were conducted with one DA, from a different Kebele, as an assistant modulator. As the qualitative data that could be obtained from the session was considered as a very important data for the study, discussants were allowed to speak without any reservation with only some proper interception to keep the discussion on track. With all the encouragements made, it was also observed that some discussants were passive and usually dominated by other active participants.

Key informant interviews were conducted with representatives of stakeholders from Ministry of Agriculture, GIZ and Holleta Research Center. All the interviews were audio-taped. Taping the interview was helpful to capture some important details and to deviating from the checklist, whenever required. The procedure also assisted in the attempt made to identify relevant themes and patterns in process of transcription.

Observation and informal discussions also provided the opportunity to the researcher to have a holistic perspective on some important attitudes and interactions among the community in communication and knowledge sharing and on some practices in rainwater management. RAAKS tool of actor linkage (B4/a/linkage matrix) was used to collect data on intensity and purpose of linkages among all relevant stakeholders in a way to see the degree of integration of the system.

3.3.2. Secondary data

Review of relevant literatures both in electronic and printed formats from MoA at different levels, ILRI, IWMI, NGOs, Woreda Administrative office, NBDC project documents, reports, briefs, updates, presentations, slide shares and videos has enabled the researcher to extract supplementary information useful for the study.

3.4. Data Analysis

The objectives of this study call for a more qualitative data analysis. Yet, simple quantitative analysis approach was also used as a supplementary to allow a parallel mix analysis. Savitri, (2000) rationalizes quantitative methods of data analysis can be of great value to the researcher who is attempting to draw meaningful results from a large body of qualitative data. Quantitative analytical approaches also allow the reporting of summary results in numerical terms to be given with a specified degree of confidence. She illustrates with example, if it is of interest to learn about people's perceptions of what poverty means for them, it is likely that the narratives that result from discussions across several communities will show some frequently occurring answers that can be coded. Quantitative approaches provide the opportunity to study these coded information first and then to turn to the remaining qualitative components in the data.

The quantitative data collected mainly through interview schedule from the farming community was fed to Statistical Package for Social Scientists (SPSS) version 17.0 for analysis. Simple descriptive statistical tools such as percentage, frequency, ranking, mean, and standard deviation was used to display the analyzed data.

For the data obtained through focus group discussions with the beneficiary community and key informant interviews with respondents in the other three organizational stakeholders, a qualitative analysis was used. Schilling (2006) asserts presenting research findings from qualitative content analysis is challenging. But, in this study, to interpret meaningful patterns and themes in stakeholders' perception and understanding of basic rainwater management concepts and practices and on knowledge sharing and communication practices, challenges and tools in the network, qualitative analysis method was found to be suitable. Based on this, after the audio-taped data from the FGDs and interviews were transcribed, it was qualitatively analyzed using narrative analysis approach for describing and interpreting relevant concepts. According to Fritz (2008) narrative analysis focuses on close readings of stories told by participants which seeks to understand human experience and/or social phenomena through the form and content of stories analyzed as textual units.

Analysis of the data collected using RAAKS tool (actor linkage matrix-B4/a) yielded the Actor Linkage Mapping as well as Actor Linkage Matrix of main stakeholders that exist in communication and knowledge sharing system of rainwater management in the study area. Triangulation was also used to improve the validity and strength of the research findings. Method triangulation was an important form used to compare results of qualitative and quantitative data obtained through interview, survey and observation. The study also attempted to compare the results of this study with other previous findings and litratures, elsewhere, through triangulation with theories.

4. RESULTS AND DISCUSSION

This chapter discusses in detail the results obtained from the analysis of data. It is organized into five sections. The first section attempts to give some general information on profile of respondents. The second section presents understanding of different stakeholders on concepts and practices of rainwater management. The third section deals with knowledge sharing practices and challenges among the stakeholders. The fourth section is devoted for evaluating and identifying communication and knowledge sharing tools to different stakeholder categories. Actor linkage mapping and linkage matrix are depicted in the fifth section.

4.1. Profile of Respondents

Sample respondents of the study consist of both male and female individuals. The male respondents were found to be 91.8 % of the total sample household whereas the remaining 8.2% were female. The age of respondents ranges from 22 to 68 years with mean age of 42.5 years. Regarding the marital status of respondents, 0.8%, 86.7%, 5% and 7.5% of household heads are found to be single, married, divorced and widowed respectively.

With regard to their education, out of the total respondents 74.1% of them are illiterate, 17.7%, 6.6% and 1.6% are who can read and write, who have primary level education and secondary level education respectively. Respondents who have education level from grade one to six were categorized as primary level and those who are from grade seven to twelve were in secondary education level category.

Table 4. Profile of sample households (n=120)

	Category	n	%
Sex			
	Male	110	91.6
	Female	10	8.4
Age			
	Age of respondents	Mean	SD
		42.4	12.31
Marital status		N	%
	Single	1	0.8
	Married	104	86.7
	Divorced	6	5.0
	Widowed	9	7.5
Educational level			
	Illiterate	89	74.1
	Can read & write	21	17.7
	Primary level(Grade 1-6)	8	6.6
	Secondary level(Grade 7-12)	2	1.6
Household size			
		Mean	SD
	Household size of respondents	6.22	2.22
Major source of living		n	%
	Crop production	14	11.7
	Crop and livestock production	106	88.3

The household size of respondents ranges from 2 to 13 with a mean value of 6.22. The household is often composed of the household head, spouse, children and some other people living in the house. The major source of living (88.3%) for the sample households is mixed crop-livestock production. The remaining 11.7% makes their living only from crop production.

4.2. Stakeholders' Understanding of Rainwater Management Concepts and Practices

Different stakeholders have different roles, interests, aspirations and competencies to understand and perceive important concepts and practices in rainwater management. This sub section tries to describe and analyze stakeholders' understanding on the basic concepts and practices of rain water management in the Nile Basin Development Challenge.

4.2.1. Understanding of rainwater management by farmers

Based on the survey result, 58.3% of the total respondents claim to know the meaning of "rainwater management". Whereas the rest (41.7%) answered they don't know the term. This could imply that the farmers probably may have their own ways of describing rainwater management. The respondent farmers have tried reflected their perception for the meaning of rainwater management. The table below illustrates how they defined the term "rainwater management" in a broader category.

Table 5. Meaning of rainwater management by sample heads of households (n=120)

Explanation	n	%
Capturing rainwater in pond and use it for crop, livestock and domestic purpose	22	18.3
Irrigating the land by diverting runoffs	12	10
Making terraces to hold water	8	6.6
Holding floods in rainy season to keep soil moist and prevent erosion	12	10
Store rainwater in house for washing materials	2	1.6
Capturing water straight from rain or from roof	6	5
To use rainwater for crop production	8	6.6
Do not know the meaning	50	41.7
Total	120	100

The result showed that the majority of farmers related the concept of rainwater management with capturing rainwater for agricultural and domestic use, irrigating their land through water diversions and holding water through physical structures for increased soil moisture. This implies that farmers have knowledge of some basic RWM practices and have their own ways of understanding some technological innovations in the wider concept of rainwater management.

To further investigate their knowledge, the study examined farmers' familiarity with different rainwater management practices. The different practices are outlined in the table below with their level of recognition in the study area. Out of the total sample 75% of them replied to have knowledge of cut of drains. The second and third popular rainwater management practices are pond/cistern and terraces which are known by 45.8% and 43.3% of the respondents respectively.

Table 6. Familiarity with important rainwater management practices (n=120)

Practices	n	%
Ponds/cisterns	55.00	45.8
Water diversion schemes	52.00	43.3
Hillside terraces	52.00	43.3
Cutoff drains	90.00	75
Earthen bunds	38.00	31.6
Micro-basin/trenches	5.00	4.2
Vegetated stone-soil-stone bunds	35.00	29
Gully plugging	45.00	37.5
Percolation tanks/infiltration zones	30.00	25

During focused group discussions it was explored that farmers had been recently advised and trained by DAs on how to construct Cutoff Drains and some farmers, on steeper areas with better household labor, are trying to practice it. The researcher also observed the practice on some farmlands in Kolugelan Kebele but the structures are very simple and small in size with no waterways or storage structures to receive the water from the small ditch.

Knowing such practices may not necessarily mean the farmers are using the technologies on their farms. Having practical experience on a particular approach is believed to make their knowledge more profound as it gives them the opportunity to learn from experience, to customize the practices to their situation or blend it with their indigenous knowledge. Respondents were asked if they practice any of these rainwater management technologies.

The survey results indicates only 35%, 32% and 21% of the respondents are practicing cut of drains, terraces and water diversion schemes respectively on their plots which are the highest among the other practices.

Table 7.rainwater management practices used by sample heads of households n=(120)

Practices	n	%
Ponds	9.00	7.5
Water diversion schemes	26.00	21.6
Hillside terraces	39.00	32.5
Cutoff drains	42.00	35
Earthen bunds	15.00	12.5
Micro-basin/terrace	4.00	3.3
Vegetated stone-soil-stone bunds	25.00	20.8
Gully plugging	15.00	12.5
Percolation tanks/infiltration zones	0.00	0.00
Total	120	100

While mentioning the most important reasons for not able to adopt the different rainwater management practices that farmers are familiar with, 49.2% of the respondents responded "lack of resources" to materialize the practices was their reason. 25% and 10% of them put "lack of practical knowledge/skill" about the practices and "lack of interest" as their reason respectively. This could indicate, in addition to lack of resource to uptake the practices, there is lack of practical know-how on some practices that farmers are familiar with.

During a focused group discussion revealed that farmers have their own traditional knowledge on some rainwater management practices. The farmers use simple water diversions schemes from the Melka river as a form of small irrigation, which is locally known as *Goderacha*, to cultivate mostly vegetables. They also try to manage the flood coming to their farm by using simple soil bunds which usually does not last too long specially when there is heavy rain. Gully erosion was also mentioned as a serious problem but as it needs farmers' collaborative

effort to build structures, like Check dams, it was not easy for them to take collective measures. The discussants also added the Woreda agricultural office is recently teaching them on how to make Earthen bunds and Trenches on hillsides. The researcher also had the chance to observe while DAs were training farmers on the practices during which the opportunity was used for informal discussion after the training.

Discussants explained how such structures can improve the moisture and fertility of their soil by holding runoffs but they were not practicing it as it was a new approach for them. They have also learned how to make *cisterns* for storing rainwater from Holleta Agricultural Research Center on some demonstration sites but it was done in small number of farms and was prematurely stopped. This made it hard for them to translate the experience as the technology needed intensive labor and they couldn't get the waterproof linings for making the cistern. The implication is that farmers were getting familiar with new rainwater management practices which would contribute to their improved knowledge in concepts and practices of rainwater management.

Interviewees from Holleta Research Center also confirmed the attempt made by the center to develop *cisterns* on three demonstration sites for potato seed multiplication in commercializing potato production in the area. Some farmers were able to have access to water all year round producing up to 350 quintal of potato per hectare but it was researchers' conviction that the recommended technology was not promoted enough and given the necessary technical support by the Woreda office so that the majority of farmers would have benefited from the technology.

While discussing informally with some farmers and DAs, there has been an attempt to train farmers on some practices of rainwater management from time to time but not much happened when it came to adopting the practices as commitments in diffusing the practices was not sustainable both from the government and the farmer side. However, it was observed on the training sessions, trainings on the practices are given in a sense of urgency and indiscriminately to all farmers with little consideration to difference in farmers' asset base, their needs, adoption capacities and diversification of resources across landscapes. Possibly,

farmers may happen to learn and be familiar with some practices but if the practices do not fit into their socio-economic and biophysical settings, the possibility of adoption would be less. The importance of considering the difference in socio-economic and biophysical contexts among farmers was also noted by Awulachew (2010) in his study in the highlands of Blue Nile basin where plot characteristics like plot area, slope, soil type; availability of labor and other land security scenarios to be among the important factors determining the decision to adopt a particular technology. Gizaw (2010) also stated that in the highlands of Ethiopia, many soil conservation measures were implemented to tackle soil erosion and land degradation but are not fitted to the farming system and eventually less adopted by farmers. Less attention to local assessment based conservation approaches and lack of assessment of aspects that represent farmers' perspective are often indicated reasons for the failure of soil conservation programs.

Increasing water availability and productivity for both agricultural and domestic consumption are the two important approaches in rainwater management practices. Birhanu *et al.,* (2011) state that rainwater management practices are geared towards enhancing availability of water and improving uptake and conversion by plants. The survey result showed most respondents (98.4%) agree practicing such rainwater management increases their water availability and productivity.

Different explanations were given by respondents how rainwater management practices enhance water availability and productivity. The majority of respondents related water availability and productivity with ground water recharge, spring formation and increasing soil moisture. Table 6 shows the main explanations given by the respondents on how adopting the practices would enhance water availability and productivity.

Table 8. Explanation for how RWM enhances water availability and productivity. (n=120)

Explanation	n	%
Ground water can be recharged	32	26.6
Springs will be formed	24	20
The soil will be moist for crop production	28	23.3
Water can be made available in dry season	18	15
Stored water in ponds can be used in dry season	6	5
Holding running water increases moisture on the farm	6	5
Soil will not be washed away by running water	4	3.3
No Explanation	2	1.6
Total	120	100

4.2.1.1. Cropping strategies and water use efficiency

Questions were posed to respondents on different cropping strategies that enhance crop water use efficiency. The cropping strategies include different crop management practices like appropriate planting date, plant population, fertilizer application and weed control; other advanced cropping systems like crop rotation, intercropping/alley cropping; application of lime and manure to ameliorate acidic soil; and planting high value and high yielding crops. Most of the respondents (90.8%) think improving cropping strategies can increase crop water use efficiency. The remaining respondents (9.2%) do not think the same way. The possible reason was, as observed in discussions, difficulty of relating different cropping strategies directly with crops water uptake efficiency as farmers would have a specific way of understanding and measuring the effects of different cropping strategies.

The above explanation can be strengthened by the survey result that all the respondents at least practice one of the cropping strategies on their farm for some reason they can justify. This also implies that farmers have their own way of understanding how different cropping strategies are useful for their farm production and productivity. Respondents tried to give different reasons how applying different cropping strategies help in improving crop water use efficiency.

Table 9. Explanation to how cropping strategies improve water use efficiency (n=120)

Explanation	n	%
Can get higher production from more water and wet soil	58	48.3
Can get higher income from better production	26	21.6
Crop management practices and cropping systems help to consume soil nutrients efficiently	9	7.5
Using manure and lime helps plants to get nutrients and air from improved soil	10	8.3
Cultivating crops with different water requirement and plant them based on the available water	6	5
No explanation	11	9.1
Total	120	100

During the focus group discussions, although it was theoretically challenging for them to articulate how different cropping strategies through nutrient recycling, water infiltration and increased soil moisture affect crop water use efficiency, farmers have their own way of understanding the effect. Most of the participants associated the effect of practicing different cropping strategies with the amount of production gained. Lee and Long (2007) also substantiates the idea that for farmers and land managers, water use efficiency is the yield of harvested crop product achieved from the water available to the crop through rainfall, irrigation and the contribution of soil water storage.

Other interesting insights were also reflected by farmers relating different cropping strategies with crops water use efficiency. They have a practice of cultivating different types of crops on different lands to be able to use water efficiently. For instance, on hillsides and slops they cultivate peas and linseed because it does not need too much moist as the hillsides have low capacity of holding water but crops like wheat and barley need more moist soil so are on plane lands. It was also mentioned controlling weed on farm plots is very important because weed compete with crops for water.

They have learned on trainings how fertilizers would make crops use more water which increases the productivity of crops. Holleta Research Center also taught them about the

advantages of row cropping which they only practice it for our potato cultivation. They have a series land shortage which made them reject the idea of using row cropping for other crops like wheat and barley as the practice consumes more space.

4.2.1.2. Practices to integrate livestock in RWM

Regarding respondents' understanding on the implications of rainwater management on the livestock subsystem, most respondents (95%) think their livestock production and productivity can be enhanced with efficient capture, storage and use of rainwater.

For an open ended question administered on the interview schedule, survey respondents have given different explanations on how the different rainwater management practices can contribute to their livestock production and productivity.

Table 10. Importance of rainwater management practices for the livestock subsystem

Importance	n	%
Diverting floods rehabilitates grazing lands for animals to feed on	24	20
Preventing water contamination helps animals to get clean and additional water for increased milk and meat production	7	5.8
Feeding animals with Cut and carry system is important when there is grazing field shortage	20	16.6
Crop residue is important feed source for livestock productivity	44	36.6
Cross breeding helps to get more milk and meat	9	7.5
By capturing runoffs water can be made available for animals and production will not decrease in dry season	10	8.3
Stored water can be used for milking cows	20	16.6
No explanation	6	5
Total	120	100

Group discussants expressed that crop residues are the main, for most farmers the only, sources of feed for animals. Some well-to-do farmers with better land size and resources also prepare hay for dry seasons. There are also few farmers who cultivate water productive feeds like *Oat* which is locally known as ***shemame*** as a supplementary feed source. But most farmers only depend on crop residues for feeding livestock. Many discussants said they have simple storage facility for crop residues to keep it away from rain as it spoils the residue producing unpleasant smell for animals. They have little concern for the water loss from the residue if it is not properly stored. Strategic livestock watering is not an issue to the participants. Animals are watered on the nearby Melka river and springs which are also used for domestic consumption but they try to fence the springs so that the animals will have access to the water with minimal contamination. Farmers in the study area have little knowledge on how strategically placed livestock watering points would increase access to inaccessible grazing areas. Destocking as a strategy to fit into the stocking capacity of the system is not a practice in the area but some farmers are starting to cross breed their dairy cattle with Holstein friesian and Jersey breeds initially solicited by Holleta Agricultural Research Center.

Due to the serious land shortage problem, grazing fields are being turned to agricultural lands. Now farmers are even obliged to travel to hot low land areas like *Digo* for grazing during cultivation period as their plot is covered with crops. This indicates farmers are practicing mobility as a risk minimizing strategy to deal with shortage in grazing land. Group discussants know about enclosing grazing fields for rehabilitation as they use to fence grazing lands in earlier times when there was enough grazing field. In rainy season, farmers still try to improve grazing lands by diverting floods and runoffs to the field but due to the ever reduced carrying capacity of the grazing land, the practice is not helping them very much.

4.2.1.3. Diversification of tree cover

Diversifying tree cover, as part of agro forestry, is one of the important interventions in rainwater management to improve water availability and productivity, and to diversify income source through woodlot. In trying to assess respondents' understanding whether increasing

and diversifying tree cover is useful to increase water availability and productivity, 95.9% of the respondents agreed that trees are important in increasing water availability and productivity. The reasons they gave for their responses are summarized on the Table below.

Table 11. Perception on importance of trees for improving water availability and productivity

Explanation	n	%
Trees will hold running water	26	21.6
Trees assist formation of springs	16	13.3
When there is tree the soil is moist and fertile	32	26.6
Trees attract rainfall	28	23.3
Falling leaves decay and fertilize the soil	10	8.3
Planting indigenous trees around springs increases the amount of water	3	2.5
No explanation	5	4.1
Total	120	100.0

Focus group discussants revealed that although farmers use to plant trees traditionally, it was only recently through trainings and mass media that they started to realize the importance of trees in holding runoffs, facilitating percolation and mitigating negative environmental consequences like floods and drought. They stated their main reason for planting trees use to be for economic purpose.

Box 1: Farmers' perception on importance of diversifying tree species

Participants illustrated; "We have learned trees can retain water in the soil keeping our land fertile. We also eye witnessed how deforestation has caused problem in our area. Many springs used to flow when our area was covered with trees but now it's all dried up and lost. We also know eucalyptus tree is not good for our land. We want to replace it with indigenous tree species. The tree is destroying our land making it "acidic" so that no other plant grows around it. We are planting now *koso*, *danisa*, juniper, *hexxo* and recently, acacia which we got from the Woreda seedling station. We still have plenty of eucalyptus trees on our land but it is only for generating income. If our income improves, we don't need it on our land". Date: 27/01/2012.

It can be inferred that adverse consequences from mismanagement of trees have given farmers practical lesson on the importance of proper management. It also showed their changing perception on the purpose of cultivating trees from a more economic interest to realizing its role for ecosystem services through the knowledge they acquired from different information sources.

4.2.2. Understanding of rainwater management by development actors

Key informant interviewees from GIZ as a development actor in the study area preferred to comprehend concepts and practices of rainwater management in relation to the prevailing situation in the study area. This is a sound reason as it shows the attempt to take into consideration of the concept of landscape approach to rainwater management in which different rainwater management practices are thought to have different impacts under different landscapes and biophysical conditions.

It was described that land degradation has become a serious problem in the Juldu highlands changing the land use pattern of the area with increasing fertilizer consumption for every quintal of crop produced on a hectare of land. If it was not for the marginal income generated from wood lot/mainly eucalyptus tree/ and potato cultivation at homestead level, the area would have been even in a more serious problem of food insecurity than it is already now. It was emphasized that land and water management through different rainwater management practices in the area has become a necessity to avert the situation and turn the area into its production potential once again.

Experts from GIZ understand rainwater management as a concept that has a number of practices with multifaceted benefits in a particular farming system. It assists formation of perennial rivers and springs, supports vegetation growth, improves agricultural production and productivity and can also generate employment opportunities in activities like irrigation development.

Two rainwater management interventions, for decreasing land degradation problems on steeper areas and, for improving production and productivity of farm lands, were illustrated by the experts. To decrease land degradation problems in steep areas, an integrated approach of area enclosure, physical structure and vegetation cover were recommended. It was explained that the intervention starts with empowering farmers to avoid reckless human and livestock encroachment on the hillside followed by development of water harvesting structures and finally, implementing agro-forestry practices and cultivation of different forage and grass species that could restore the natural environment and at the same time can be used as feed source for livestock. The importance of this approach is also illustrated by Brehanu (2011) in which biophysical measures integrated with area enclosure is important rainwater management practice to maintain the productivity of land which has been degraded and abandoned.

To improve productivity on farm lands, experts mentioned the importance of building moisture harvesting structures, like terraces and bunds, on which different forage and grass species can be cultivated for livestock feed which, at the same time, would help to improve soil fertility. Different rainwater management practices like check dams for decreasing gully erosion; cutoff drains and waterways for decreasing runoffs at peak rainy season and development of water wells for domestic purpose were also mentioned as important rainwater management practices to improve production and productivity of the area.

To enhance productivity of the livestock subsystem, in addition to taking measures to improve water availability; proper management of grazing lands and improvement of animal breed were stated as important interventions in rainwater management. The explained interventions correspond with the feed management, water management and animal management components to improve livestock water productivity as part of rainwater management practices.

Experts did not emphasize the need for institutional arrangements to improve the marketing and demand side of agricultural development through better market linkages of farmers,

which is an important component in rainwater management in encouraging farmers to produce better quality and quantity agricultural products and to become more market oriented.

4.2.3. Understanding of rainwater management by policy makers

Key informant interviews were held with experts in the Ministry of Agriculture on their perception and understanding of concepts and practices of rainwater management. The interviews revealed that experts perceive rainwater management as a similar approach to rainwater harvesting. In the course of the interview, the terms 'rainwater management' and 'rainwater harvesting' were being used interchangeably.

Rainwater management is a broader concept with different land and water management interventions, including rainwater harvesting, across local, landscape to basin scale with due consideration of policy and institutional interferences in the rainwater management arena. Merrey and Tadelle (2011) also define the term 'rainwater management' (RWM) broadly to include soil and water conservation (SWC), *in situ* and *ex situ* rainwater harvesting, conservation farming, and small-scale irrigation as well as better fertility and crop management with examining the extent to which policy change and institutional strengthening and reform can combine with new technologies to spur widespread innovation.

Experts explained that arid and semi arid areas of the country have stayed being the focus of Ministry of Agriculture in implementing rainwater harvesting practices. It was only recently the need for rainwater harvesting technology interventions in the highland parts of Ethiopia was emphasized and possible measures were considered.

Surface or underground water harvesting are two ways of how rainwater can be captured in the experts' understanding. The main objective of harvesting rainwater in rain fed agriculture is to avail water in times of dry season by distributing the available water throughout the season. In rainfed agriculture, rainfall variability in time and amount is mentioned as one of the rationales to materialize rainwater harvesting practices. Rainwater harvesting involves

various practices for intervention in highland areas like Juldu which usually have relatively adequate rainfall in rainy season but also faces water scarcity in dry seasons.

A number of rainwater harvesting practices were mentioned by the experts that are believed to be appropriate into highland areas of Nile basin like Juldu. It was explained in places where rainstorm intensity exceeds the rate of infiltration of the soil, managing runoffs should be the most important intervention point in highland areas as runoffs not only can be used for productive purpose but also can cause potential damage to the land if not properly managed. Awulachew (2010) also recommended on his study in highland areas of the Blue Nile basin that runoff generating areas should receive prioritization for implementation of watershed management Practices.

Experts also mentioned excess water can be diverted in to small structures like *waterways* in to farm plots or can be captured in *ex-situ* water harvesting systems to be used for agricultural and domestic purposes. On farm plots, *in-situ* harvesting structures like terraces and bunds can also be used to reduce the slope which helps to hold soil and the water between terraces to facilitate percolation and increase soil moisture. Trenches with different size were also mentioned based on proportion of catchment area to runoff area.

One expert emphasized the importance of considering the livestock subsystem in rainwater harvesting intervention as crop and livestock components are interrelated. Forage development on and around water harvesting structures, development of watering points and grazing land management strategies are also important practices in rainwater harvesting.

4.2.4. Understanding of rainwater management by researchers

Key informant interviews were held with researchers from Holleta Agricultural Research Center on their understanding and perception of rainwater management concepts and practices. Researchers understand rainwater management as broad concept incorporating different management practices for improving production and productivity of both crop and livestock components especially in a rain fed mixed farming production system.

Researchers focused more on the rainwater harvesting techniques and less on some biological practices, such as different cropping systems and conservation agriculture. It was explained that there are two ways of harvesting rainwater which are, either harvesting rainwater directly from roofs around homestead, or through different rainwater capturing and storing techniques like ponds and percolation tanks and other structures that increase soil moisture like terraces and bunds. But emphasizing that interventions and practices can be different on different soil types. It was also mentioned about the importance of agro-forestry and cultivation of grass strips on furrows which can minimize water flow and prevent rill erosion and gully formation. The cultivation can be used as a feed source for livestock and at the same time has implication for ecosystem service.

While explaining about rainwater management, researchers gave more emphasis on vertisoil management which more adaptive research was made on the practice at the institution. Draining vertisoils on cultivated land is mentioned as one of the practices that can be used as an entry point for rainwater management in the Nile Basin Development Challenge.

Box 2: Researchers' illustration on importance vertisoil management in the area

Ato Hailu stated; "To deal with the problem of water logging in vertisoil, the farmers traditionally use 'residual moisture' technique by extending their plantation date from the beginning of the rainy season. But by using various surface drainage alternatives like Broad Bed Maker (BBM) it is possible to use the drained water from vertisoil for subsequent cropping which we call it *Double Cropping"*. He added, "the land in Jeldu area is much degraded with declining productivity calling for a more robust and integrated land and water management intervention". Date 29/01/2012.

A broader explanation and a number of technical approaches in rainwater management were mentioned by the researchers which include some of the practices that are identified by Nile Basin Development Challenge as appropriate interventions for the study area. As it was mentioned earlier, the concept of rainwater management, as a recent approach in Ethiopia, is not only confined to technological aspect of managing rainwater. It also embraces institutional and policy interventions that enable water to be captured, stored and efficiently utilized. Amede *et al.,* (2011) explained rainwater management focuses more on the institutions and

policies than on the technologies and advocates increased water storage and water productivity at various scales; in the soils, farms, landscapes, reservoirs and basins.

The other important concept that was not stressed by the researchers is the 'landscape approach' for intervention of rainwater management. As CPWF (2011) stated the concept of rainwater management is based on a landscape approach with a systematic integration of system paradigm that considers broad social, economic and institutional networks that cut across hydrological boundaries.

4.3. Knowledge Sharing on Rainwater Management

4.3.1. Knowledge sharing for farmers

Questions regarding the importance of sharing knowledge with water stakeholders were presented on interview schedule to sample households. Most of the respondents (80.8%) replied knowledge sharing and working with different stakeholders is advantageous. Majority of them associated the importance with improving their knowledge/skill on important practices and increasing their access to resources.

Table 12. Households' perception on importance of knowledge sharing with stakeholders

Reason	n	%
Improves our knowledge/skill	32	26.7
Helps to resolve conflict of interest among stakeholders	13	10.8
Helps to increase access to resources/agricultural inputs/	31	25.8
Guarantees sustainability of project outputs	21	17.5
Not important	23	19.2
Total	120	100.0

Discussants in the focus group underscored the importance of sharing knowledge and experience with other stakeholders. They believed it gives the opportunity for stakeholders to

understand their problems and address their material and financial resource needs and also can be sources of new technologies, knowledge and information.

Different sources of knowledge and information with different access levels and preference to farmers in the study area are available to learn new practices and share experience in agriculture in general and in rainwater management in particular. Farmers use such sources both in formal and informal settings. Farmer-to-farmer learning is also valuable for the transfer and spread of knowledge.

As indicated in Table 11, among possible knowledge and information sources available in the study area, Relatives/friends/neighbors, rural radio programs and trainings/demonstrations/farm visits, were found to be the most important sources of knowledge and information respectively. Similar result was also found by Dereje (2005) where, neighbors and other fellow farmers rank first as information and knowledge sources of the farmers.

Table 13. Relative importance of information/knowledge sources (n= 120)

Source	Total Score	Rank
Relatives/friends/neighbors	486.00	1st
Rural radio programs	339.00	2nd
Trainings/Demonstrations/Farm visits	320.00	3rd
Development agents	307.00	4th
Community leaders	169.00	5th
Research centers	81.00	6th
NGOs	72.00	7th

The implication could be social networks are still serving as an important medium to share knowledge among farmers in the study area. Even though there are possible direct contacts with farmers from NGOs/Project workers/ and agricultural research centers, also much of such institutions endeavor comes through the government /Woreda/ office. So, in cases where farmers are not aware of this, their recognition as knowledge and information source can be undermined to some extent. But in discussions some farmers mentioned about efforts of

NGOs and Holleta Research Center to reach them through Woreda agricultural and Kebele offices.

Focus group discussants emphasized that demonstration plots and farm visits are important as they think it gives them the opportunity to see different technologies practically. It was mentioned *Radio Oromia* is an important source of information on water and land management practices. The FM radio station has programs on water and land conservation and other important agricultural practices which the farmers are able to listen even when working at their field. Development agents are also available to consult them on some important practices by coming to their farm. The Holleta Agricultural Research Center and few NGOs also come up with some important land and water conservation practices but have a concern that their reach is limited to only few farmers.

Among the reasons the respondent farmers gave why they chose their first important knowledge source, 50.8% of them responded the source is 'easily accessible'. An implication of this can be accessibility of the knowledge sources was relatively important criterion whether a source is more important or not for the respondents. Of the sample households 27% and 22.5% choose 'credibility' and 'provision of appropriate information and knowledge' as their main reason of preference respectively.

Table 14. Reasons for choice of important knowledge sources

Reason	n	%
It is easily accessible	61	50.8
It is credible source	32	26.7
Provides appropriate and useful information/knowledge	27	22.5
Total	120	100

Discussants also confirmed knowledge and experience sharing are important to learn and adopt new rainwater management practices. Some participants explained with example how the knowledge on pond making form Holleta Research Center helped some farmers to get

water in dry season and even started to produce vegetables / potato, onion/ three times a year. Others also stated they have taken lessons from other farmers' experience and can do the same if they can get access to financial and material resources.

4.3.2. Challenges in knowledge sharing for farmers

In an attempt to explore the main challenges for the spread of knowledge in rainwater management in the study area survey respondents were asked to identify important challenges. The most important challenges mentioned by the farmers are summarized in the table below.

Table 15. Challenges in knowledge sharing for farmers

Challenges	n	%
Model farmers are reluctant to share new technologies	16	13.3
We think trainings are not interesting, time consuming and there is no enough training material	31	25.8
We don't have the resources to translate the knowledge we get into practice	29	24.1
We don't have constant follow up after technology is introduced	16	13.3
We don't have enough social interaction to learn from other farmers	8	6.6
No challenge	20	16.7
Total	120	100

The implication of the above finding is farmers did not give much attention for trainings as they think training sessions have a number of drawbacks. As many governmental and non-governmental initiatives attempt to reach the majority of farmers through model farmers, lack of knowledge sharing among these farmer categories could be taken as one major challenge for the success of knowledge sharing. Lack of resource to translate the knowledge they already acquired was also found to be another major challenge for farmers as it could limit their opportunity to learn from practical experience and to share the practically tasted knowledge.

On the discussion session, farmers stated trainings and practical demonstrations from the research center and some NGOs are usually given in small scale to selected farmers and there is a problem of easily acquiring the knowledge from those farmers as they decline to share their experience. Farmers participatory research by FARM-Africa (2001) in southern Ethiopia also explains the scenario in which participant farmers on the research explained some training activities raised interest and/or suspicions among neighboring farmers, highlighting the importance of communicating to local farmers through community structures to ensure everyone is informed about project activities. There could be a number of driving factors why knowledge cannot easily be shared from "model" farmers to the other farmers and it needs further specific study in identifying the factors contributing to slow transfer of knowledge between these farmer categories so that the knowledge transfer would be smooth with far reaching impact.

It is also farmers' concern that many previous initiatives were short lived without sustainable knowledge sharing and cooperation making them reluctant to learn and share experiences with full heart. Some of the participants also think there are shortcomings from their side that has been a challenge for effective knowledge sharing.

It was mentioned farmers have problem of efficiently using and sustaining technologies and knowledge they acquire from stakeholders. For instance, NGOs develop water storing structures teaching them how to manage but they could hardly manage it as everybody uses it recklessly before it became useless. Farmers think they were supposed to share the knowledge and experience to other nearby farmers but they couldn't even keep it for themselves. They are not sure this will not happen in the future too stating their awareness should change first. This implies that farmers understand challenges for effective knowledge sharing could come from all stakeholders including them.

The other important challenge illustrated regarding knowledge sharing with development agents is that farmers think most of the information and knowledge that DAs come up with are similar and something they know. So, many farmers usually do not give too much attention to what DAs have to say. Some of the discussants asserted the advice given by DAs

are similar that they don't get much new in it. The implication could be many of the practices that DAs share with farmers are already known practices by the farmers but could not be adopted due to other socio-economic or biophysical factors. The other implication is, even though the DAs have knowledge of important practices, they might be reluctant or are not motivated to communicate it with farmers.

Inefficiency of training approaches and communication tools used in trainings, which is discussed in the third section of this chapter, are other notable challenges mentioned by the discussants. For effective knowledge sharing well designed training methodology with appropriate communication tools and approaches that suit into farmers' level of competence is necessary. As Wuletaw (2010) stressed, in the absence of equipped training materials, demonstration areas, inputs, training of trainers and appropriate training methodologies, the trainings couldn't achieve its objectives to address the required level of knowledge sharing experiences.

4.3.3. Knowledge sharing for development actors

The key informant interviews revealed that experts gave much emphasis on the importance of knowledge sharing with stakeholders. They believe stakeholder platforms are important arrangements to facilitate learning process and advocacy and to deal with technical, institutional and policy issues related with rainwater management.

With regard to their knowledge sharing practices with the other three stakeholders, experts stated they have more efficient communication and stronger linkage to share knowledge and experience with Ministry of Agriculture including the Woreda agricultural office in the study area. The Nile Basin Development Challenge innovation platform is also an important mechanism which the experts mentioned to share knowledge and experience on important rainwater management concepts and practices. It was mentioned that, so far, no viable communication has been materialized with Holleta Research Center even through there is a plan to do so.

Key informants explained to expedite knowledge sharing and technology transfer at the local level, the organization has formed watershed committees at the Woreda, Kebele and community level through which different trainings and knowledge sharing events are organized and materialized.

4.3.4. Challenges in knowledge sharing for development actors

Informants from GIZ stressed the main challenge to share knowledge in rainwater management is the tendency of stakeholders to be more activity oriented than being result oriented. This was to mean, many stakeholders extremely occupy themselves in their internal activities failing to give the necessary attention for joint learning and collective action in achieving a common goal. The focus of learning alliances on deliverables such as reports than on processes and mechanisms for integration were also important challenges. Different professional approaches of stakeholders, varying interests and values are also other important challenges in the view of experts from development actor.

GIZ as a development actor in the study area has direct contact with the local farmers. In line with this, some challenges were also mentioned for effective knowledge sharing with farmers. Attitude problem both from the professional and the farmer side is a major challenge in the eyes of the experts stating professionals are in a mind set of giving and teaching something to the farmer as if the farmer knows nothing. On the other hand, farmers seem more inclined to financial and material support than trying to acquire the knowledge that empowers them to efficiently manage and use the available resources.

Experts tried to explain their perception with a scenario illustrating when they contacted farmers for the first time through the watershed committee, a considerable number of farmers appeared on the meeting. They observed that the circumstance was unusual for the DAs as many farmers fail to do so when other trainings and knowledge sharing events are organized by the Woreda or Kebele offices. The experts were informed by the DAs that farmers' presence in large numbers is related with the perception farmers have that NGOs come up with some kind of financial or material resource.

The problem associated with “professionalism” as a challenge to knowledge sharing has been mentioned for quite some time to be one of the major drawbacks of the traditional and linear research and development approach which notified the need for a shift to more participatory approaches like innovation systems paradigm. On the other hand, farmers might prefer interventions that deal with both technical innovations and other relevant resources and arrangements that enable them to materialize new practices. This does not necessarily imply that farmers are more inclined to material inputs and resources. This more importantly signifies the need for a more holistic intervention approach where technical, institutional and policy interventions would be integrated to deal with the multidimensional and complex challenges that smallholder farmers are facing. Merrey and Tadelle (2011) also illustrated that it is often claimed, incorrectly, Ethiopian agriculture has failed to innovate spontaneously for higher productivity, reflecting an assumed conservatism and reluctance to change on the part of Ethiopian farmers. This is not the case, as experiences such as SG 2000 with promoting modern maize and wheat production, has shown: when the benefits are clear with good market access, Ethiopian farmers respond.

4.3.5. Knowledge sharing for policy makers

Experts from Ministry of Agriculture explained knowledge sharing has two dimensions in their situation. The first is in the government structure from federal down to the farmer through Regional, Zonal, Woreda and Kebele administrations in which policy, institutional and technical matters related to land and water resource management practices are shared, discussed, planned and implemented. The other aspect was a horizontal type of communication to share knowledge, experience and promote collective action with different stakeholders working in the land and water management arena.

4.3.6. Challenges in knowledge sharing for policy makers

As a stakeholder in the Nile Basin Development Challenge at the National level, delegates from the Ministry of Agriculture illustrated some challenges related to sharing knowledge in rainwater management. Interviewees from the Ministry also shared the conviction that there should be a viable communication for knowledge sharing among stakeholders. But due to some limitations, which are found to be mostly internal, the opportunity has not been seized efficiently.

Box 3: Challenges in knowledge sharing for policy makers

> Ato Daniel explained; "We surely understand the importance of sharing experience with stakeholders. But it is a pity we are not efficiently using the potential. You know, we are usually occupied in other routine activities and meetings making it hard to actively participate in such initiatives. Besides, our culture is not that good when it comes to knowledge sharing and joint learning from each other. I don't mean we don't communicate or share knowledge with stakeholders, but it is far below enough. I don't think we should communicate and learn from each other only when the opportunity comes in your way. It must be a planned activity from the beginning. We really need to change this trend". Date: 09/02/2012.

Understanding the barriers and working towards a change in knowledge sharing culture is an important element for facilitating effective learning mechanisms. According to Gupta and Gonvindarajan (2000) knowledge sharing should be a corporate value, which defines how work gets done and how everyone thinks. In short, a culture of knowledge sharing goes deeper than superficial behaviors and captures the heart and minds of the people in an organization.

Experts also pinpoint lack of strong network with stakeholders as one of the major challenges for knowledge sharing. It was emphasized a viable network of actors is an important precondition to have efficient communication and knowledge sharing. A failure to have a plan

in advance how, where and when to harness and transfer knowledge as a challenge was also mentioned by a communication expert.

Box 4: Challenges in knowledge sharing for policy makers

> Ato Million stated "It is important that we have a plan for sharing knowledge just like we plan for other our activities. Our knowledge gaps as well as potential stakeholders who would share their experience to fill the gap should be identified. Without doing this, even if we have the right connection, we will not be able to exploit it. But we don't have this trend. We just recently become a little bit aware of the concept of knowledge management while working with foreign projects engaged on capacity building and technical assistance like GIZ". Date: 09/02/2012.

Lack of clearly defined strategy and plan to communicate and share knowledge will have implication in promotion of rainwater management. The lack of well thought out plan to share knowledge on the holistic approach of RWM have its own contribution why the experts confined the concept only to its technological intervention. This would have been their less concern compared to institutional and policy matters as officials from a ministry office.

4.3.7. Knowledge sharing for researches

Key informant researchers, like the other stakeholders, emphasized the importance of having efficient communication and knowledge sharing with water stakeholders. It was mentioned initiatives like Nile Basin Development Challenge needs a coordinated effort among different concerned institutions and actors to share knowledge and experience, to efficiently utilize collective resources and to avoid duplication of efforts. Knowledge sharing and communication is important in creating common understanding on principles and practices of rainwater management which otherwise ultimate objectives of initiatives are compromised from conflict of interest among stakeholders.

Box 5: Case story by a researcher on the importance of knowledge sharing

Ato Getachew illustrated; “I remember when rainwater harvesting as a technology was introduced in the country. It came through Ministry of Agriculture to be directly diffused in the pretext of “technology shopping”. We, as researchers, believed that new technologies need to be tested first and should come out through adoptive research before it is recommended to farmers. But this was a time taking process in the eyes of the policy makers. The technology was a failure at the end. You see, this is a result of conflict of interest. As technology end users, farmers also have their own interests and aspirations and this also works for other development actors. So, having efficient communication, knowledge sharing and dialogue to reconcile differences at least on some basic issues, among all potential stakeholders is very important. This will help to resolve conflict of interest in working towards a common objective on the issue of rainwater management”. Date: 29/01/2012.

4.3.8. Challenges in knowledge sharing for researches

Researchers underscored that the need for communication and knowledge sharing among stakeholders has mostly been mentioned as important component in the life time of any initiative. But not, in most cases, practically implemented. It was indicated there could be some effort at the beginning of a project but does not usually sustain through the course of its life time. Researchers mentioned, when it comes to commitment, most stakeholders do not seem determined for their cause which is usually expressed in reluctant actions like assigning the wrong person in platforms, change of delegates from time to time and failure to regularly attend in platforms. This situation not only waste the opportunity of knowledge sharing and joint learning but also finally leaves the whole burden to the institution/organization that have a lion share on the initiative. It can be inferred that lack of commitment and continuity of effort among stakeholders is a major challenge for knowledge sharing in the eyes of researchers which usually leads to lack of significant influence on policy makers.

Researchers claimed that there are no big challenges when it comes to sharing knowledge with farmers. It was emphasized researchers have a better communication and knowledge

sharing tradition with farmers. They try to test new technologies with farmers in practical oriented and participatory way, give trainings to selected “model” farmers that are identified by Ministry of Agriculture or regional and local agricultural offices and try to take lessons from farmers’ indigenous knowledge. It was their conviction that after a technology is recommended it is mostly up to the government, specifically the Ministry of agriculture, to act up on the process of diffusion and adoption.

The above explanation has its own implication as far as a challenge in sharing knowledge is concerned. In discussions farmers have also raised that efforts from Holleta Research Center and NGOs only reach to some selected farmers and they could hardly learn from such “model” farmers as such farmers are not ready to share their experiences. Farmers are important stakeholders, mostly as technology end users, in the knowledge sharing continuum. So, if knowledge about new practices in rainwater management is not reaching to the majority of farmers, then researchers’ attitude to limit their effort as major stakeholders in promoting the spread of knowledge to the intended end users can be taken as a challenge in the process.

4.4. Knowledge Sharing and Communication Tools

Suitable tools are vehicles to synthesize and share knowledge in rainwater management among different actors. Effective knowledge sharing is about two-way communication and this needs evaluating the performance of the existing tools and identifying tools that suit for different stakeholders.

4.4.1. Knowledge sharing and communication tools for farmers

Different questions were solicited on the survey and FGDs sessions to evaluate the knowledge sharing and communication tools that are mostly used in trainings and knowledge sharing events. Out of total respondents the survey result shows 95% of them have at least once attended trainings on land and water management administered by Woreda and Kebele offices, NGOs or Holleta Research Center.

Different communication and knowledge sharing tools are used by training facilitators to provide the intended information/knowledge in the best possible way. Based on the questionnaire survey to identify the most frequently used knowledge sharing and communication tools by training facilitators in the study area Training Manuals, Blackboard, Demonstration plots and Farm Visits are found to be the most used teaching aids respectively.

Table 16. Frequently used tools by training facilitators (n=120)

Tools	Total Score	Rank
Training manuals	503.00	1st
Blackboard	476.00	2nd
demonstration plot	388.00	3rd
Farm visits	331.00	4th
flipchart	90.00	5th
poster	65.00	6th
leaflet/pamphlet	45.00	7th
visual media	32.00	8th
book	23.00	9th
radio	12.00	10th

The implication of the findings was that facilitators used much theory methods rather that practical approaches which will have its own inference whether the tools are efficient in conveying the intended message to the farmers.

FGD discussions revealed that most of the time training facilitators use training manuals and just after brief discussions they give one copy to a farmer who can read and write so that he would explain to others. Although it has been the intention of the government to focus farmer trainings on a more practical approach, in the study area trainings are still inclined to a more theoretical method. Similar result was found by Wuletaw (2010) in Fogera district, Amhara National Regional State, that 90.0% of his respondents indicating trainings were carried out

by using modules focusing more on theoretical part and only 1.7% stated demonstrations, and field visits are being used in trainings.

Blackboard is also used as a teaching aid in farmer training centers (FTCs). The Woreda and Kebele offices do not use flipcharts as a teaching aid but it is occasionally use by some NGOs in trainings. Sometimes there are Leaflets/pamphlets in training sites but farmers do not have access to take and read it or make their children read it for them. None of the participants have mentioned about the use of Audio-visuals in training sessions but DAs asserted, although it was for few times, films were used to show important land and water management practices from other areas. This seems true as it was mentioned by few survey respondents as one of the tools used in the above table. The participants added after trainings there are sometimes field visits and demonstrations on some farms of 'model farmers' to see the practices that were taught on the training session.

A question was posed to respondents if the tools used by training facilitators were suitable for them. About 54% of the respondents answered the tools used were not suitable. The most important reason is difficulty of understanding which would possibly be related with either inefficiency of the tools used or lack of appropriate communication skill by training facilitators.

Table 17. Rating on suitability of tools used by training facilitators

Reason	n	%
Not easy to understand	30	25
It is easily forgettable	19	15.8
No access to the tools used	11	9.1
Content/message is not relevant	5	4.1
Tools used are suitable	55	45.8
Total	120	100.0

It was also exposed in the focus group discussion that farmers think trainings that are organized by the Woreda or Keble offices are not that relevant to learn something new to them.

Box 6: Farmers' perception on the way trainings are conducted

> One discussant states; "The trainers hold a bunch of paper and try to teach us. We barely learn from it, it is a waste of time. We like to learn new things in a simple way without wasting our time. The other discussant said "we are usually told that we would learn the new practices on fields but most of the time we just go home after trainings". Another discussant adds "I was a soldier in the past regime and know how to read and write. I am usually one of those few farmers chosen to elaborate the ideas on the manual to the other farmers so I get the chance to take the training manuals with me and read it at home. There are many important practices on the manuals that we are not familiar with but most farmers are not in a position to learn this way. It is better to teach us everything on the field". Date: 28/01/2012.

The opinions of these farmers on the training approach seem contradictory but it also provides am important insight. Farmers think trainings are not that important because there are no much new things to learn. But it is less likely that training facilitators always come with practices that farmers are familiar with. The opinion of the last discussant, from farmer's point of view, also supports the idea. The implication of this would be, Even if training facilitators brought new and important practices, the communication tools and approaches used in trainings were not suitable enough to transfer the intended knowledge and practices to farmers.

4.4.2. Suitable knowledge sharing and communication tools for farmers

As part of the survey, respondents were asked to choose their best-bet knowledge sharing and communication tools in order of importance to be used in trainings and other knowledge sharing events. As the Table below indicates Farm Visit, Demonstration plot, Visual Media and radio programs are the most suitable communication tools respectively.

Table 18. Suitable communication and knowledge sharing tools by farmers

Tools	Total Score	Rank
Farm visit	595.00	1st
Demonstration plot	514.00	2nd
Visual media	417.00	3rd
Radio	286.00	4th
Blackboard	239.00	5th
Training manual	131.00	6th
Flipchart	117.00	7th
Poster	81.00	8th
Leaflet/pamphlet	52.00	9th
Book	32.00	10th

The result showed that there is more inclination by farmers to a practical oriented learning process. It also showed their affiliation to audio-visual and mass communication tools for sharing knowledge. Similar result was also obtained from a study at Mkoji catchment in Tanzania by Sedney *et al.* (2005) that demonstration plot as a suitable knowledge sharing tool was selected by the local farmers.

Different reasons were forwarded by farmers why they choose their best-bet knowledge sharing and communication tools. As can be seen from Table 18, the most important reasons were “in practical learning knowledge is permanently kept”, “we can easily see and understand” and “tool is easily available”, which also shows the emphasis given by farmers to a better way of capturing knowledge.

Table 19. Reason for choice of suitable tools (n=120)

Reason for choice	n	%
It is easily available	20	16.6
Can easily see and understand	32	26.6
In practical learning knowledge is permanently kept	40	33.3
Practical learning is motivating	7	5.8
Helps to see practices from other places	5	4.1
It is not time wasting	12	10
It is cheap and affordable	4	3.3

4.4.3. Knowledge sharing and communication tools for development actors

Different communication and knowledge sharing tools are used by the experts to gather information and to learn about important concepts and practices in rainwater management and translate it to the beneficiary community and other local stakeholders in the study area.

Books and other printed documents in the form of guidelines, technical handbooks and training manuals which are prepared by the Ministry of agriculture, International Water Management Institute, International Livestock Research Institute and other development actors working in land and water management are very important knowledge sharing tools that assist them in all processes from planning to implementation of projects on rainwater management. It was explained that Conferences, Workshops and Trainings are also other important face-to-face communication and knowledge sharing tools with stakeholders.

All the key informants voted for computer and web-based knowledge sharing and communication tool like video/audio conferencing, e-mail, online chat, database utilities with different multimedia formats, as it was accessible to most of them, cheaper with current information and the language was well understood. It was emphasized that the advantage of

web-based applications is twofold. One, it fosters an efficient two-way communication with different stakeholders and also it provides access to relevant knowledge sources in multiple formats and contents.

Different communication and knowledge sharing tools have their own advantages and disadvantages. The experts from GIZ have presented their justifications for their preference for web-based applications. Such applications, as knowledge sharing tools, have many advantages for organizations given increased globalization and the need for rapid knowledge transfer not only with stakeholders at local and national levels but also across borders and time zones.

The experts think different tools and methods should be used when it comes to communicating farmers. According to the experts' observation on trainings, farmers were noticed to get easily bored when written documents are used as training materials. They suggest a more practical oriented approach on demonstration sites and farm plots arguing such methods are more easy ways not only to show farmers important practices in rainwater management but also to encourage them to share their practically tested indigenous knowledge.

It was found that training manuals and other documents are usually prepared in English language to be translated into local language at the Regional and Woreda offices. Two problems can be created in the process. First, there is a possibility of relevant content distortion in the translation process before it gets to the farmers and secondly, format modifications to fit the documents to farmers' level of competence may not be made. These modifications can be inclusion of dramatic and communicative pictures or exclusion of some technical jargons. These problems are more likely happening as farmers on the survey and focus group discussions mentioned fully written training manuals are one of the most frequently used teaching aids by training facilitators. The other suggested communication tool for farmers by experts form GIZ is audiovisuals in the form of videos and films.

Box 7: Experts' perception on communication and knowledge sharing tools for farmers

Ato Yonas explained;"we believe FTCs have to be equipped with audiovisuals. We have provided audiovisual materials like TV and VHS to FTCs in five Woredas in Oromia regional state. Juldu is expected to get in the next phase. Compiling good practical experiences in rainwater management in the form of films or videos will be an easy way for farmers to learn". The other expert added "we don't also have to forget the social aspect of knowledge sharing. For instance, when some talented farmers express their ideas dramatically or in a way of storytelling you would see farmers' attention easily drawn. So, training facilitators should be creative enough not only for easy transfer of knowledge but also for its long lasting effect". Date: 05/02/2012.

4.4.4. Communication and knowledge sharing tools for policy makers

Key informants from Ministry of Agriculture raised a number of issues related to communication and knowledge sharing tools. For the experts, the existing communication and knowledge sharing tools are not efficient at the desired level. One expert explained academic and other research outputs in the form of journals, articles and other forms of publications are not easily available. It was possible to refer some books, though mostly obsolete, in the library but the library has not been functioning now for almost two years after change of location was made by the ministry. If it was not for the internet access they have now to read some open access resources, there would have been almost nothing to read except some simple publications like Newsletters and fliers.

This is not a shared conviction among the experts. One expert argued that it is not obligatory to have access to academic publications in the form of journal or any other research outputs in their situation as they are managing to do our work efficiently with what we already have.

It can be inferred that peoples' preference to a particular knowledge sharing tool does not only depend on the actual efficiency of the tool in serving its purpose but it also depends on the tool's perceived usefulness by individuals or groups. The explanations of experts from Ministry of Agriculture also show the same scenario.

The interview revealed that face-to-face communications in the form of formal and informal meetings, conference, workshops and seminars are taken as the most influential knowledge sharing and communication tools among policy makers. Experts stressed intensive discussions and dialogue among internal and external stakeholders is one of their most important activities as policy makers. To address ambiguous or unstructured tasks, such as setting strategy, making difficult decisions or resolving conflicts, face-to-face communications were mentioned not only important but essential. A study by Lee (2010) in some developing countries also showed that employees in government organizations perceive face-to-face communication to be a more effective communication channel compared to computer-mediated and web-based communication.

4.4.5. Communication and knowledge sharing tools for researchers

Concerning the existing knowledge sharing and communication tools key informants from Holleta Research Center explained that Journal articles, proceedings, books and other published materials are their main sources of knowledge apart from the experimental research carried out in the station. It was explained Workshops, Seminars, Conferences and Annual reviews are also important communication methods to share knowledge about rainwater management practices.

But it was observed the institution has a dial-up internet connection with a very low bandwidth and irregular connectivity which makes it almost impossible to download relevant materials. Researchers have to go to head quarter and ILRI libraries in Addis Ababa to get access to a faster internet connectivity and more recent books and publications.

According to the researchers, it has become almost impossible to get published materials. They used to have access to *issues* from reputable journals publishers in contract payment. But now because of their assumed access to internet all of that has been terminated arguing it is really difficult for them to move forward in this situation.

In this dynamic world where new scientific outputs are released every now and then, where existing thought and theories are substituted with new emerging ones, lack of access to state-of the-art communication technologies has a fundamental implication for the countries research competency. As Roling (1997) noted, people who had academic qualifications were something very special, elite, and above all, experts, who could solve problems for the rest of us. Alas, those good old days are definitely gone. Professionals can no longer operate on the basis of acquired status. The knowledge they have gained soon becomes obsolete.

Informants also expressed lack of organized database where different relevant published and unpublished materials on rainwater management can easily be found and shared from other institutions working on rainwater management.

Box 8: Researchers' concern on luck of organized database

Ato Biniam stressed; "There has always been a discussion at the launching of new projects about the need for a database for electronic documentation and easy access of relevant materials that includes trained people who maneuver knowledge as members of project team but not much happens practically. In a situation like this it's hard to take lessons from past experiences and avoid duplication of efforts". Date: 29/01/2012.

In general a combination of face- to -face communication and other web-based applications like internet, web based databases, email and video/audio/ conferencing are first rated knowledge sharing tools by the researchers. It was justified face-to-face communications are initially very important to create the link but once the linkage is formed information and knowledge in printable or other multi-media formats can be shared in a fast and more reliable way through web-based application until another face-to-face communications becomes necessary.

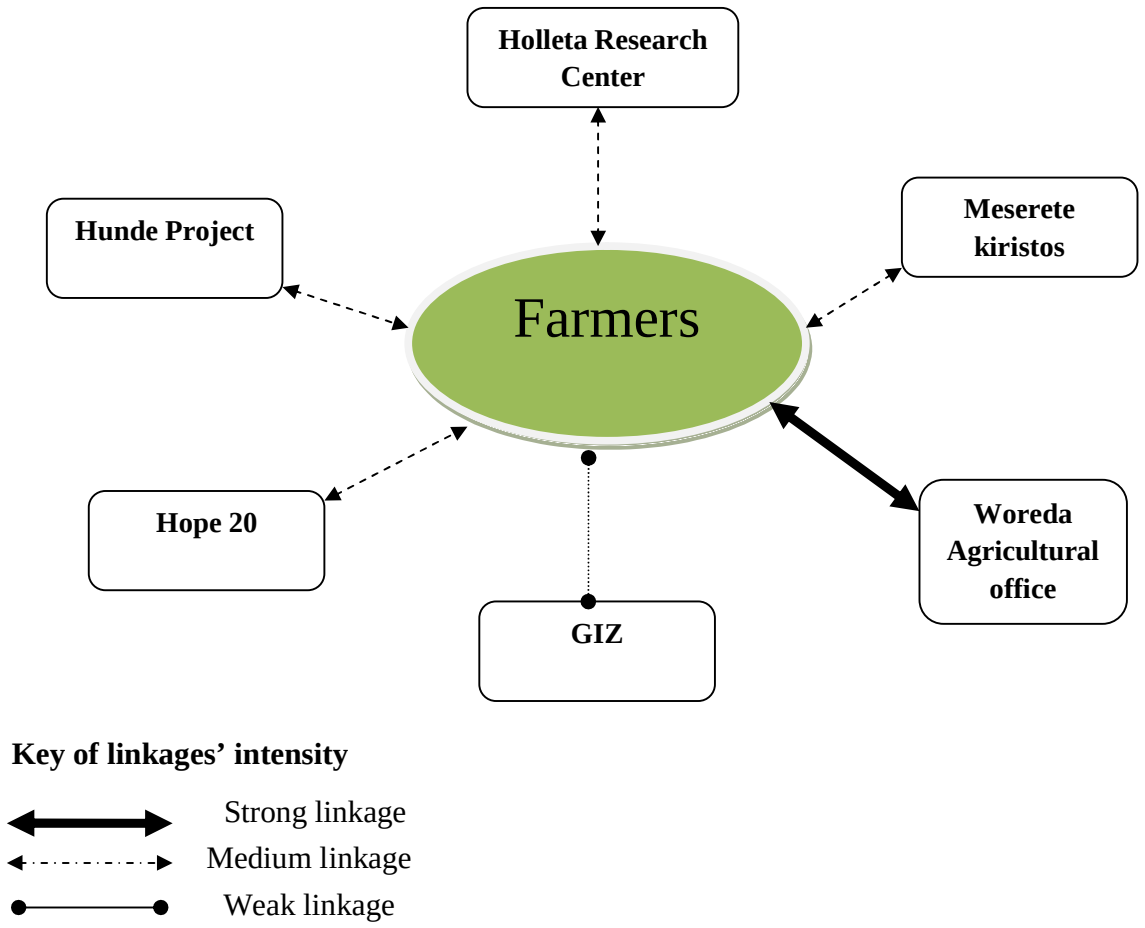
Like the experts illustration, knowledge sharing with computer-based communication tools would be more productive if it is supported with face-to-face communication methods which allow social presence. As the study by Powell *et al.,* (2004) showed, virtual teams who held early face-to-face meetings formed better interpersonal relationships, trust, respect, socialization and an improved understanding of project objectives.

4.4.6. Actor linkage analysis

Linkage among important actors working in land and water management has a paramount importance to share knowledge and experience and mobilize scarce resources towards improving the resilience of livelihoods of smallholder farmers in the study area. Farmers are the prime actors and ultimate end users in the overall endeavor.

As linkage analysis was not in the main objectives of this study, RAAKS tool was used than the corresponding window to limit the analysis to a narrower range of issues. The study attempted to systematically describe the existing actors' linkage with farmers in the study area. Actor linkage map was produced by putting farmers at the center and connecting other actors based on their contribution to the system.

Figure 4. Actor linkage map developed by FGDs and Key informants



As depicted in the actor linkage map, discussants put strong linkage with the Woreda Agricultural office. Actors like Ministry of Agriculture and Oromia Regional Bureau of Agriculture are acting through the Woreda agricultural office. The possible reason for the strong linkage could be related with the relative accessibly of the office and its role in facilitating linkage between farmers and other GOs and NGOs in the study area. It was found that there is a medium linkage between farmers and Holleta Agricultural Research Center, Hope 20, Hunde and Meserete kiristos projects. There is a weak link between farmers and GIZ as the project was in a transition period between study and intervention at the time of data collection.

The analysis and summary of information collected through key informant interviews and focus group discussions provided the actor linkage matrix. The intensity (tightness of connection), and purposes of linkage or interfaces between pairs of actors is also shown in the linkage matrix. However, it was found that the study KAs have poor actor profile with few actors engaged in land and water resource management. There used to be a missing linkage among local development actors but communications are being established after local innovation platform meetings of NBDC. From the table below, Dark shading indicates for medium linkage types. 'Light' shading indicates weak linkage between those actors. 'Nil' indicates there is no institutional linkage between actors. All the remaining boxes indicate the strong linkages.

Regarding the purpose of linkage, the Woreda Agricultural office is relatively active in facilitating support that comes from NGOs which includes identifying participant farmers for particular initiative. It also receives technical support and shares information with the NGOs and the research center and identifies farmers' training needs. Most technical support and agricultural input supply to farmers comes from the Woreda Agricultural office as efforts from NGOs and Holleta Research Center also comes through the Woreda office. The different actors in the study area are either directly engaged in water development and natural resource management activities or in expediting other enabling conditions like access to credit, equipping FTCs.

Table 20. Actor Linkage Matrix

Actor	Farmer	Holleta Research Center	Woreda Agricultural Office	GIZ	Hope 20	Hunde project	Meserete kirstos
Farmer		Provision of technology; Indigenous knowledge sharing	Technical support; input supply(tree seedling, forage, grass seed); Facilitation of support	Provision of new technology; technical and material support	Portable water development; technical and material support	Facilitating credit; tree seedling provision	FTC teaching aids; facilitating credit
Holleta Research Center			Selecting and organizing farmers; training need identification;	Nil	Information sharing	Nil	Nil
Woreda Agricultural Office				Information sharing; facilitating support; technical and material support	Information sharing; facilitating support; technical and material support	Information sharing; facilitating support; technical and material support	Information sharing; facilitating support; technical and material support
GIZ					Nil	Information sharing	Nil
Hope 20						Information sharing	Information sharing
Hunde project							Information sharing
Meserete kiristos							

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary and Conclusions

The study attempted to address the objectives on four sample stakeholders for the Nile Basin Development Challenge from Policy makers, Development actors, and Research centers working on rainwater management and off course, farmers in the study area which are the beneficiary community and prime stakeholders in the development challenge.

Both qualitative and quantitative data were collected through interview schedule and Focused grouped discussions for sample households in the study area. Observation and informal discussions were also important instruments to back up the data obtained through the formal procedures. To capture relevant data from officials, researchers and experts from the other stakeholders key informant interviews were employed.

Simple statistical tools like percentage, frequency, mean, standard deviation and ranking were used to display the data obtained through open and closed ended questions administered on the schedule. Categorization was made on perceptions and different explanations given on concepts and practices of rainwater management and on communication and knowledge sharing practices, challenges and tools for beneficiary community. To describe and interpret the data harnessed on similar themes for the other stakeholders, qualitative assessment in the form of narrative analysis and was important procedure. RAAKS tool of actor linkage analysis was employed to assess strength and linkage interfaces among relevant actors in the study area.

Despite the fact that farmers in the study area have their own cross-generational indigenous knowledge on some rainwater management practices, they were found to have limited practical knowledge on advanced and scientific practices. They also lack relevant resources to uptake the practices that they are already familiar with. Close to half of the respondent farmers (41.7%) were not familiar with the term “rainwater management”. Farmers were found to have little concern and know-how about RWM practices to enhance the productivity

of water for their livestock subsystem. Systematic approach for the integration of crop, livestock and agro forestry subcomponents is important notion in the wider sphere of rainwater management.

Researchers and experts from sample stakeholders were found to have adequate knowledge on important rainwater management technologies and practices. These practices range from physical structures to rainwater harvesting and biological measures that have implications for the productivity of different farm components and ecosystem services. However, the study revealed that there is a high tendency to perceive the concept of rainwater management from the technological innovation aspect. Rainwater management as an approach focuses equally, even more, on other institutional innovation and policy matters that are necessary to optimize the benefits of technologies. A mere focus on RWM technologies has a fundamental implication especially when it comes to delegates from Ministry of Agriculture who are at the heart of policy and institutional matters.

The survey result showed that Relatives/friends/neighbors, rural radio programs and Trainings/Demonstrations/Farm visits are the most important knowledge sources for farmers on important rainwater management practices. Ease of access to the sources, reliability and provision of appropriate information being the most important reason for their choice. As far as challenge in knowledge sharing is concerned, inability of model farmers to share their experiences, luck of resources to translate the acquired knowledge into practice and problems associated with training approaches and tools used were found to be the most important challenges for farmers.

Even though, interviewees from Ministry of Agriculture, Holleta Research center and GIZ have a shared belief on the importance of communication for improved knowledge sharing and joint learning in concepts and practices of rainwater management, they were found to be doubtful about pragmatic implementation and sustainability of such engagements. Lack of commitment; lack of integrating knowledge sharing in organizational plan; different professional approaches; varying interests; poor knowledge sharing culture; lack of strong network; lack of enabling technologies; and focus of learning alliances on deliverables than

on process of integration were found to be the most pronounced challenges for improved knowledge sharing in rainwater management.

With regard to communication and knowledge sharing tools used in trainings and other knowledge sharing events for farmers, Training manual, Blackboard, Demonstration plots and farm visits were found to be the most frequently used tools by training facilitators. FGDs also substantiated the finding where written manuals and documents are often used materials which contributed to farmers' lose of interest in trainings and perceive it as less educational. More than half of the respondents (54%) think the tools used in training sessions are not suitable for them. Difficulty of understanding, being forgettable and lack of access to the tools used are the most important reasons given why the tools used were not suitable for them. It can be concluded that a more theoretical approach on trainings was less favored by a considerable number of sample respondents as it was not an "easy-to-learn" method. Respondent farmers also showed their interest to a more practical knowledge sharing tools. Farm visits, Demonstration plots, Visual media and Radio programs were found to be among the best bet communication and knowledge sharing tools in order of importance. Apart from practical oriented tools, farmers also preferred audiovisual and mass communication tools which give them the opportunity to learn both theoretical and practical aspects of rainwater management. Permanence of acquired knowledge through practical learning, ease of understanding and availability of tools were found to be the most important reasons for respondent farmers to choose their best bet tools.

Key informant interviewees from Ministry of Agriculture, Holleta Research center and GIZ use different tools and methods to communicate and share knowledge in rainwater management. Experts from GIZ mostly use books in the form of guidelines, technical handbooks and also training manuals prepared by Ministry of Agriculture and other local and international research institutes. Web-based applications and different forms of face-to-face communications are also important mechanisms to harness and share experience in rainwater management. No series problem on the available tools was mentioned by experts from GIZ. Web-based tools like audio and video conferencing, database utilities, internet, email, online

chat were found to be the most suitable tools for the experts because it was easily accessible, cheaper with current information and the language is easily understandable.

The existing communication and knowledge sharing tools for delegates in the Ministry of Agriculture were found to be inefficient. Even though it was not a shared conviction, access to academic publications both in printed and printable formats and luck of access to recent books was mentioned as one of the challenges. It was found that formal and informal meetings, Workshops, Conferences, Seminars and other face-to-face communications were the most important communication and knowledge sharing tools for policy makers justifying the difficulty of handling ambiguous and unstructured tasks in a virtual communication.

Researchers from Holleta Agricultural Research Center often do not have reliable access to the most common web-based application like internet. However, face-to-face communications like Annual reviews, Workshops, Seminars and Conferences are important tools to exchange and share knowledge on rainwater management. In general, a combination of face-to-face communications and different web-based applications were found to be the most favored tools for the researchers. It was justified that face-to-face communications are important mechanisms to materialize a viable linkage among stakeholders but once the link is formed, wed based applications can easily facilitate two-way communication and provide access to different knowledge sources in multiple formats.

5.2. Recommendations

While empirical evidences for effective knowledge sharing practices are limited in our context, the following recommendations are made based on the results found and the conclusions drawn from the study to assist researchers, policymakers, and development actors to work together to maximize knowledge sharing success in rainwater management.

Promotion of farmer-to-farmer knowledge sharing is valuable for an easy transfer of knowledge. While stakeholders are working model farmers, considerable emphasis should be given not only on knowledge sharing between the stakeholders and model farmers but also on

developing mechanisms for an easy transfer of knowledge from model farmers to the majority.

Stakeholders should use appropriate tools in trainings and other knowledge sharing events to improve farmers' knowledge on advanced and scientific rainwater management practices. Moreover, while trying to introduce new rainwater management practices to farmers, other enabling policy and institutional settings should also go hand in hand to increase the level of technology uptake and spread of knowledge.

Even though, there is a shared conviction to focus on practical oriented training approaches for farmers, the results showed that there is a more orientation to theoretical methods in the study area. There needs to be a shift to more hands-on practical methods by stakeholders. To this end, field visits/days, demonstrations on farm plots and other practical methods should be practically used as best-bet knowledge sharing tools. Attempts should be made to equip FTCs with audio-visual tools to share knowledge in rainwater management from elsewhere which at the same time help farmers to change their perception towards trainings through an entertaining and educational approach. Broadcasting relevant topics in rainwater management through local FM radio stations should also be considered in a way to reach to the majority of farmers. This can be made by transmitting informal and formal training sessions on theoretical aspects of important practices, facilitating radio discussion programs, radio plays or through participating or inviting farmers with relevant stories to share their experience. Training manuals also needs be prepared with formats that fit into farmers' level of understanding. Inclusion of interesting pictures and illustrations, or story telling narrations would encourage farmers to think about or discuss important themes.

For knowledge sharing to be successful among researchers, policymakers, and development actors, significant investments of time and resources are required. Stakeholders should develop mechanisms to check for continuity of efforts and their commitments to enhance joint learning and create common understanding on concepts and practices of rainwater management. Their learning alliances would become more effective if it focuses more on

processes and mechanisms for integration than on distinct meetings and their deliverables like reports.

Policy makers, researchers and development actors have different access to and preference for a range of communication and knowledge sharing tools. So, choices of tools need to consider the intended target groups. Different forms of Face-to-face communication methods should be taken as best options for interacting with policy makers whereas, virtual communications through different web based applications would work best with development actors. For researchers, companioning web based applications that facilitate virtual communications with different face-to-face communication methods would be more appropriate.

6. REFERENCES

Adane Kassa, 2011. 2nd 'National Platform meeting on land and water management in Ethiopia. Stakeholder meeting report. Available at: http://nilebdc.wikispaces.com. Accessed on: March 23, 2012.

APWF, 2009. Knowledge Networking for Water Security in the 21st Century: Knowledge hub. Available at www.apwf-knowledgehubs.net, accessed on February, 25, 2012.

Awulachew, S. B.; Yilma, A. D.; Loulseged, M.; Loiskandl, W., Ayana, M., Alamirew, T. 2007. Water Resources and Irrigation Development in Ethiopia. International Water Management Institute. Colombo, Sri Lanka 78p. Working Paper 123.

Awulachew, S.B., 2010. Improved water and land management in the Ethiopian highlands and its impact on downstream stakeholders dependent on the Blue Nile. CPWF Project Number 19: CGIAR Challenge Program on Water and Food Project Report series, www.waterandfood.org.

Bessette Guy, 2006. People, Land and Water: Participatory Development Communication for Natural Resource Management. First published in the UK, USA and Canada by Earthscan and the International Development Research Centre (IDRC). pp. 173.

Birhanu Zemadim, Teklu Erkossa, Amare Haileslassie, Matthew McCartney, Deborah Bossio, Bharat Sharma, Fergus Sinclair, 2011. Rainwater Management Systems in The NBDC: Emerging Menu of alternatives. Slide presented on Science and Reflection Workshop, May, 2011, Addis Ababa, Ethiopia.

Bohmann, K., 2004. Media for Rural Development: A Guide for Media Use. GTZ/InWEnt, Eschborn; Available at: http://www.gtz.de/agriservice. Accessed on July 26, 2011.

CapNet, 2004. Applying Knowledge Management : A tool for Capacity Building Networks in Integrated Water Resources Management. Working paper. Available at www.cap-net.org/sites/cap-net.org, Accessed on February, 28, 2012.

CPWF, 2010a. Rainwater management for resilient livelihoods. Rainwater management in the Ethiopian highlands: Assessing and anticipating the consequences of innovation. CPWF Brief 5. Available at: http//nilebdc.wordpress.com. Accessed on August 10, 2011.

CPWF, 2010b. Submission Document – Nile Coordination Project 5. Addis Ababa, Ethiopia. Available at: http//nilebdc.wordpress.com Accessed on June 05, 2012.

CPWF, 2011a. News from the Nile Basin Development Challenge. Update 2. Available at: http//nilebdc.wordpress.com Accessed on June 05, 2012.

CPWF, 2011b. Rainwater management for resilient livelihoods: Thirty years learning to improve rainwater and land management in the Blue Nile basin of Ethiopia. CPWF Brief 6. Available at: http//nilebdc.wordpress.com Accessed on August 12, 2011.

CPWF, 2011c. Rainwater management for resilient livelihoods. What is a local innovation platform. Brief 7. Available at: http//nilebdc.wordpress.com Accessed on June 07, 2012.

CTA, 2010.Closing the Knowledge Gap: Integrated Water Management for Sustainable Agriculture. Annual seminar. South Africa, Johannesburg, 22–26 Nov 2010.

Daniel Tadesse, 2008. Access and utilization of agricultural information by resettler farming households: the case of metema woreda, north Gondar, Ethiopia. A Thesis for M.A Degree in RDAE. Haramaya University.

Daniel Z. Levin, Rob Cross, Lisa C. Abrams and Eric L. Lesser.Trust, 2002 Knowledge sharing: A critical combination. IBM Institute for Knowledge-Based Organizations. IBM U.S.A.

Davice, M., 2001. Knowledge (Explicit and Implicit) Philosophical Aspect. In: International Encyclopedia of the Social and Behavioral Sciences, Smelser, N.J. and P.B. Baltes (Eds.). Elsevier Science Ltd., USA.

Debora De Cosmi and Brian Reed, 2009. Communication within multi-stakeholder platforms in water resource management: Ethiopian case study. 34th WEDC International Conference, Addis Ababa, Ethiopia, reviewed paper 324.

Dereje, Hamza, 2005. Assessment of farmers' evaluation criteria and adoption of improved bread Wheat varieties. M.Sc. Thesis, Haramaya University.

Dessalegn Molla, 2008. Social networks and diffusion of agricultural technology: the case of sorghum in metema woreda, north Gondar, Ethiopia. A Thesis for M.A Degree in RDAE. Haramaya University.

Davenport, T., De Long, D., and Beers, M., 1998. Successful knowledge management projects. *Sloan Management Review, 39*(2), 43-57.

Dixit, Sreenath and Wani, SP., 2003. Integrated watershed management through consortium approach: Team building for watershed consortium. Global Theme 3: Water, Soil and Agro diversity Management for Ecosystem Resilience. An Open Access Journal published by ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 52 pp., August 2006 | Volume 2 | Issue 1.

Dolores Ma., Tongco C., 2007. Purposive Sampling as a Tool for Informant Selection: Ethnobotany Research & Applications. *Journal of plants, people and applied research* 5:147-158.

Dondeynaz C., P. Mainardi, C. Carmona Moreno, & A. Leone, 2009. Water, sanitation and hygiene: Sustainable development and multisectoral approaches: A web based communication and information system tool for water management in developing countries, refereed paper 292. 34th WEDC International Conference, Addis Ababa, Ethiopia.

FARM-Africa, 2001. Farmer Participatory Research in Southern Ethiopia: The Experiences of the Farmers' Research Project. Project Experiences Series. Published by Farm Africa 9-10, Southampton Place, London.

FAO, 2001. Irrigation manual, planning development monitoring and evaluation of irrigated agriculture with farmer participation. FAO, Annual report, Rome, 80pp.

FAO, 2003. Communication and Natural Resource Management. Publishing Management Service, Information Division, FAO, Rome, Italy.

GTZ, 2003. Media for rural development. Agri-service Bulletin No.10, Sector Project Knowledge Systems in Rural Areas. Available at: http://www.gtz.de/agriservice, Accessed on July 26, 2011.

Fritz. K, 2008. Case Study & Narrative Analysis. Johns Hopkins University press. Johns Hopkins Bloomberg, school of public health, USA.

Global Development Network, 2007. Knowledge management as an enabler of change and innovation. Proceeding of the Conference for Policymakers and Practitioners, June 11-13, Cairo, Egypt, pp: 1-10.

Gizaw Desta, 2010. Conceptualizing rill erosion as a tool for planning and evaluating soil conservation in Angereb watershed, Ethiopia: Methodological development Research Report for Q505 project supported by Eastern and Southern Africa Partnership Program (ESAPP). Amhara Region Agricultural Research Institute (ARARI).

Gupta, A..; Govindarajan, V., 2000. Knowledge flows within multinational corporations. *Strategic Manage. J.* 2000, *21*, 473-496.

GWP, 2003. Sharing knowledge for equitable, efficient and sustainable water resources management. C8.2 sharing data for IWRM. IWRM Toolbox Version 2 – Foreword, update.

GWP and INBO (International Network of Basin Organizations), 2009. A handbook for integrated water resources management in basins. Published by GWP and INBO. PP 100.

Hansen, S., Avital, M. (2005). "Share and Share Alike: The Social and Technological Influences on Knowledge Sharing Behavior," Case Western Reserve University, USA . *Sprouts: Working Papers on Information Systems*, 5(13). Available at: http://sprouts.aisnet.org/5-13. Accessed on, June 06, 2012.

Hendriks Paul, 1999. Why Share Knowledge? The Influence of ICT on the Motivation for Knowledge Sharing. *Research article*. Knowledge and Process Management Volume 6 Number 2 pp 91–100.

ITW, 2007.Water Use Efficiency in Agriculture: The Role of Nuclear and Isotopic Techniques, Available at: http://www.mendeley.com. Accessed on January 28, 2012.

IWA, 2007. Industry Sector Report for WSSD: Principles of Integrated Water Resources Management in Urban Areas. Available at: http://www.gdrc.org/uem/water/iwrm/1pager-01.html Accessed on June 15, 2011.

IWMI, 2007. Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. London: Earthscan, and Colombo.

Jeffrey Cummings, 2003. Knowledge Sharing: A review of related literature. The World Bank operetions evaluation department. Washington, D.C.

John Rockström, Nuhu Hatibu, Theib Y. Oweis, and Suhas Wani, 2007. Managing water in rainfed agriculture. IWMI (International Water Management Institute) Part 4 Ch8-16 final.indd 318.

Kaplan. F and Ashley J., 2003. Synchronous and asynchronous communication tools. Knowledge management, Story Telling. Executive update online.
Available at: http://www.centeronline.org/knowledge/article. Accessed on June 2011.

Kebebe Ergano, Alan Duncan, Aberra Adie, Abate Tedla, Gebremedhin Woldewahid, Zewdu Ayele, Gebreyohannes Berhanu and Nigatu Alemayehu, 2010. Implementation challenges of innovation systems perspective in fodder production in Ethiopia. Proceedings of innovation and sustainable development in agriculture and food. June 28 – July 1, Montpellier, France.

Kim A Stephens, 2011. Integrated Rainwater Management: Move to a Levels-of-Service Approach to Sustainable Service Delivery. Asset Management BC Newsletter. Available at: www.waterbucket.ca/gi/sites/wbcgi/documents/media/322.pdf, Accessed on August 5, 2011.

Kumar Harish, 2006. Folk Media and Rural Development. *Indian Media Studies Journal*, Vol.1, No.1. Department of Journalism & Mass Communication, Maharishi Dayanand University. pp 94-95**.**

Laban Peter, Mona Barghout, Patrick Moriarty, and Shawkat Sarsou, 2005. Stakeholder Dialogue and Concerted Action for Integrated Water Resource Management. Working Paper No. 6 (Version 2). Available at: ec.europa.eu/research/water-initiative/pdf/iwrm.../wp6-sdca_en.pdf, Accessed on June 10, 2011.

Laura German, Hussein Mansoor, Getachew Alemu, Waga Mazengia, Tilahun Amede and Anne Stroud, 2006. Participatory Integrated Watershed Management: Evolution of Concepts and Methods. Article under review in Agricultural Systems. African Highlands Initiative (AHI) .working papers # 11.

Lee Cheng Ean, 2010. Face-to-face Versus Computer-mediated Communication: Exploring Employees' Preference of Effective Employee Communication Channel. *International journal for the advancement of science & arts*, vol. 1, no. 2, 2010 28

Leeuwis Cees, 2004. Communication for Rural Innovation. Rethinking Agricultural Extension. Blackwell Publishing Company. Oxford, UK. Part 2, PP 59.

Lily Tsui, Sherry Ann Chapman ,Laurie Schnirer, Sheena Stewart, 2006. Strategies and Recommendations for Researchers, Policymakers, and Service Providers. A Handbook on Knowledge Sharing. Community-University Partnership for the Study of Children, Youth, and Families. University of Alberta Edmonton, Alberta.

Lingling Zhang, Xiuyu Zheng, Jun Li, Guangli Nie, Guoqing Huo1 & Yong Shi, 2008. A Way to Improve Knowledge Sharing: from the Perspective of Knowledge Potential. *J. Serv. Sci. & Management*, 2008, 1: 226-232.

Lotfy H. R., 2007. Involving Stakeholders in Transboundary Water Management in Southern Africa, IV International Symposium on Transboundary Waters Management, Thessaloniki, Greece, 15th – 18th October 2008.

Mast Claudia, Simone Huck, Ansgar Zerfass, 2005 .Innovation Communication. Outline of the Concept and Empirical Findings from Germany. Innovation Journalism Vol 2. No. 7 – May 13 2005. Department of Communication Studies and Journalism, University of Hohenheim, Stuttgart, Germany.

Merrey, D.J. and Tadele Gebreselassie, 2011. Promoting improved rainwater and land management in the Blue Nile (Abay) basin of Ethiopia. NBDC Technical Report 1. Nairobi, Kenya, ILRI.

Mikinay Hilemariam, 2008. Social networks and gender dimensions in use of irrigation by farmers in Alamata woreda, southern Tigray, Ethiopia. A Thesis for M.A Degree in RDAE. Haramaya University.

Mogus Shiferaw, 2006. Keeping an Eye on Decentralization and Specification of a Resource Policy: an Overview of the Policy Study to the Promotion of RWH. Proceedinqs of a MoARO/MoWR/USAIO/lWMI symposium and exhibition held at Ghio Hotel, Addis Ababa, Ethiopia 7-9 March, 2006.

Myers Mary, 2008. Radio and Development in Africa: A Concept Paper Prepared for the International Development Research Centre (IDRC) of Canada. Discussion paper, pp 55 Available At: www.dfid.gov.uk/r4d/projectsAndProgrammes.asp?OutputID, Accessed on August 2, 2011.

Pfeifer Catherine, 2011.CGIAR Challenge Program on water and food. Report of the N3 Technical partner meeting 28-29th of March 2011, Addis Ababa.

Powell, A., Piccoli, G., & Ives, B., 2004. Virtual teams: A review of current literature and directions for future research. *Data Base, 35*(1), 6.

Robert l. Johnson, 2003. Rebuild the agricultural research and extension system in Nigeria. Kansas state university. Available at: www.nigerdeltacongress.com, Accessed on February, 20, 2012.

Rockström, John, Jennie Barron and Patrick Fox, 2003. Water Productivity in Rain-fed Agriculture: Challenges and Opportunities for Smallholder Farmers in Drought-prone Tropical Agroecosystems. CAB International. Stockholm, Sweden.

Roland k. price, 2007. knowledge sharing. Discussion paper for the session on knowledge sharing. Institute for water education. delft, the Netherlands. Available at www.unesco-ihe.org, accessed on February, 23, 2012.

Romanow Paula, David Bruce, 2006. Communication & Capacity Building: Exploring Clues from the Literature for Rural Community Development. *Journal of Rural and Community Development* 1 (2006) 131-154.

Sally Burch, 2007. Knowledge sharing for rural development: challenges, experiences and methods. Latin American Information Agency. Quito, Ecuador.

Sally. H, 2003.Advances in integrated water resources management research in agriculture: Integrated water and land management research and capacity building priorities for Ethiopia. Proceedings of a MoWR/EARO/IWMI/ILRI international workshop held at ILRI, Addis Ababa, Ethiopia, 2–4 December 2002, pp 46-57.

Savitri Abeyasekera , 2000. "Quantitative analysis approaches to qualitative data: why, when and how", Statistical Services Centre, University of Reading, United Kingdom.

Sawah El Sondoss, Alan McLucas and Jason Mazanov, 2009. Communication about Water Management in the Australian Capital Territory: A System Dynamics Modeling Approach. University of New South Wales, Australian Defense Force Academy Northcott Drive, Canberra, Australia.

Schilling, J.,2006. On the pragmatics of qualitative assessment: Designing the process for content analysis. *European Journal of Psychological Assessment, 22*(1), 28-37.

Serrat, Olivier, 2008. Notions of Knowledge Management.. *International Publications.* Paper 140. Available at: http://digitalcommons.ilr.cornell.edu/intl/140. Accessed on June 06, 2012.

Servin G., 2005. ABC of Knowledge Management. NHS National Library for Health: Knowledge management specialist Librar http://www.library.nhs.uk/knowledgemanagement/. Accessed on June 05, 2012.

Simone Staiger Rivas, Alessandra Galie, Bernhard Hack, Maria Alexandra Jorge, Vanessa Meadu, Florencia Tateossian, Gauri Salokhe, Nancy White, 2010. Learning to share knowledge for global agricultural progress. *International Journal of Web Based Communities* 2010 – Vol. 6, No.2 pp. 209-226.

Swaans, K., 2011. Report of a Planning Workshop on a National Innovation Platform on Land and Water Management in Ethiopia, Addis Ababa, Ethiopia, April 8, 2011. Addis Ababa, Ethiopia, ILRI.

Sydney S. Kasele, Malongo R.S. Mlozi, Nuhu Hatibu, 2005. Knowledge Sharing and Communication Tools for Dialogue Issues on Productivity of Water in Agriculture in Mkoji Sub-catchment, Tanzania. Proceedings of the east Africa river basin management conference, 7-9 march 2005, Sokoine University of agriculture, morogoro, Tanzania.

Tilahun Amede, Shirley Tarawali and Don Peden. Cambridge university press, 2011. Improving water productivity in crop-livestock systems of drought-prone regions, editorial comment. Volume 47 (s1), pp. 1–5 c.

UNICEF (United Nations International Children's Emergency Fund), 1999. Towards better programming. A Manual on Communication for Water Supply and Environmental Sanitation Programmers. Water, Environment and Sanitation Technical Guidelines Series - No. 7. United Nations, New York.

Warner Jeroen, 2005. Multi-Stakeholder Platforms: Integrating Society in Water Resource Management? Ambiente & Sociedade – Vol. VIII n 2. Wageningen University, Netherlands.

Wimmer, R. & Dominick, J., 2006. Mass media research: An introduction (8th Ed.). Thompson Wadsworth peblishing: United States of America.

Woldemlak Bewket, 2003. Towards integrated watershed management in Ethiopian highlands: the Chemago watershed case study. PhD thesis, Wageningen University and research center.

Wuletaw Mekuria, 2010. Effectiveness of modular training at farmers' training center: the case of Fogera district, Amhara national regional state, M.Sc. Thesis, Haramaya University.

APPENDIX

7. APPENDIX

Interview Schedule

*Enumerator name*_____ *date of interview*_____

Kebele _____ *village name*_____

Instruction: Start with greeting in local language. Introduce yourself before starting the interview. Inform the respondent politely to whom you are working for and explain the purpose of the interview. Fill the responses in the space provided or circle alternative response (s) where appropriate.

I. Household Characteristics

1.1 Name of respondent _____

1.2 Age of the respondent _____

1.3 Sex of respondent

1. Female 2. Male

1.4 Marital status of the respondent

1. Single 2. Married 3. Divorced 4. Widowed

1.5 Educational level of the respondent

1. Illiterate 2. Read and write 3. Primary education(grade 1-6)
4. Secondary education(grade 7-12) 5. Above secondary

1.6 Household size (number)

I. Female _____ 2. Male _____ 3. Total_____

1.7 Major source of living

1. Crop production 2. Livestock Production 3. Crop and Livestock production
4. Wage Labor 5. Others (specify)_____

II. Understanding and Knowledge Sharing on Principles and Practices of Rainwater Management

2.1. Do you know the meaning of rainwater management? 1= YES; 2 = NO

2.2. If YES, can you explain the meaning? ----------

2.3. Do you know some rainwater management practices? 1= YES; 2 = NO

2.4. If YES, which one of these rainwater management practices do you know?

Practices	Put √ mark
• Ponds/Tanks/Cisterns	
• Water diversion schemes	
• Hillside/ Stone/ Bench Terraces	
• Cutoff drains	
• Earthen bunds	
• Micro-basins, Trench, Eyebrow terrace	
• Vegetated stone-soil-stone bunds	
• Gully plugging	
• Percolation tanks/Infiltration zone	

2.5. If YES, where did you get the knowledge?

1. DA advisory service/Gov./ 2. NGOs 3. Mass media 4. Own experience

5. relatives/neighbors/friends 6. Other (specify) ----------

2.6. What water sources in your locality do you think can be used for agricultural and domestic

purpose? (more than one choice is possible)

1. Rainfall 2. Rivers 3. Springs 4. Groundwater

2.7. Do you think capturing and storing rainwater has importance? 1= YES; 2 = NO

2.8. If YES, what do you think is the importance? ----------

2.9 Do you capture, store and use rainwater? (More than one choice is possible) 1= YES; 2 = NO

2.10. If YES, which of these practices/techniques do you use?

1. Ponds/Tanks/Cisterns 2. Water diversion schemes
3. Hillside/ Stone/ Bench Terraces 4. Cutoff drains 5. Earthen bunds
6. Micro-basins, Trench, Eyebrow terrace 7. Vegetated stone-soil-stone bunds
8. Gully plugging 9. Percolation tanks/Infiltration zones

2.11. If NO, what prevents you from practicing them?

1. Lack of knowledge/skill 2. Lack of money/material 3. Not important to me
4. Lack of interest 5. Other (specify) ----------

2.12. Do you think by adopting different water management practices you can increase your water availability and productivity? 1= YES; 2 = NO

2.13. If YES, explain how adopting different water management practices increase water availability and productivity? ----------

---

2.14. Do you think crops water use efficiency/crop water uptake/ can be increased by improving your cropping strategies? (Refer to choices in the next question for possible strategies) 1= YES; 2 = NO

2.15. Which of these cropping strategies do you practice to increase your crop water use efficiency? (More than one choice is possible).

1. Planting high yielding and high value crops
2. Crop management practices /appropriate planting date, plant population, fertilizer application and weed control/
3. Advanced cropping systems /Crop rotations, intercropping, alley cropping /
4. Use lime and manure to ameliorate acidic soils
5. I don’t practice any of them

2.16. If you practice at least one of the above cropping strategies, how do you think it will improve crop water use efficiency? ----------

---

2.17. Do you think your livestock productivity will increase by efficient storage and use of water? 1= YES; 2 = NO

2.18. Which of these strategies do you practice to increase your livestock water productivity? (More than one choice is possible).

1. Managing grazing lands /soil conservation, cut off drains, flood diversion etc./
2. Select water productive feed /crop residues, improved feed storage urea treatment, chopping of course, cut and carry, /
3. Conserve water /runoff, discharge, prevent contamination/
4. Strategic livestock watering.
5. Destocking and cross breeding
6. I don't practice any of them

2.19. If you practice at least one of the above strategies, how do you think it will improve your livestock productivity? ----------

---

2.20. Do you think increasing and diversifying tree cover is useful to increase water availability and productivity? 1= YES; 2 = NO

2.21. If YES, how do you think it helps? ----------

2.22. If YES, Do you plant or cultivate any tree species to help you increase water availability? 1= YES; 2 = NO

2.23. If YES, mention the most common tree species you plant/cultivate. 1. ----------

- 2. ---------- 3. ----------

2.24. Do you think practicing different rainwater management strategies help to mitigate negative environmental consequences (eg. Floods and Draught) in your area?

2.25. If YES, how do you think it helps? ----------

2.26. Do you think similar rainwater management practices should be applied in all areas (upland, midland or bottomland)? 1= YES; 2 = NO

2.27. If YES, explain your reason----------

2.28. If NO, also explain your reason----------

2.29. Do you think rainwater management practices upstream will have an impact on downstream water users/farmers? 1 = YES; 2 = NO
2.30. If YES, can you mention some of the impacts you know? 1. ----------
---
2. ---
3. ---
2.31. Do you think a collective farmers' effort on water resource management is more important than individual effort for improving farm productivity in your area? 1 = YES; 2 = NO
2.32. If YES, explain your reason ----------

III. Knowledge Sharing on Rainwater Management

2.33. Do you think working with other water stakeholders/actors/ in your area /NGOs, Gov. Body, other water users/ has any advantage to improve water management and productivity in your area? 1 = YES; 2 = NO
2.34. If YES, what do you think is the most important advantage of working with other stakeholders?

1. Improves knowledge and experience sharing among stakeholders
2. Helps to resolve conflict of interest among stakeholders
3. Helps to increase access to resources/financial, material/
4. Guarantees sustainability of project outputs
4. Other (specify) ----------

2.35. What are the most important (in order of importance) sources of information/knowledge about important practices on rainwater management?

1. Relatives, friends and neighbors
2. Training, Demonstration & Field days
3. Rural Radio programs
4. Television
5. Community leaders
6. An agent of the government (Like DAs)
7. Research centers
8. NGOs/project workers/
9. Others (specify)----------

write the numbers of choices

2.36. Why 1st ranked knowledge source is the most important to you?

1. It is easily accessible
2. It is credible/trusted source
3. Provides appropriate and useful information/knowledge
4. Other (specify) ----------

IV. Most Used Communication Tools for Knowledge Sharing in RWM

3.1. Do you think knowledge sharing and learning on rainwater management will lead to better water resource use practices? 1 = YES; 2 = NO

3.2. If YES, explain how sharing knowledge will lead to better water use practices----------

---

3.3. Do you attend/get trainings on water resource management practices? 1 = YES; 2 = NO

3.4. If YES, How frequently do you get the training?

1. Once per month 2. Once in 3 month 3.Once per year
4. Other (specify)----------

3.5. If YES, who conducts the training? (More than one choice is possible)

1. Woreda offices 2. NGOs 3.Research centers 4. Cooperatives
5. Other (specify) ----------

3.6. What are the most frequently (in order of importance) used communication tools/teaching aids by training facilitators?

1. Flip chart
2. Blackboard
3. Posters
4. Demonstration plot
5. Flip charts and demo plots
6. Leaflets
7. Farm visits
8. Booklets
9. Books
10. Radio
11. Visual Media /videos, films/
12. Other (specify) ----------

write the numbers of choices

3.7. Do you think the methods used by the facilitator are suitable for you? 1 = YES; 2 = NO

3.8. If NO, why the methods used are not suitable? (More than one choice is possible)

1. It is not easy to understanding
2. It is easily forgettable
3. We don't have access to the method/material
4. Content/message is not relevant
5. The language used is not suitable
6. Other (specify) ----------

3.9. Do you believe using these communication and knowledge sharing tools has any positive impact on your knowledge and practices of rainwater management? 1=YES; 2= NO

3.10. If YES, what is the most typical impact in your opinion? (More than one choice is allowed)

1. It increases access to relevant knowledge/information
2. It gives the opportunity to get access to other knowledge sources that we don't directly have access.
3. Helps to share knowledge among farmers and with other stakeholders.
4. Other (specify) ----------

3.11. Do you believe using these communication and knowledge sharing tools has any negative impact on your knowledge/practices of rainwater management? 1=YES; 2= NO

3.12. If YES, what is the most typical negative impact in your opinion? (More than one choice is possible)

1. It overwhelms us with too much information
2. We waste time searching for information that is not relevant to us
3. The information/knowledge found is not reliable
4. Other (specify) ----------

3.13. Do you think there are challenges for the spread of knowledge on rainwater management in your area? 1=YES; 2= NO

3.14. If YES, mention some of the challenges.

1.----------

2.----------

3.----------

3.15. If you have no/limited knowledge of rainwater management practices, are you ready to attend training and other knowledge sharing events? 1= YES; 2= NO

3.16. If NO, what prevents you to attend learning and knowledge sharing events?

1. It is not important to me
2. I don't get informed when trainings and knowledge sharing events are undertaken
3. The teaching aids and tools used are not suitable for me
4. I am not convinced of the benefits
5. Other (specify) ----------

V. Best-bet Communication Tools for Knowledge Sharing in RWM

4.1. Which of the following teaching aids/knowledge sharing tools for you is the most Suitable /well understood (in order of importance) to learn and share knowledge on RWM? principles and practices?

1. Flip chart
2. Blackboard

write the numbers of choices

3. Demonstration plot
4. Flip charts and demo plots
5. Posters
6. Leaflets
7. Farm visits
8. Booklets
9. Books
10. Radio
11. Visual Media /videos, films/
12. Other (specify) ----------

4.2. Mention two reasons for your choice 1.----------

2.----------

4.3. Which of the following communication tools is the most suitable for you (in order of importance)?

1. Posters
2. Leaflets
3. Books
4. Radio
5. Newspaper
6. Visual Media /videos, films/
7. Other (specify) ----------

write the numbers of choices

4.4 What is the most important reason for your choice?

1. ----------

4.5. What other important communication and knowledge sharing tools do you use in your community to share knowledge and information? 1----------

2 ---------- 3----------

CHECKLIST FOR FOCUS GROUP DISCUSSIONS (FDGs)

a) Understanding of RWM Principles and Practices

1. What do you think is the meaning of rainwater management?
2. What rainwater management practices do you know?
3. Where did you get the knowledge?
4. What water sources in your locality can be used for agricultural and domestic purpose?
5. How do you make water available in dry season?
6. What do you think is the importance capturing and storing rainwater?
7. What practices/techniques do you use to capture and store water for later use?
8. How do you think improving your cropping strategy affects crops water uptake efficiency?
9. What cropping strategies do you practice to increase crops ware uptake efficiency?
10. How do you think efficient use of water increases your livestock productivity?
11. What strategies do you practice to increase your livestock water productivity?
12. How do you think increasing and diversifying tree cover affects water availability?
13. What tree species do you plant to help you increase water availability? Why these species?
14. How do you think proper water management practices help to mitigate negative environmental consequences (eg. Floods and draught) in your area?
15. Do you think similar rainwater management practices should be applied in all /upland midland, bottomland/?
16. What effect do you think poor water management at upstream will have on down stream users?
17. How do you think collective farmers effort is important than individual effort to improve water resource problems in your area? Any collective effort made in your area?

B). Knowledge Sharing and Communication Tools

18. What do you think is the advantage or disadvantage of working with other water stakeholders/actors in your area /NGOs, Gov. Body, other water users/ to avert water shortage in your area?
19. What are the main actors available in your area that work directly or indirectly on rainwater management?
20. How frequently and with whom do you contact or share knowledge and information?

No	Stakeholders	Always	Sometimes	Rarely	Never
.	Farmers				
.	Woreda Agricultural office/An agent of the government (Like DAs)				
3	NGOs/project workers/				
4	Holleta Research center				
5	Farmers' cooperative members				
6	Input supplier organizations				

Mark √

21. How the intensity of linkage of stakeholders/actors looks like?

No	Stakeholder/Actors Linkages	1.	2	3	4
1	. Farmers				
2	. Woreda Agricultural office /An agent of the government (Like DAs)				
3	NGOs/project workers/				
4	Research centers				

✓ Informal linkage

* Formal linkage

For Very Strong linkage 4 symbols

For Strong linkage 3 symbols

For Weak linkage 2 symbols

For Very weak linkage 1 symbols

22. What is the purpose of linkage with the actors?

No	Stakeholder/Actors Linkages	1.	2	3	4
1	Farmers				
2	Woreda Agricultural office/DAs				
3	NGOs/project workers/				
4	Research centers				

23. What do you say on “knowledge sharing and learning on rainwater management will lead to better water use practices”
24. If you attend trainings on different water resource management practices, who usually conducts the training?
25. What are the most important communication tools/teaching aids that are used frequently by training facilitators?
26. Did you understand well through the method used by the facilitator? If NO, why?
27. What communication tools/approaches do you use as a source of knowledge and information on rainwater management?
28. What Impact do you believe using these communication and knowledge sharing tools has on your practices on rainwater management?
29. Is there any rainwater management practice (for crop or livestock productivity) adopted by you that was recommended by Gov. body (DAs), development actors/NGOs or research institutes?
30. What are the challenges for the spread of knowledge on rainwater management in your area?

31. What things prevent you from attending trainings and knowledge sharing events in rainwater management?
32. How do you asses these knowledge-sharing tools (Radio, newspaper, leaflets, posters, books, visual media)? In terms of the following criteria:

    a). Content/message b). Language used c). Ease of understanding

    d). Ease of use e). Availability of materials

CHECKLIST FOR KEY INFORMANTS

(Local NGOs, MoA, Holleta Research Center)

1. What is your perception on RWM concepts and practices and its importance?
2. What are your sources of Knowledge on the issue?
3. What do you say on your access to source of knowledge?
4. What is your perception on importance of the stakeholder platform?
5. What do you say on the need for common understanding on the issue?
6. What are the challenges for effective knowledge sharing in RWM?
7. How do you evaluate knowledge sharing and communication tools you are using now?
8. What knowledge sharing and communication tools do you think would be suitable to improve knowledge sharing and joint learning on the issue?
9. How do you try to translate the knowledge you get from different sources that farmers do not have access so that it could fit into farmers' level of competence?
10. Is there any good practice/innovation recommended by you in rainwater management that reached and adopted by the farmers in this way?
11. How frequently do you share these knowledge and information with other actors?

Stakeholders	Always	Sometimes	Rarely	Never
Farmers				
Woreda Agricultural office				
NGOs/project workers/				
Holleta Research center				
Farmers' cooperative members				
Input supplier organizations				

Mark √

12. How does the intensity of linkage of stakeholders/actors looks like?

No	Stakeholder/Actors Linkages	1.	2	3	4	5	6
1	. Farmers						
2	Woreda Agricultural office						
3	NGOs/project workers/						
4	Holleta Research Centers						
5	Farmers' cooperatives members						
6	Input supplier organizations						

✓ Informal linkage

* Formal linkage

For Very Strong linkage 4 symbols

For Strong linkage 3 symbols

For Weak linkage 2 symbols

For Very weak linkage 1 symbols

13. What is the purpose of linkage with the actors?

No	Stakeholder/Actors Linkages	1.	2	3	4	5	
1	. Farmers						
2	Woreda Agricultural office						
3	NGOs/project workers/						
4	Holleta Research Center						
5	Farmers' cooperatives members						
6	Input supplier organizations						