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MSc Thesis Communication and Innovation Studies Group

THE IMPACT OF AGRICULTURAL POLICIES ON SMALLHOLDER INNOVATION CAPACITIES

The case of household level irrigation development
in two communities of Kilde Awlaelo woreda, Tigray regional state, Ethiopia



Wageningen, August 2009

MSc Management of Agro-Ecological Knowledge and Social Change

Specialisation: Communication and Innovation Studies

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Thesis code: CIS-80430

ACKNOWLEDGMENTS

I would like to express my appreciation and deepest gratitude to my supervisor, Dr Annemarie van Paassen for her helpful guidance, constructive comments, and encouragement throughout the thesis work.

The author is deeply grateful to the International Livestock Research Institute (ILRI)-IPMS (Improving Productivity and Market Success), IPMS- Ethiopian Farmers' Project, Addis Ababa, for financing all my study and research costs.

I would like to express the deepest appreciation to Dr Abera Deressa, the State Minister, ministry of agriculture and rural development of Ethiopia for his support and encouragement. I would also like to thank Dr Dirk Hoekstra IPMS project coordinator and Dr Berhanu Gebremedhin for their support and encouragement.

I would like to express my gratitude to Ato Abay Woldu, the head of Tigray bureau of agriculture and rural development for his vital encouragement and support. I would like to acknowledge and extend my gratitude to the staffs of the bureau of agriculture and rural development who have provided assistance in numerous ways.

Deepest gratitude is also due to Ato Michael Tsehaye, the head of water resources development bureau for his assistance in the collection of information and sharing his experiences. His contribution to the research fieldwork was vital.

Special thanks also to all the people who spared their time and provided various support during the fieldwork of the research. I would like to mention Fiseha Bezabih, Mulugeta Balema, Haileselassie Wores, Woldegebriel, Habtu, Kinfegebriel, Hailu Berhe, Tsige Asgedom, Tsegu, Amare, Aynalem,, Nigsti, Abraha and Mohammed from BoARD, Gizachew and Solomon from Food Security and Early warning, Tesfay from Helvetas, Kiros and Ghiday from TAMPA, and Mekonnen and Kahsay from REST.

The author would like to express his deepest appreciation to Dr Gebremedhin Woldewahid for his continuous encouragement and support during the study and fieldwork.

I am also grateful to my colleague Ato Tesfay Hagos for his invaluable contribution and encouragement. The author is pleased to thank Birke Enyew from ILRI-IPMS for here great contribution in facilitating my study.

My special and sincere thanks are to all farmers, extension workers, and taibia administrators in Abraha Atsbaha and Mahbere Weyni for their kind cooperation, in sharing their invaluable experiences and feedbacks. I would also like to thank the staffs of agriculture and rural development in Kilde Awlaelo for their contribution during the fieldwork.

Finally I would like to express my love and gratitude to my wife Gezu Ambaye for her understanding and continuous encouragement, special thanks are for our children: Biruk, Frtuna and Senay for their love and patience.

Berhane Hailu

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Abbreviations

BoANR	Bureau of agriculture and natural resources
BoARD	Bureau of agriculture and rural development
BoFED	Bureau of finance and economic development
BoWRD	Bureau of water resources development
CIDA	Canadian International Development Agency
CoSAERT	Commission of Sustainable Agriculture and Environmental Rehabilitation of Tigray
CSA	Central Statistics Authority
CTA	Technical Centre for Agricultural and Rural Cooperation ACP-EU
DFID	Department for International Development
ECA	Economic Commission for Africa
ESRDF	Ethiopian Social Rehabilitation and Development Fund
FAO	Food and Agriculture Organisation
FDRE	Federal Democratic Republic of Ethiopia
GTZ	German society for technical cooperation
IFAD	International Fund for Agricultural Development
	The Institutional Learning and Change (ILAC)
IFPRI	International Food Policy Research Institute
ILAC	The Institutional Learning and Change
IWMI	International Water management Institute
ISNAR/ IFPRI	International Service for National Agricultural Research/ International Food Policy Research Institute
KIT	Royal Tropical Institute
MDG	Millennium Development Goals
MoA	Ministry of Agriculture
MoARD	Ministry of Agriculture and rural Development
MoFED	Ministry of Finance and Economic Development
OECD	Organisation or Economic Co-Operation and Development
TRG	Tigray Regional Government
UNU-MERIT	United Nations University – Maastricht
UNU- INTECH	United Nations University-Institute for New Technologies
WFP	World food Program

ABSTRACT

Agricultural production in Ethiopia is characterised by subsistence orientation, low productivity, low level of technology and inputs, lack of infrastructures and market institutions, and extremely vulnerable to rainfall variability. It has a rapidly increasing population currently close to 74 million and yet about 39 percent of the population lives on absolute poverty of less than a \$1 a day poverty line while close to 80 percent falls below US \$2 a day poverty line. The government of Ethiopia has formulated policies and strategies to guide over all development with focus to rural and agricultural development. The agricultural strategy emphasizes commercializing subsistence agriculture through capacity building of various actors, development and adoption of high yielding technologies, diversification of high value commodities, and sustainable use of natural resources. Irrigation development is one of the major pillars of the rural development strategy. In more recent years, the priority of irrigation development has shifted from large-scale approaches to small-scale and household level interventions. This research was conducted in two communities of Kiltie Awalelo district, in Tigray regional state where household level irrigation intervention has been introduced at a massive-scale aiming at achieving food security and poverty alleviation among the rural poor. The research has investigated the impact of agricultural policies on innovation capacities of smallholders in the case of household level irrigation. Data was collected using qualitative methods which incorporated semi-structured interviews, focus group discussions and opinions of key informants. The main findings of the research indicate that irrigation promotion has expanded in terms of area and number of beneficiaries after a change in strategy from large-scale to household level. However, the policy is dominated by top-down approaches reflected in highly centralised planning and blanket intervention processes. These approaches have highly affected the innovation capacity of smallholders which led to the failures of the household level irrigation interventions. The study findings indicate that attitudinal problems are the major factors for the top-down policy practices. Investigations on community responses to top-down policy interventions have shown that while majority community areas attempt to implement policy strategies without making significant adaptations, few communities respond in a creative way and attempt to develop local level innovations to address their demands. According to the research findings, the key factor for such differences is attributed to the competences and commitments of local level leadership. However, it was found that local level innovations are negatively affected by the top-down macro-policy hence innovation enabling environment both at local and macro-level is key to the success of innovation capacity.

The research suggests the need to introduce new way of policy intervention that takes into consideration the contemporary context for agriculture and innovation thinking approach.

CHAPTER ONE: INTRODUCTION

This chapter presents the socio-economic context of Ethiopia. It explores the major factors influencing agricultural production and food insecurity, and highlights current policy initiatives. Finally, it explains the problem statement and provides the overall objective of the research.

1.1. Background

Ethiopia is one of the largest countries in Africa both in terms of population and land area with diverse demographic, socio-cultural and agro-ecological features. It has more than 70 ethnic groups with over 73.9 million population (CSA, 2008) and about 1.12 million square kilometres of land area (MoARD, 2008).

Ethiopia's economy is predominantly agrarian where agriculture plays a key role in the social and economic development. The sector employs more than 83% of the population, accounts for 46.3 % of the national gross domestic product (GDP) and is the source of over 90 % of the export revenues (MoFED, 2006). Smallholder agriculture is the dominant sub-sector accounting for 95% of the total cultivated land and production (CSA, 2008).

Agricultural production is characterised by subsistence orientation, low productivity, low level of technology and inputs, lack of infrastructures and market institutions, and extremely vulnerable to rainfall variability. The economy of Ethiopia is based largely on low productive rain-fed agriculture where production heavily depends on rain for its success or failure. According to recent reports by MoARD (2008), crop land under irrigation is only 5 percent of the total cultivated area in the country. The greatest challenge in the country has been the prevalence of deep rooted and multi-dimensional poverty and food insecurity. Because of its structurally food deficit for many decades, Ethiopia has been persistently exposed to food aid dependency to feed millions of its people.

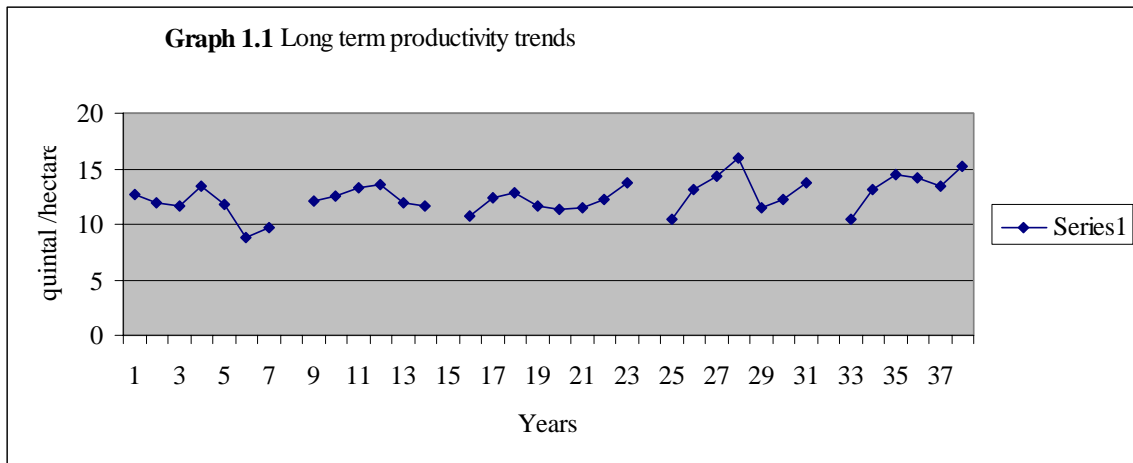
1.2 Poverty and food insecurity

With gross national income per capita a mere US\$ 160 per year, Ethiopia's average income is much less than \$1 per person per day, placing it 202nd out of 208 countries (World Bank 2006). It has a rapidly increasing population currently close to 74 million and yet about 39 percent of the population lives on absolute poverty of less than a \$1 a day poverty line (MoFED, 2006) while close to 80 percent falls below US \$2 a day poverty line (World Bank, 2005). Incidence of

extreme poverty is higher in rural areas (39.3 percent) compared to urban areas (35.1 percent) (MoFED, 2006).

In recent years, Ethiopia's economy has registered encouraging progress. Economic assessment reports by government (MoFED, 2006) indicate that the country has experienced promising economic growth in the past few years. Despite such improvements however, empirical evidences show that poverty decline is marginal. World Bank assessment on national poverty trend of the country for the past fifteen years between 1990 and 2004 indicates a slow pace of poverty reduction with only a decline from 38.4 percent to 36.2 percent of the population (WB, 2005).

Likewise long-term agricultural productivity trends compiled from CSA show that during 1972 to 2009, average crop yield has continued almost stagnant for most years (graph 1.1).



Source: compiled from CSA (2007, 2009)

Despite its many riches such as vast agricultural land, huge water resources and a big number of working force, several studies have documented that the country has been food deficit with worsening trends since at least the 1970s even in years of good harvest suggesting the prevalence of deep-rooted poverty.

According to the ministry of agriculture and rural development report (2006), there are 8.3 million people chronic and 6.7 million people transitory food insecure in the country.

An increasing trend of food insecurity has forced the country to depend on food aid to meet the food needs of its vulnerable people. Dangaro (2001 cited in EC CSP, 2007) states Ethiopia has received between 600,000 and 800,000 MT of food aid yearly for fifteen years. Despite

considerable food aid assistance, however, there is an increasing proportion of the population which face food insecurity which implies food aid can not address the problems of chronic food insecurity on a sustainable basis. Transitory food insecurity is triggered largely by droughts that result in crop failures. Several studies (FDRE, 2001; MoARD, 2006; Fitsum et al, 2006) have documented drought in Ethiopia has become recurrent in recent years.

1.2. Agriculture and irrigation policies

Since the change of military regime in 1991, the government of Ethiopia has formulated policies and strategies to guide over all development with focus on rural and agricultural development. The fundamental development objectives are to build a free-market economic system in the country, which will enable it develop rapidly, extricate itself from dependence on food aid and poor people to be the main beneficiaries from economic growth (MoFED, 2002).

The agricultural strategy focuses on commercializing subsistence agriculture through capacity building of various actors, development and adoption of high yielding technologies, diversification of high value commodities, establishment of marketing system, development of irrigation and water harvesting technologies, and sustainable use of natural resources (Deressa, 2008). Irrigation development is one of the major pillars of the rural development strategy. In more recent years, the strategy of irrigation has shifted from large-scale approaches to small-scale and household level intervention. Following the new policy, most regional states including the study area, Tigray, have introduced household level irrigation schemes at massive scale aiming to achieve food security. For instance a report by the ministry of agriculture and rural development (MoARD, 2007) indicates that in 2007 alone about 952,000 households have built small water harvesting ponds to promote irrigation at farmer level.

Nevertheless, such intensive interventions lack comprehensive studies that can help improve the effectiveness of policy approaches in achieving food security and poverty reduction.

Agriculture in Ethiopia is confronted with several social and environmental issues. Much of the rural population lives in a state of chronic food security. Recurrent drought, degradation of natural resources and rapid population growth are among the main causes of poverty and food insecurity. To reverse these trends, agriculture can play a central role much better than other sectors in the Ethiopian context in which more than 80 percent of the population is rural. For agriculture to play its role, literature on agricultural transformation emphasize the need for innovative and responsive agricultural policies. Thus this research is interested to study how the innovation system thinking can positively contribute to poverty alleviation and food security in the study area.

1.4. Problem statement and overall objective of the research

The study area is Tigray regional state, one of the most drought prone regions in the country. Since 2002, the regional government of Tigray is implementing an integrated agricultural development program which aims at achieving food security in 80 percent of the rural poor. Irrigation development primarily the household level strategy is among the top priorities of the food security program. Since 2003, a massive-scale plan of household level irrigation was adopted aiming to promote irrigation in 0.5 million food insecure households. In this program, diverse actors of government organizations, international and indigenous NGOs, micro-finance institutions, the private sector and farmers are involved at different levels with different tasks. Nevertheless, reports have indicated (BoARD, 2006) such interventions are encountering various social and technical problems that have challenged the strategy and implementation approaches.

The impact irrigation intervention in achieving food security and poverty alleviation will depend to what extent the policy approach is able to deal with collective issues and dimensions of interaction, organization and management between diverse actors with various interests involved in the processes. Its effectiveness much depends on how far it is able to provide complex solutions which are appropriate to local agro-ecological and social conditions. The outcome depends how much the intervention process is flexible to adapt to emerging and unpredictable changes in the course of implementation.

Household level irrigation policy is a new and only recently introduced and lacks in-depth studies in policy approaches. The intervention is not well supported by comprehensive research which is able to rigorously examine the assumptions, approaches and implementation processes in the context of socio-economic, political, and cultural dimensions of the study area.

The overall objective of this research is therefore to understand to what extent the current household level irrigation policy encourages or prevents innovation development in the system of agriculture in general and in smallholders in particular. The research findings will help understand in re-thinking and improving existing policy implementation approaches in the context of creating enabling environment for innovation in the study area. The specific research objectives are formulated as follows:

- understand agricultural policy impacts on smallholder innovation capacity ,
- identify policy components that enhance or impede smallholder innovation capacities,

- Explore complementary policy opportunities that enhance smallholder innovation capacity,

1.5. Thesis structure

This thesis has seven chapters. In chapter one, an overview of country socio-economic context that assesses the agriculture and food security situation is presented. In this chapter problem statement and the overall objective of the research and the thesis structure is discussed. Chapter two discusses the theoretical and conceptual framework that guided the research. It explains innovation development perspectives in the linear model, participatory approaches and the innovation systems. In addition, this chapter explains the model developed for the research study. Chapter three describes the research methodology. Chapter four presents the study findings on large-scale irrigation approach. In addition, this chapter describes in detail the socio-economic context of the area under study. Chapter five discusses major research findings for a creative community response. In chapter six, research findings for the second community is discussed. Chapter seven presents conclusions and theoretical reflections with tentative recommendations of the research.

CHAPTER TWO: THEORETICAL FRAMEWORK

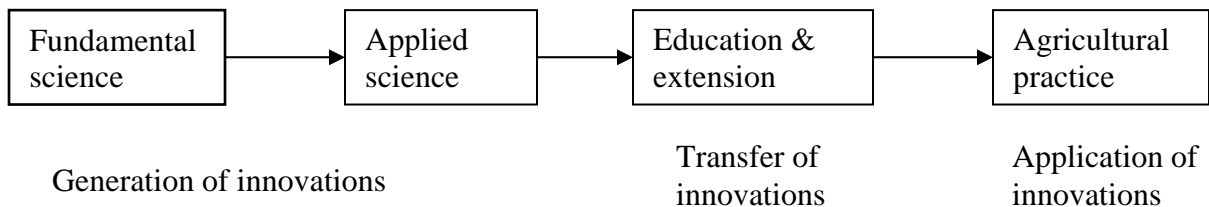
This chapter presents the theoretical framework regarding the research subject with a detail explanation of major perspectives in the area of innovation development. First, it explores the linear model thinking in innovation. Next, it refers to participatory approaches and examines the strengths and shortcomings in relation to innovation development. Further, this chapter presents system-based innovation perspectives, by focusing on the concepts of the agricultural knowledge and innovation systems (AKIS) and the agricultural innovation systems (AIS). The last part explains the conceptual framework designed for the study and the research question.

2.1. The linear and ‘top-down’ model of innovation perspective

2.1.1. Transfer of Technology

According to Leeuwis (2004), the linear model assumes a one-way and uninterrupted flow of technologies from fundamental scientists, to ultimate users via various intermediaries and delivery mechanisms (figure 2.1).

Figure 2.1 The linear model of innovation



Source: Leeuwis (2004)

Technology is information that is put into use to accomplish some task (Eveland, 1987 cited in Rogers 2002); it is essentially information, knowledge about the physical world and how to manipulate it for human purposes (Rogers, 2002). According to Rogers (2002) Technology Transfer is the application of information into use. Transfer is essentially the communication of information (technology), a communication process through which the results of scientific research are put into use.

Agricultural extension is the defining metaphor for all technology transfer activities and models (Eveland, 1987 cited in Rogers, 2002). This is because the agricultural extension model was so successful, at least by reputation, in achieving its original objectives of increasing agricultural production in the United States (Rogers, 2002). Rogers argues the essential factors in the relative

success of agricultural extension as a technology transfer system are two interrelated levels of extension specialists who link agricultural researchers with county extension agents, who then communicate with farmers; adequate funding for technology transfer and a research system oriented to finding solutions to farmers' problems (Rogers, 2002).

Biggs (1990) defines the technology transfer model the 'central source' model, in which the state supported research is the source of knowledge generation, innovation or new technology. Biggs further states that this 'central source' model led to hierarchical systems of research and extension, where communication and information flow was linear and unidirectional, from the researchers (the centre) to farmers (the periphery) via extension.

2.1.2 Shortcomings of the model and its policy implications

Large number of research evidences indicate, that this model has strongly influenced and laid the basis for agricultural research and extension policies in developing countries. Arnold and Bell (2001 cited in World Bank, 2006) explained that the linear model of innovation mirrored the belief that "basic science leads to applied science, which causes innovation and wealth". The policy implications of this "science push" model was simple: "if you want more economic development, you fund more science".

Roling (2006) states that, the training and visit (T &V) system tried to incorporate this model all over Africa. Despite the funding and promotion by the World Bank, the T & V model has been found to be ineffective, inefficient and unsustainable (Asiabaka and Mwangi 2001, Anandajayasekeram et al., 2001 cited in Asiabaka ,2001). Extension services have been criticized for excluding poor people and being supply-driven highly centralized, and non-participatory (dominated by a single channel of knowledge transfer) (Asenso-okyere et al., 2008).

Throughout Africa, Roling (2006) asserts, most policy-makers, ministry officials, research administrators, economists, and researchers cannot imagine any other theory of innovation than the linear model and continue to adhere to it, even after years of failure in situations where it does not apply. Roling argues that the production of agricultural technologies by research, even if they 'work' in the experiment station, is absolutely no guarantee for diffusion.

Sumberg (2004) similarly argues agricultural research in Africa had generally yielded few benefits for poor people because it was elitist and out-of-touch with rural realities; focused on better endowed areas as opposed to the marginal areas (where poor people were assumed to live); discipline or commodity as opposed to system- or livelihood-oriented; too often interested only in

productivity to the detriment of sustainability; “reductionist” as opposed to “holistic”; and top-down or supply driven, not participatory or demand-driven.

Yaker commenting on inappropriate planning and policies in Africa pointed out that planning and policy practices have often a negative impact on various aspects of sustainable food production (Yaker, 1993 cited in Asiabaka, 2001). According to him, development agenda have invariably ignored the need for grass root and people participation, are ‘top-down’ and often tailor-made from a developed economy that has a different economic, social and political landscape from the African setting which is characterized by poor economy and rain-fed agriculture.

Several studies on agricultural extension services have shown that this approach has excluded the poor, was supply driven, highly centralized and non-participatory.

Cabral and Scoones (2004) state policy research on African agriculture has focused on ‘policy fixes’, based often on idealised models of the ways things should be, rather than the way they are, or are likely to be. Researchers, consultants, donor agencies and decision-makers at government offices therefore concentrate on devising solutions for problems and overlook the complexities of the process of translating such elaborate, technical policy prescriptions into practice.

According to Leeuwis (2004), the role of communication in the top-down approach was looked at an ‘instrumental’ way, characterised by two important and interrelated features. First, instrumental forms of communicative intervention take place *after* the goals and corresponding policies and /or innovations have been defined by outside agencies. The prime idea is to persuade as many people as possible to *accept* a given policy or to *adopt* a given innovation. A second feature is that communication is used deliberately as a policy instrument (in conjunction with other instruments) in order to steer and direct human behaviour, which is thought of as being largely predictable.

The linear policy approach has been subject to extensive criticisms by various scholars for its blanket recommendations which are badly adapted to diverse problems and its failure to adapt with the fundamental changes of the agricultural development context. As Israel states, key areas of rural development policy, such as agriculture and natural resource management are inherently of low specificity, as the exact outputs demanded of staff and the steps for achieving them are hard to precisely define, making monitoring of performance correspondingly highly complex (Israel, 1989 cited in Keeley and Scoones, 2003). Portela has similarly elaborated that

the model is too uniform, not taking into due account the socio-cultural environment, the particular circumstances in which project implementation occurs, and the characteristics of the different clientele groups, for instance, planning the improvement of village irrigation schemes without taking into consideration the specific local needs, water rights, and rules of water allocation and distribution (Portela,1990 cited in FAO 1997) ; or planning for the dissemination of a given technology package without an adequate understanding of the farming systems and the diversity of farmer's problems, potentials, rationales, and strategies (FAO, 1997).

Thompson et al. (2007) point out that agricultural and resource management problems typically tend to be classic 'systems' problems, where aspects of systems behaviour are both complex and unpredictable and where causes, while at times apparently simple, when finally understood are always multiple. These problems are often non-linear in nature, cross-scale in time and space and dynamics in character.

Describing the reasons why current environment for agriculture is so dynamic. Hall et al (2005) state that agriculture is becoming increasingly interconnected with regional and domestic markets and competitive pressures are rising; rapid social change is occurring, including urbanization and changing food preferences and systems; intensification of agriculture is associated with rising pest and disease problems; and environmental degradation is on the increase.

Since the conventional agricultural development approaches such as the diffusion of innovation model are not responsive to the changing context, scholars have developed alternative agricultural development pathways (Hall et al, 2005). Hall (2007) recommends an alternative approach of agricultural development based on broad range of goals and interest groups ('multifunctionality'), with collective intelligence by involving collaboration of different knowledge sources, connected to the global market settings ('interconnectedness of scale') in an increasing rate and 'non-linearity of change'.

2.2. Participatory approaches

2.2.1. Definition of participation

Participation is a process through which stakeholders influence and share control over development initiatives and the decision and resources which affect them (World Bank website in 2001 cited in Leeuwis, 2004). Leeuwis (2004:249) elaborates key characteristics of participation including the following points:

- All relevant stakeholders should be involved in the participatory process;

- Participants must have equal opportunities to speak out;
- 'ownership' needs to rest with participants as much as possible;
- Participation must lead to the 'empowerment' of participants;
- It is illegitimate to intervene in a "top-down" mode during participatory processes;
- The role of interventionists is mainly to facilitate critical learning and dialogue;

2.2.2 Farmers' participatory approaches

Farmers' participatory research and development alternatives emerged in response to failures of many linear approaches to achieve desired development goals. Goulet (2008) states the concept of "Participation" applied to development work, arose in the 1970's, based on the fundamental recognition that poor and disempowered people, and marginalized communities, abound with knowledge, creativity and capacities that are not recognized or valued by dominant research and development practices.

Since the 1980s, considerable changes have taken place in thinking about development interventions. Many donors, host governments and development organisations embraced the concepts and the related methods of participatory approaches. In an attempt to move away from an era of more directive and top-down interventions, the project proposals in the 1990s were dominated by concepts such as participation, decentralisation, Participatory Rural Appraisal (PRA), empowerment, community-based development. In other words, the language of policy makers and practitioners in the field of development changed considerably (Pijnenburg, 2004).

According to Scoones and Thompson (1994), Farmer *First* book published in 1989, was the more widely accepted philosophy of farmers' participatory approaches. The *Farmer First* book argues that the approaches and methods of transfer of technology which have served industrial and green revolution agriculture do not fit the resource-poor farming of the third, complex, diverse and risk-prone agriculture. It contrasts the more traditional, technology-driven, with its standardizing package of practices, with the complementary farmer-first approach or paradigm, which generates baskets of choices to enable farmers to vary, complicate and diversify their farming systems (Scoones and Thompson, 1994). The core aim of participatory alternatives as explained by Thompson et al. (2007) was to put farmers at the center of the innovation process, working in collaboration with scientists to design new technologies and adapt existing ones to local

circumstances. Advocates argued for recognition of the value of local knowledge moving away from the image of farmers as passive recipients of externally derived technology, to involve them as active, creative partners in technology development processes (Chambers, et al., 1989 cited in Thompson et al., 2007).

The views and scope of applications of participatory approaches in research and development have significantly changed during the past decades. Landerchi (2001:3) states “the 1990’s saw participation being advocated on larger scale, being moved beyond the boundaries of project or grassroots interventions to other spheres of social, economic and political life”. Today, a wide range of participatory approaches have been developed including Farmer-Action Research, Participatory Technology Development, Participatory Action research, Participatory Rural Appraisal, Gender Analysis, Stakeholder Analysis, Community Based natural Resource Management and the Sustainable Livelihood Approach (Thompson et al., 2007).

Various authors point out that the application of participatory approaches in research and developments have helped to develop radical rethinking in development strategies. Scoones and Thompson (1994) describe that there have been significant advances in the development of “farmer-friendly” approaches to understanding the complexity of agricultural and livelihood systems. They also state “the bureaucratic organizational structures and rigid operational procedures found in most conventional agricultural research, extension and teaching institutions have been confronted” (1994, p.1).

Hall, et al (2008) argue that farming systems and participatory research paradigms were important institutional innovations and helped build up further knowledge on the relative merits of alternative ways of organising the innovation process. These models, in many senses, laid the foundations for the innovation systems paradigm. They legitimised the role of technology users in the innovation process; they recognised that innovation draws information from multiple sources; they championed the idea of participation; and they saw how action research could be used to explore development phenomena that are complex and evolutionary in nature.

Today, governmental and non-governmental organizations in developing countries are widely advocating to involve rural populations particularly the poor in various economic and political interventions. For instance a recent report by the World Bank (2006:33) concludes: “eradicating extreme poverty demands learning from the poorest themselves about what poverty is and

building up with them a more comprehensive knowledge of how things happen and what needs to be done”

2.2.3. Critiques to participatory approaches

There are critiques that participatory approaches have failed addressing the key challenges in research and development. Along this line, Roncoli (2006) argues that in the context of highly constrained timeframes participatory rural appraisal reduced to the deployment of a ‘battery of techniques’ by teams of hurried consultants. Consequently, the potential for ethnographic insight and local empowerment is lost, as the research remains drive by an external agenda.

Pijenburg (2004) comments how participatory development approach views local community. He states that not enough attention has been paid to local diversity, to different groups within the community that may have different interests. These differences may not always be visible on the surface. Mosse and Goebel observed that the public nature of PRA for example may have obscured local complexities and validated dominant views (Mosse, 1994; Goebel, 1998 cited in Pijenburg, 2004). In this way, the intervention may empower the already more powerful in the community (White, 1996; Mohan & Stokke, 2000 cited in Pijenburg, 2004). Further more Mohan and Stokke argue that the move towards approaches in participatory development practice results in focusing heavily on the “local”. This tends to underplay broader economic and political structures (Mohan and Stokke, 2000 cited in Pijenburg, 2004).

Thompson et al (2007) concerned with the limitations of participatory approaches suggest that the manner in which local challenges can be addressed by and with rural poor should take into account not only indigenous knowledge and practices, but also the dynamics and governance issues at higher scales, including the national, the regional and the global (Thompson et al., 2007).

Long (2004:36) argues that participatory approaches do not empower local people; rather they exacerbate cultural differences and conflicts. He states:

Intervention processes are embedded in, and generate, social processes that imply aspects of power, authority and legitimating; and they are more likely to reflect and exacerbate cultural differences and conflict between social groups than they are to lead to the establishment of common perceptions and shared values. And, if this is the normal state of affairs, then it becomes unreal and foolhardy to

imagine that facilitators can gently nudge or induce people and organisations towards more 'participatory' and equitable modes of integration and co-ordination. This is the paradox of neo-populist discourses and participatory methods aimed at empowering local people.

2.3. Systems-based perspectives of innovation

Under this perspective, the study has focussed on two more recent and widely practised approaches: the agricultural knowledge and innovation system and the agricultural innovation systems.

2.3.1. Agricultural Knowledge and Innovation Systems (AKIS) approach

According to FAO (2000), an Agricultural Knowledge and Information System approach assumes important to link people and institutions to promote mutual learning and generate, share and utilize agriculture-related technology, knowledge and information. The AKIS aims to integrate farmers, agricultural educators, researchers and extensionists to harness knowledge and information from various sources for better farming and improved livelihoods. Röling (2007) states AKIS is a network of actors in a theatre of innovation. These actors potentially can make complementary contributions towards innovation. The network is based on shared perceptions with respect to the issues at stake.

The articulation of AKIS in the late 1980s broadened the range of actors to include agricultural education organisations who were seen as playing a role in rural innovation. Moreover, the development of AKIS was a turning point for the extension field, situating traditional extension practice into a wider system. It was a normative model, presenting what an ideal agricultural knowledge system should look like (Hirvone, 2008).

The purpose of AKIS is to facilitate continuous innovation in agriculture related practices. It has a strong focus on how information and ideas are communicated between the various actors in rural areas and how this knowledge can be harnessed for rural livelihoods; recognizes learning and innovation in an interactive process (Assefa, et al., 2006).

Critiques to the AKIS approach point out its insufficient focus on concrete technological solutions and its incapacity to deal with agents on a broader sectoral, program, or commodity scale (Hartwich, 2007). The World Bank (2006) similarly argues that the focus of AKIS is restricted to actors and processes in the rural environment and the framework pays limited attention to the

role of markets (especially input and output markets), the private sector, and the enabling policy environment.

Household level irrigation, the focus of this study, requires strong linkages with the private sector for market access and knowledge flows and an enabling policy environment to continuously respond to rapidly changing development contexts. Considering the arguments indicated above, the AKIS concept can not offer a holistic understanding to the objective of this study that aims to gain insights into the activities of a wider set of actors and an enabling environment in the irrigation sector.

2.3.2. Agricultural Innovation Systems (AIS)

Understanding the concept of innovation

There is a shift in thinking about the design of interventions for rural poverty reduction. From a fairly narrow project-based thinking there is more and more attention for an innovation system perspective (KIT, 2009). This approach is reinforced by Hall et al (2005) who state ‘innovation is essential if farmers and businesses are to survive and compete successfully in the rapidly evolving environment associated with the contemporary agricultural sector’ (p.1).

Innovations are new ideas, practices, or products that are successfully introduced into economic or social processes (Asenso-okyere, et al., 2008). According to Hall et al (2005), innovation is neither research nor science and technology, but rather the application of knowledge (of all types) to achieve desired social and/or economic outcomes. This knowledge may be acquired through learning, research or experience, but it cannot be considered as an innovation until it is applied. As opposed to the focus on novelty that is central to the concept of invention, innovation is the process by which organisation “master and implement” the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country or the world (Mytelka, 2000)

An innovation is not just trying something new but successfully integrating a new idea or product within a process that includes technical, economic and social components (Spielman, 2006). According to him, this definition stresses three important features. First, innovation is the creative use of different types of knowledge in response to social or economic needs and opportunities. Second, a trial becomes an innovation only when it is adopted as part of a process; many agents try new things but few of these trials yield practices or products that improve what is already in use. Third, innovations are accepted as such in specific social and economic environments.

Innovations may be brand new, but they are more often new combinations of existing knowledge and this may involve both product and process innovations (Hall, 2006). Product innovations may be goods or services. It is a matter of *what* is being produced. Process innovations may be technological or organisational. It concerns *how* goods and services are produced (Edquist, 2001). According to him, product innovations ('material kind') are the main mechanism behind changes in the production structure. Further more, he emphasizes that it is crucial to take into account also organizational process innovations and services ('intangible'), since they are important to economic growth and employment (Edquist, 2001).

Leeuwis (2004) emphasizes that innovations have multi-dimensional character and we can only speak of a complete innovation if an appropriate mix and balance exists between technical devices and social-organizational arrangements. He defines innovation as a package of new social and technical arrangements and practices that implies new forms of co-ordination within a network of interrelated actors. Leeuwis further stresses that for an innovation to be successful, the process needs to include deliberate efforts to create effective linkages between technological arrangements, people and social-organisational arrangements.

Innovation is a result of interaction among different actors making complementary contributions (Röling, 1996), a creative and interactive process where various forms of knowledge and technology are shared and put into productive use.

The understanding of innovation in the AIS perspective is a fundament shift of rethinking from the linear approach. Innovation is now understood as an interactive process between many organizations and their activities. It uses to all types of knowledge including scientific/technical and indigenous. A certain innovation is said to be successful when it is applied into productive use.

What drives innovation?

Understanding what drives to most innovations and its process of dissemination is fundamental to policy interventions. In the linear model approach, research is considered as the main source of innovation. Kline and Rosenberg (1986) state the model assumes a well-defined set of stages, that innovations are assumed to go through. Research (science) comes first, and then development and finally production and marketing. Since research comes first it is easy to think as this is the critical element. They argue that, although some important innovations stem from scientific breakthroughs, this is not true most of the time. von Hippel and Lundvall revealed that

“in most settings, the experience of users, not science is deemed to be the most important source of innovation” (von Hippel, 1988; Lundvall, 1988, cited in Fagerberg, 2006, p.9). Hall similarly argues that, ‘usually’ sectors emerge because entrepreneurs identify new market opportunities and innovate to gain market access and “occasionally”, research interventions promote innovation when organized in ways that promote interaction (Hall, 2009).

For innovation to take place there must be continuous learning and the opportunities to learn depend on the degree and type of interactions between and among the different enterprises, organizations and related sectors, as well as institutional behaviours, which determine the extent and rate at which information and knowledge are produced, transferred and utilized (CTA/UNU-INTECH/KIT, 2005).

Agricultural Innovation System framework (AIS)

The AIS emerged as a response to the limited explanatory power of conventional economic models that view innovation as a linear process driven by the supply of research and development (R&D) (Hall et al., 2006) The systems of innovation approach is considered by many to be a useful analytical approach for better understanding innovation processes as well as the production and distribution of knowledge in the economy. It is an appropriate framework for the empirical study of innovations in their contexts and is relevant for policy makers (Edquist, 1997).

Sumberg (2004) points out systems including innovation systems are made up of components (“the operating parts of the system”), relationships (“the links between the components”), and the attributes (“the properties of the components and the relationships between them”).

The concept of innovation system consists of the agents involved in the innovation process, their actions and interactions, and the formal and informal rules that regulate their practices and behaviours (Lundvall 1985, et al. cited in Devis, et al., 2007). Edquist (1997) defines innovation systems as all important economic, social, political, organizational, and other factors that influence the development, diffusion, and use of innovations.

According to Hall, et al (2006:12), innovation system is “the networks of organizations or actors, together with the institutions and policies that affect their innovative behaviour and performance, bring new products, new processes and new forms of organization into economic use”. They state, as an evolutionary model, the focus is on interaction between actors and their embeddedness in an institutional and policy context that influences their innovative behaviour and

performance”. Hall (2006) describes the innovation system as a system of all actors involved in the production, diffusion, adoption and use of knowledge; shaped by the habits, routines and practices (institutions) of actors and particularly the way these habits relate to knowledge sharing and acquisition and to learning. The innovation systems concept embraces not only the science suppliers but the totality and interaction of actors involved in innovation. In other words, the concept extends beyond the creation of knowledge to encompass the factors affecting demand for and use of knowledge in novel and useful ways (World Bank, 2006).

The innovation system framework distinguishes institutions from organizations. Edquist and Johnson (1997) define organizations as formal structures with an explicit purpose and consciously created such as companies, universities, government and non-government bodies while institutions are sets of common habits, routines, established practices, rules, or laws that regulate the relations and interactions between individuals, groups and organisations. They state institutions are the crucial elements in the innovation processes because they shape the actions of the organizations and the relations between them.

According to Fagerberg, et al., (2006), a central finding in innovation research is that firms seldom innovate in isolation. Interaction with customers, suppliers, competitors, and other various private and public organizations is very important and a “system perspective” is useful in understanding and analysing such interactions.

Agricultural innovation system framework is being applied in rural development for analysing innovation performance of the sector. A number of authors and organizations (e.g. Spielman et al., 2006; Hall, et al., 2007; World Bank, 2006; IFPRI, 2007) have applied the innovation system framework in several case studies in the agriculture sector of developing countries. Research evidences indicate that the innovation system framework can operate at different levels and scales, from country level innovation system to sub-national systems of innovation, commodity specific innovation system and local innovation systems (World Bank, 2006; Hall, et al., 2007; KIT, 2009). However, it is suggested that agricultural innovation system needs expand more to address rural innovation, poverty alleviation, natural resource management and economic growth (World Bank, 2008).

Defining innovation capacity

Several authors (e.g. Spielman et al., 2005; Hall et al., 2008) stress that, to identify and use existing information to create something new requires new forms of innovation capacity of the

individuals and organizations involved in the process. The ability of actors to innovate is a central component of the innovation system concept that enables to cope with unpredictable challenges and opportunities of contemporary agriculture. According to Hall et al (2007), the innovation system perspective conceptualises capacity in terms of the different actors, skills and resources that are needed to allow innovation to take place on a continuous basis. They indicate innovation capacity is developing a set of skills, interactions and links that enable producing, accessing, translating, and most importantly putting into use knowledge in socio-economically useful ways. The concept stresses that institutional settings including the policy environment are a critical part of this capacity and that capacity development is often an issue of institutional and policy change. There are a number of factors that influence innovation capacities of actors. Hall (2009) suggests, innovation capacity development need to focus on a set of interventions that include strengthening scientific and other skills and information in research, enterprises, training and developmental organizations, supportive practices and routines, patterns of interaction within an economy and enabling policy environment.

Agricultural innovation systems and developing country agriculture

Spielman (2005) notes that there is an acute need to apply AIS in developing country agriculture because international and national agricultural research systems face significant institutional and organizational challenges that have resulted in insufficient funding, difficulties in training and maintaining good scientists, obstacles to accessing new scientific knowledge and technology.

In spite of this, Mytelka & Oyeyinka (2003) state that the innovation system in developing countries is poorly developed and known to be subject to widespread systemic dis-articulation. They identify five broad types of systemic weaknesses, namely:

- (a) Rigidities in Organizations - reflected in the presence of obsolete or inappropriate institutions;
- (b) Sub-optimal Knowledge Networks-there may be no interaction, little interaction or inappropriate types of interaction among critical actors. The resulting information asymmetry among others, may lead to poor flows of information and knowledge among critical economic agents within the system of innovation.
- c) Path-dependent System Failure-organizational inefficiency may thus stem from their history and their connectedness to previous environments.
- (d) Organizational ineffectiveness –the relevance of existing research and training institutes, for example, has been questioned;
- (e) Institutional Gaps- in developing countries, the systemic weakness found in the innovation system is, in part, a result of the fundamental weakness of political-policy institutions and processes.

Strengths of agricultural innovation system approach

The innovation systems concept recognizes a broader range of actors and disciplines/sectors involved in innovation, particularly the private sector in its many guises along the value chain. Innovation systems analysis recognizes that creating an enabling environment to support the use of knowledge is as important as making that knowledge available through research and dissemination mechanisms. In the same way, an innovation system encompasses a wider set of activities that are likely to support innovation by including such processes as the creative adaptation and financing of innovation. Like AKIS, the innovation systems concept places greater emphasis on the interaction between actors, but the innovation systems encompasses a wider set of relationships that can potentially foster innovation (World Bank, 2006).

The innovation systems approach broadens the AKIS perspectives by focusing on (a) the processes by which diverse agents engage in generating, disseminating, and utilizing knowledge; (b) the organizational and individual competencies of such agents; (c) the nature and character of their interactions; and (d) the market and non market institutions and infrastructures that affect the innovation processes.

The approach focuses on interactions, knowledge-sharing, and continuous learning. It addresses novel issues, such as the capacity of individuals and organizations to learn, change, and innovate; the nature of iterative and interactive learning processes among innovation agents; and the types of interventions that enhance such capacities and processes (IFPRI, 2008). As Spielman (2005) argues, the innovation system approach can help policymakers, researchers, research managers, donors, entrepreneurs, and others identify and analyze new ways of encouraging innovation. It does so by offering greater insight into the complex relationships between diverse actors, processes of institutional learning and change, market and non-market institutions, public policy, poverty reduction, and socioeconomic development.

Innovation system thinking represents a significant change from the conventional linear approach to research and development. It provides analytical framework that explore complex relationships among heterogeneous agents, social and economic institutions, and endogenously determined technological and institutional opportunities (Agwu et al., 2008). It is attractive not only because it offers a holistic explanation of how knowledge is produced, diffused, and used but also because it emphasizes the actors and processes that have become increasingly important in agricultural development (World Bank, 2006). Spielman (2005) states the innovation systems framework “opens the ‘black box’ of innovation” to analyze the roles of different innovation agents, the types

and quality of the interactions between them, and the formal and informal institutions that structure the innovation processes.

According to OECD (1997), an understanding of the innovation system can help policy makers identify leverage points for enhancing innovative performance and overall competitiveness. It can assist in pinpointing mismatches within the system, both among institutions and in relation to government policies, which can thwart technology development and innovation. Policies which seek to improve networking among the actors and institutions in the system and which aim at enhancing the innovative capacity of firms, particularly their ability to identify and absorb technologies, are most valuable in this context.

Limitations of agricultural innovation system approach

Some authors argue that the issues of natural resources management, inclusiveness for the poor and marginalised groups, and sustainability are not central in the AIS framework and suggest these domains need to be addressed. For instance, Assefa et al., (2006:43) pointed out:

In grassroots innovation systems, where market influence is weak, environmental issues are particularly important. The further from industrialized settings, the stronger is the people's link with the environment and most of them live from natural resources. Moreover, social capital in the grassroots systems greatly influences natural resource management and how innovation in this respect affects sustainability.

Other limitations of the approach relates to the gap in empirical evidence on the practical application of the concept in transforming agriculture specifically in developing countries, where smallholder farming is dominant. It is increasingly recognised that the operational aspect including practical guidelines of the concept remain largely unexplored.

2.3.3 Conceptual framework and definition of concepts

Conceptual framework

To formulate the conceptual framework for analysing innovation capacity, the key question that needs to address is which components and factors of the innovation system should capacity development focus in order to enable a well functioning of the system. Woolthuis et al (2005:609) in their study on 'a system failure framework for innovation policy design' suggest 'the innovation-policy framework' that is based on analysing two basic components: 'missing actors' and 'rules/system failures'. In describing the two categories, they state:

'Missing actors' are organizations such as customers, firms, policy departments, research institutes, consultants, etc. that act and there by co-create not only product and technologies but also the institutional framework in which they function. The 'rules/systems' are the conditions that are either specifically created by actors, or have spontaneously evolved, that influence not only the functioning of individual actors, but also the system as a whole. These include infrastructural failure, institutional failure, interact ional failure and capabilities failure (p.611).

Edquist (2001) points out that 'system failures' relate to the causes behind the problem and it is a matter of identifying functions that are missing or inappropriate and which lead to the 'problem' in terms of comparative performance. According to him (p.19), there are at least four main categories of system failures (which are partly overlapping):

- 1) Functions in the innovation system may be inappropriate or missing,
- 2) Organisations may be inappropriate or missing,
- 3) Institutions may be inappropriate or missing, or
- 4) Interactions or links between these elements in the system of innovation may be inappropriate or missing.

This research aims to understand the problems and causes of innovation capacity within the innovation system perspective. As stated above these problems might be related to organizations (actors) and their functions, habits and practices ('hard' and 'soft; institutions), actors' interactions and policies. Identification of theses problems should be based on empirical evidences which certainly require analytical tools.

Hall et al (2007:49) propose four main analytical categories (the 'Four Element' tool) for understanding innovation capacities. These are:

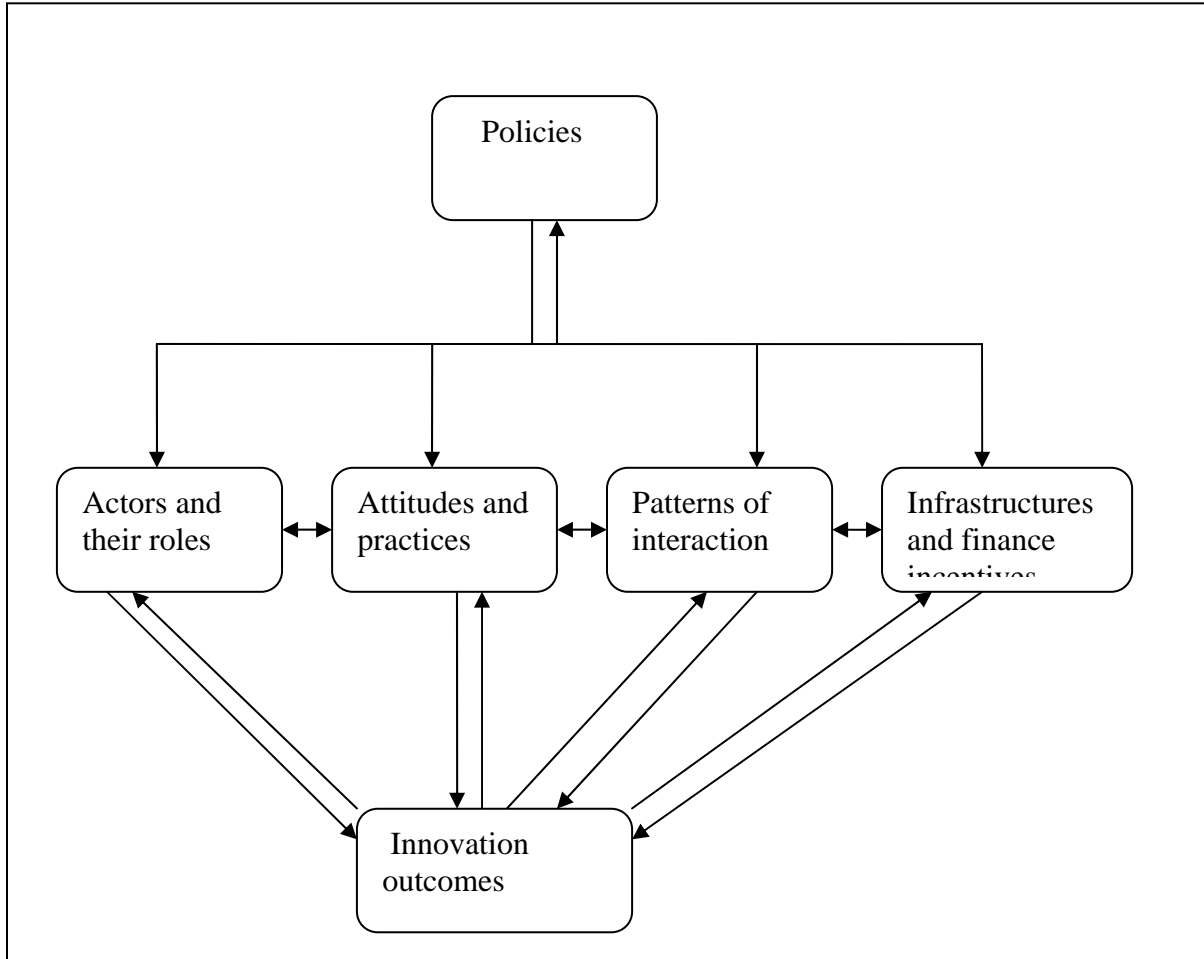
- 1) Actors and the roles they play
- 2) Patterns of interaction between actors
- 3) Habits and practices (institutions)
- 4) The enabling environment (policies and infrastructure)

In addition to these categories however, the innovation system literature (e.g. World Bank, 2007) highlights that some innovation activities require financial support as an enabling environment for their success. This component is important for this study because literature review on problem assessment indicates that financial constraints such as credit and investment are one of the bottlenecks in smallholder irrigation development.

Based on the literature review discussed above, an analytical framework (figure 2.2) is developed for this study to understand and analyse the impact of policy on key determinant factors to achieve irrigation development of smallholders. The capacity categories include actors and their role, attitudes and practices, patterns of interaction, and infrastructures and finance. The framework shows a two-way interaction between policy and the components of innovation capacity. A similar illustration is also shown between innovation outcomes and capacity.

Edquist (2001) states there are a complicated two-way relationship of mutual embeddedness between institutions and organisations, and this relationship influences innovation processes. The framework indicates that the relationships between policy and the innovation process (developing capacity) is not a linear model relationship but a complex relationship in which there is a continuous and multi-directional interactions taking place. For instance an enabling policy will encourage actors to play their role, facilitates interactions to take place, etc. These opportunities can in return lead to shape policies towards stimulating innovation development. Successful irrigation innovations may attract more actors to be involved (such as agro-processing enterprises, marketing cooperatives), can demand more new technologies and infrastructures and thus influencing on organizational and institutional dynamics and the policy environment. Further more, it is assumed that the process involves several actors who practice both vertical and horizontal linkages and interactions. Understanding these complex interactions is central and the most challenging in innovation system study.

Figure 2.1. Policy-innovation capacity framework



Source: adapted from Hall et al (2007)

Definition of concepts

Actors and their roles

Actors are individuals and organizations that include a broad range of entities such as public sector departments, private companies and enterprises, NGOs, farmers' organizations, etc. There are also informal actors who are most often 'invisible' to 'outsiders' because they do not have formal structures (FAO, 2003). Both formal and informal actors are players in the innovation system. Because this research aims at understanding the role of policy in shaping the response of farmers and other actors, policy makers and local farmers are considered as key actors in the process of data gathering and analysis.

The linear model and the agricultural innovation system perspective have different views on the role of actors in innovation development. The linear model emphasizes on research and extension organizations to promote agricultural development. Nevertheless, several evidences have proved that multiple sources of innovation actors outside government have significant contribution to knowledge creation, diffusion and application. For instance, World Bank (World Bank, 2006) case study investigations revealed that the private sector and farmers play a central role in innovation process.

The innovation system concept recognizes that innovations emerge from systems of actors and stresses for continuous interaction among them. These actors have often conflicting interests and objectives originating from different degrees of economic, social and political power. Because of these factors, the key challenge in most innovations is either the right types of actors are absent from the process or there are missing links and limited interactions between them.

Very often, the innovations and innovation processes of greater interest to the poor, are much neglected, left unsupported or even undermined and repressed (Berdegue, 2005). This observation is also important from capacity development point of view. In the linear or top-down approaches, policies and technological interventions are decided by outsiders and farmers are expected to adopt pre-defined innovations. The central question in innovation development is how to create an enabling environment where all relevant actors who have shared concerns can define their development agenda and actively participate in planning, implementation and evaluation processes. The innovation system framework can offer a better solution to overcome this gap. To understand how the innovation system is performing, the functional analysis starts off with a survey of all actors within the system and subsequently assesses them on "how?" and "how well?" they contribute to the key functions that the innovation system needs to perform (CTA/UNU-INTECH/KIT, 2005)

It examines who the key actors are and what role they do play in the process. At the same time it maps the extent of their relationships by exploring existing and missing linkages and identifies the causes for failures. This actor inventory helps to identify policy interventions that can effectively remove the constraints and make use of opportunities for the benefit of smallholders including the marginalised groups.

The need to revisit the roles of research and extension systems

In the conventional approaches, innovation was regarded as technical product created in research and the focus was building the capacity of research organizations. However, practical experiences and empirical evidences have proved that most of what scientists develop in research sites is hardly suitable to the demands and local situations of farmers (Leeuwis, 2004; World Bank, 2006, 2007; Hall et al, 2006, 2007, 2008).

In innovation system perspective, the role of research is changing from that of the traditional practice. Innovation is an interactive process and relies from multiple knowledge sources of the public, private and civil societies. Innovation case studies by the World Bank (World Bank, 2006) demonstrate that in most successful innovation cases research played a relatively small role. Investigations show that the key challenge in most innovations has not been to create new inventions but rather to adapt and use existing ones. The case study findings conclude that “research is important but not always central to innovation”. This has implications for the role of research in innovation system. It is increasingly emphasized that the support to research must focus more on developing strong interactions and linkages between research and relevant sectors. It is essential that the research system engages universities, private sector research and civil societies and stimulate the scaling-up of farmers’ local innovations. Research must address issues related to natural resource management, subsistence farming, and over all rural development and employment (Hall et al, 2008; World Bank, 2008).

Similarly, the functions of the extension system must be shaped in the context of innovation system concept. Extension must shift from dissemination of “pre-defined” policies and technologies to interactive and learning approaches. According to Leeuwis (2004), extension as a communication for innovation should be serve as a ‘two-way’ or ‘multiple –way process’, in which several parties can be expected to contribute relevant insights, and which may have implications for all parties (not only farmers, but also researchers, extensionists, policy makers, agricultural industries, etc) involved in the process. Agwu et al. (2008) emphasise that the new approach should promote not only technical innovations, but also institutional, organizational, and managerial innovations. Extension needs to provide a wider range of services to a more diverse clientele to improve their capacity to access, adapts, and uses knowledge, inputs, and services. Extension systems must be flexible, user-driven, and focused on local problems. Developing better habits and practices that promote wider interaction and learning is perhaps the greatest challenge for extension organizations (World Bank, 2008). Extension must serve as a bridge to link farmers with other farmers, research, the private sector, training organizations, input and

credit suppliers, and policy makers to demand-driven innovations. As the World Bank (2008) states, essential activities and mechanisms of extension service include: organizing forums and supporting establishment of producer organizations; promoting information flows; and experimenting with new approaches to facilitate access to knowledge, skills, and services from a wide range of organizations.

Empowering smallholders and attracting the private sector

Different studies indicate that differences in power, resources and capacity may exclude smallholders particularly the rural poor and disadvantaged groups in an innovation system application. It is believed that teaching and enhancing the learning capacities of smallholders, and strengthening their local organizations are important ways of empowerment. Innovation system application should recognize the role of farmers and other rural stakeholders as the engine for innovation (World Bank, 2008). Policy support is needed to coordinate and facilitate interaction among all groups and ensure that poor people's demand is addressed in the process.

The private sector organizations play a central role in innovation (World Bank, 2006). Private sector organizations including agro-industries, input supply companies, and small and medium-sized rural enterprises are important for successful innovation. According to the World Bank (2006), the experience of cassava production in Ghana and the Colombian flower industry illustrate that the private sector can also play significant role in research programs to enhance innovation. These experiences indicate that the public sector needs to recognize the importance of the private sector in innovation processes.

Attitudes and practices

Attitudes and practices (institutions) are understood as the sets of common habits, routines practices, rules or laws that determine the propensity of actors and organizations to innovate. Attitudes and practices play central role in shaping interactions, learning, knowledge flows and investment (Hall, et al., 2006). Woolthuis et al (2005) distinguish 'hard institutions' which refer to the formal, written laws and regulations and 'soft institutions' which include the wider context of political culture and social values. Attitudes and practices play a central role in the capacity of actors to innovate (Edquist, 2001; Hall, et al, 2007). They define and regulate the roles of organizations. For instance some organizations may be motivated and flexible to adjust or change their activities quickly with changing circumstances, where as others may resist to change and maintain their original roles regardless of the changing context.

Attitudes and practices determine interactions among actors. Evidences show some organizations lead to interaction for wrong reasons and while others support good forms of interactions. Public and private sector partnerships and multiple actor interactions are shaped by attitudes and practices in organizations. It has been observed that an ivory tower culture in various research organizations prevent interactions with the private sector interested in technology promotion. Attitudes supporting collaboration and a tradition of sharing information with collaborators and competitors are essential to promote interaction by multiple actors. Risk taking attitudes and practices help actors to invest in training, equipment and marketing which are critical to innovation. Attitudes and practices also determine actors' response to policy changes or changing market, technological and environmental conditions. Resource allocations in pro-poor investments are similarly related to attitudes and practices of decision makers towards poverty reduction and rural development.

Conservative behaviours restrict exploiting innovation triggers while supportive attitudes help exploit opportunities to the advantage of innovation development. Describing the relationship between organizations and institutions, Edquist and Johnson (1997:59-60) cited in Edquist (2001) state:

Organisations can be said to be 'embedded' in an institutional environment or set of rules, which include the legal system, norms, standards, etc. But institutions are also 'embedded' in organisations. Examples are firm specific practices with regard to bookkeeping or concerning the relations between managers and employees; a lot of institutions develop inside firms. Hence, there is a complicated two-way relationship of mutual embeddedness between institutions and organisations, and this relationship influences innovation processes and thereby also both the performance and change of systems of innovation.

Attitudes and practices that are critical to innovation are learned behaviours that may change gradually or suddenly (Hall, et al., and 2005). To foster supportive attitudes and practices, intervention activities should focus to enhance actors' creativity, risk taking and self confidence, trust building and greater openness for learning and information sharing within and outside the organization. One way of enhancing these capacities is to invest in learning for new skills, facilitate partnerships and collaboration among actors, and provide incentives that allow actors to translate their skills into productive use.

A case study conducted by the World Bank (2006:45) reported that positive attitudes and practices in learning and cooperation helped the Foundation for Revitalization of Local Health Traditions in India to achieve successful innovation development. According to the report, these attitudes and practices include:

- An experimental approach of learning by doing.
- Continuous evaluation of program performance.
- Openness to new strategies and wide participation of staff at all levels in decision making.
- A commitment to research and implementation.
- An ideological commitment to safeguarding Indian health-care traditions.
- The adoption of a partnership approach.
- A commitment to pro-poor development.
- Excellent leadership that has shaped the Foundation's vision, attitudes, and practices and largely determined how the Foundation has articulated and implemented its mission.

Patterns of interactions

Acquiring knowledge and learning are interactive and require extensive linkages with different knowledge sources. Successful agricultural innovation system approaches nearly always feature multiple sources of knowledge and information and stakeholder engagement and partnerships that allow this knowledge to be used effectively (World Bank, 2006). Sources of knowledge may be scientific and technical, but equally they can be source of both tacit and codified (Hall, et al., 2006).

The type of interactions among actors can vary depending on the context they are involved. For instance, Hall et al (2006) observe various forms of interactions and learning (table 2.1) in innovation process.

Organizations or groups may form different forms of linkages for different purposes. For instance, when two or more organisations may decide to learn collaboratively, developing something jointly this would be partnership. Partnerships could be for example an extension organization and an NGO jointly work with community members to develop an irrigation scheme. This type of partnership may involve resource contribution agreements and learning about different techniques and managerial skills of irrigation activities.

Another type of interaction as Hall et al (2006) suggest is when an organization simply buys the goods and services of another organization. These may be knowledge embodied goods such as technologies and protocols, equipment or germ-plasm. These could be the services of a marketing organisation. This would be a linkage, but not necessarily a partnership and would probably fall under normal contract relations, including purchase of licences from holders of patterns.

Network is another way of interaction. Networks are structures that link individuals or organisations who share a common interest on a specific issue or a general set of values (Perkin and Court, 2005). According to them, networks can help at fulfilling some key functions including communication across both horizontal and vertical dimensions, creativity through interactive communication among diverse actors, and consensus around a common issue.

The type of partnership or network is highly context-specific and its development and consolidation depends on a number of factors, which can be grouped into the actors involved, the way relationships occur within the network (structure), and network management (World Bank, 2008). Perkin and Court (2005:6) provide the following checklist as 'keys to success' for networks engaged in influencing policy.

- Clear governance agreements: setting objectives, identifying functions, defining membership structures, making decisions and resolving conflicts.
- Strength in numbers: the larger the numbers involved the greater the political weight.
- Representativeness is a key source of legitimacy and thereby influence.
- Quality of evidence affects both credibility and legitimacy.
- Packaging of evidence is crucial to effective communication.
- Sustainability is vital, since persistence over a period of time is often required for policy influence.
- Key individuals can facilitate policy influence.
- Informal links can be critical in achieving objectives.
- Complementing of official structures rather than duplication

Linkages which are long term and based on trust and cooperation are important for learning and information flow. Weak ties among relevant actors are believed to restrain information flows and hence prevent innovation development. However, strong ties not always stimulate innovation. This is because in strong network individual actors are guided by other network actors in the 'wrong direction' and consequently fail to supply each other with the required knowledge (Carlsson and Jacobsson, 1997 cited in Woolthuis et al, 2005).

This checklist and the linkage typology are useful for analysing the existence, purpose and degree of linkages and how they impact on information flow and interactive learning.

Table 2.1 A typology of interactions and learning

Types of Linkage	Purpose	Type of Learning
Partnership	Joint problem solving, learning and innovation, may involve a formal contract or memorandum of understanding. May be less formal, such as participatory research. Highly interactive. May involve Two organisations or more. Focused objective-defined project	Mainly learning by interacting. Also learning by imitating and learning by searching
Paternalistic	Delivery of goods, services and knowledge to consumers with little regard to their preferences and agendas	Learning by training
Contract purchase of technology or knowledge services	Learning or problem solving by buying knowledge from elsewhere. Governed by a formal contract. Interactive according to client contractor relations. Usually bilateral arrangement. Highly focused objective defined by contract concerning access to goods and services	Learning by imitating and mastering. Might involve learning by training
Networks	May be informal or formal, but the main objective is to facilitate information flows. Provides know-how and early warning information of market, technology and policy changes. Also builds social capital, confidence and trust and creates preparedness for change, lowering barriers to forming new linkages. Broad objective	Learning by interacting
Advocacy linkages to		Interactive learning

policy process	Specific links through networks and sector association to inform and influence policy.	
Alliance	<p>Collaboration in the marketing of products, sharing customer bases, sharing of marketing infrastructure.</p> <p>Usually governed by a memorandum of understanding.</p> <p>Can involve one or more organisations. Broad collaborative objective.</p>	Learning by doing
Linkages to supply and input and output markets	<p>Mainly informal but also formal arrangements connecting organisations to raw materials, inputs and output markets. Includes access to credit and grants from national and international bodies. Narrow objective of access to goods.</p> <p>Hall et al, 2006</p>	Limited opportunities for learning. Some learning by interacting

Source: Hall et al (2008)

In linear and top-down approaches, the bureaucratic culture will strengthen more hierarchical and paternalistic forms of relationships where informal and interactive learning is limited. An enabling environment for innovation can encourage different forms of linkages that practice both informal and formal learning, vertical and horizontal communications with reciprocity and interdependency. These may include networks, partnerships and others.

Infrastructures and finance

Physical infrastructures such as roads and telecommunication facilitate rural-urban linkages and increase access of smallholders to knowledge, markets, inputs and technologies. The development of such infrastructures can help reduce transaction costs and encourage smallholders and the private sector for better investment in the sector development.

Scholars suggest (world Bank, 2008) that the innovation systems approach need to expand to the rural poor where credit facilitation and natural resources development are among the priorities in

poverty alleviation. Hence, financial incentives in the form of credit provision and direct investments are required for innovation development.

Financial incentives are also important to develop the knowledge and skills actors through training, experimentation and networking.

Enabling policies

Understanding what an enabling policy means and its effect in innovation capacity is the main focus of this study. The conceptual definitions of the innovation capacity components discussed above have also attempted to address the relationship of each category with innovation supporting policies.

Innovation policies can be understood as public actions that influence innovation processes, that is, the development and diffusion of product and process innovation (Chaminade and Edquist, 2007).

The economic or social performance of a country depends on a set of enabling conditions that foster the emergence of innovative agents. The conditions include infrastructure, effective governance of input and output markets, and a supportive policy and fiscal framework for science, technology, legal, advisory, and trade issues (World Bank, 2008). According to Hall et al (2006), policies are important in determining how actors behave. They can shape innovation and innovation capacity by affecting both the production of knowledge (for example, through S&T policy) as well as the productive use of that knowledge (for example, through market and trade policy, investment incentives, regulatory regimes, and intellectual property rights (Hall and Dijkman, 2006). In addition to providing the right incentives, resources, and support structures, policies also must be relevant to the local context and the attitudes and practices of the actors whose behaviour they are designed to influence (World Bank 2006).

As Hall et al (2006) indicate policy support of innovation is not the outcome of a single policy but a set of policies that work together to shape innovative behaviour. This means that there is a need to be sensitive to the wide range of policies that affect innovation and seeks ways coordinate these.

Mytelka (2000) observes the policies that define the enabling environment are not as such in terms of the written rules and regulations, laws and by-laws but rather the interaction between the policies and the actors. He emphasizes that, to positively influence the enabling environment for innovation, policies must interact positively with the habits and practices of the actors whose

behaviour they are designed to influence or support. This means policies should consider promoting supportive attitudes and practices of actors in order to achieve successful innovations. Policy-making requires a large extent of stakeholder endorsement and buy-in before it can be effective. In the first place to decide on policy objectives, secondly to effectively target policies, and thirdly to assure the design of policy instruments that would actually support the policy targets (KIT, 2009).

For the objective of this study, the most important aspect is to explore the role of policy in creating an enabling environment for actors to develop enhanced capacity to innovate. It is assumed that enabling policy environment is needed to ensure the participation of all relevant actors particularly smallholder farmers and the private sector, in decision making processes and productive use of innovations. Policy should give special attention to disadvantaged groups such as women to actively participate in the process. Policies can also play significant role by triggering innovations through the demand side. For instance extensive support to irrigation can expand farmers' demand for new inputs, managerial skills and market access which in turn require extensive linkages with research, extension, private sector and infrastructure providers.

Irrigation development and expected innovation outcomes

Extensive studies have documented that irrigation boosts growth and reduces poverty directly and indirectly (IFAD, 2001; Hussein & Hanjra, 2004; Darghowth, 2007; IWMI, 2007). This is largely because irrigation access allows poor people to increase diversification opportunities, reducing vulnerability caused by seasonality (Hussein, et al., 2003)

The Economic Commission for Africa (AU, 2004) reports that poverty can be as much as 20 to 30 percent lower in areas where a higher proportion of land is irrigated, where as rain-fed agriculture is far more susceptible to climatic variability. Similarly Hussain and Hanjara (2004) found a strong linkage between irrigation and poverty alleviation. According to them, irrigation benefits the poor through higher production, higher yields, lower risk of crop failure, and higher and year-round farm and non-farm employment. Irrigation enables smallholders to adopt more diversified cropping patterns, and to switch from low-value subsistence production to high-value market-oriented production. Increased production makes food available and affordable for the poor. Rockström (2000), referring to a wide range of water harvesting techniques, states, there is a large potential for these techniques to improve crop production in semi-arid regions of Eastern and Southern Africa. According to him the challenge is to find ways of anchoring innovative water harvesting

systems in the present rural communities by moulding them within the site-specific bio-physical and socio-economic contexts.

However, while irrigation can be considered as a vehicle to achieve growth and poverty alleviation, this is possible under certain conditions. One aspect of this is related to the ownership and management arrangements of the schemes. A large body of literature reports that small scale and farmer- managed schemes are more efficient in poverty alleviation than large scale irrigation projects. A report by CTA (2003) indicates that government-managed large- and small-scale schemes have generally performed far below expectations and most of the time, initial capital costs have not been recouped and the financial returns have not been able to cover operation and maintenance costs. The awareness of failure in large-scale irrigation by many governments and donor agencies has shifted the interest and focus to small-scale irrigation development (Smout, 1994; Turner, 1994; Rahmato, 2002; Abera, 2005).

The extent of benefits to the poor and sustainability of irrigation schemes depend on access to assets such as land and water resources, technologies and skills, inputs, and market and the participation of the users in decision making. Study findings by Hussein (2004) indicate that large land holders benefited more than smallholders, and smallholders benefited more than the landless. IFAD (2004) report on small scale schemes in Ethiopia, stated that a scheme far from input and output markets or in a catchment (an area with a common outlet for its surface runoff), where there are too many competing water users, will fail. The report further noted sustainable scheme is one which having succeeded has altered the mind-set of all stakeholders, who do not wish to return to the way things were.

Similarly, Rockström (2004) emphasises irrigation development including household level schemes have many aspects of interacting implications that influence their sustainability. He describes the development of the schemes interact on biophysical and social systems and suggests a system based intervention approach that takes into consideration the participation of users and development of the watershed where the water resource sustainability depends.

The literature review discussed asserts that policy interventions need to consider irrigation innovation not as pure technical development but a complex and multi-dimensional development that consists social, economic, governance and environmental aspects. This implies a well functioning innovation supportive policies will impact on innovation outcomes that are different depending on the specific contexts. The key factors that will influence include: farmers' access to assets, the institutional and organizational settings, differentiated interests and power relations,

infrastructural development and access to markets, and agro-ecological locations. However, based on the principles and concepts of innovation systems, the key generic features of the expected outcomes (Hall et al., 2007) in the irrigation system have to be among others:

Table 2.2 Enhanced innovation capacity and expected innovation outcomes

Actors/services	Expected innovation outcomes
farmers	Recognised among the key actors in decision making and negotiations about their concerns and priorities; Creation and scaling-up of new irrigation technologies expanding; Increase in productivity, promoting market oriented products that help increase their incomes; Collective action, conflict resolutions, knowledge sharing; strong linkages including with market; improved livelihoods,
Extension services	Becoming active in facilitation, interaction, creating linkages; Professional competences in technical, managerial and organizational skills;
research	agenda setting through participation of the stakeholder; Integrating local knowledge of irrigation with scientific knowledge Willingness to link and interact with others
Private sector	Linkages through technology supply (e.g. treadle /motor pumps), input/output marketing,
Policy approaches	With changes in innovation capacity, policy approaches are also changing to more supportive and enabling pro-poor innovations

Source: author

2.4. Research questions

2.4.1 General research question

Based on the conceptual framework developed for this research, the general research question to be addressed is: *what is the impact of agricultural policies on **pro-poor** innovation capacities and **pro-poor** outcomes of smallholder irrigation?* This question tries to answer policy impacts on the main components of innovation capacity. In addition, it aims to look at major innovation outcomes in the system in general and at community level in particular.

2.4.2 Specific research questions

- 1) How do policies affect the inclusion or exclusion of relevant actors? Who are the key actors and what role do they play?
- 2)
- 3) How do policies influence attitudes and practices of actors? Which components of policies do restrict innovations and which ones do not?
- 4) What forms of linkages are practices between actors and what is their contribution to accessing information and learning? What roles do policies have in facilitation these linkages?
- 5) What is the role of policies in developing infrastructures and credit facilitation? How do these provisions impede or encourage smallholder innovations?
- 6)
- 7) What types of irrigation development innovations are adopted and promoted by smallholders including the poor farmers and what are the roles of policy in this regard?

CHAPTER THREE: RESEARCH METHODOLOGY

This chapter explains the research strategy that guided the study and the different methods used for data collection and analysis. Further more, it discusses the strengths and limitations of these methods based on practical experiences of the research work.

3.1. Methodological approach

This research was interested to investigate how policy interventions affect farmers' innovation capacities in the area of irrigation development that aim at achieving food security and poverty alleviation. A case study approach, based on mainly qualitative evidences was employed in order to gain holistic view of policy impact on farmers' decisions in irrigation practices. According to Matveev (2002), qualitative research methods enable to obtain a more realistic feel of the world that cannot be experienced in the numerical data and statistical analysis used in quantitative research. Innovations are the outcomes of people's attitudes, motivations, values, and practices reflected in real-life settings where qualitative evidences can provide a better understanding to such phenomena

Yin (1984) recommends a case study when a "how" or "why" question is being asked about a contemporary set of events, over which the investigator has little or no control. Thus a case study strategy was believed appropriate to gain a holistic knowledge on how different actors with divergent interests interact and make decisions, and how these decisions influence farmers' adoption, rejection or developing irrigation innovations.

Case study is most appropriate to explain the causal links in real-life interventions that are too complex for the survey or experimental strategies (Yin, 1984). This research is aimed at investigating policy effects on farmers' irrigation practices in two communities of the Tigray regional state. These processes are complex and require different methods of data collection methods to build an in-depth analysis of innovation processes. Yin (1984) states a case study approach enables to employ a combination of different data collection methods including quantitative evidences. While the focus of this research was a qualitative type of investigation, it has also incorporated some quantitative approaches to enhance the validity of the research findings. The complementary use of qualitative and quantitative methods allows triangulation of findings which is useful to develop effective policy interventions.

3.2. Methods of data collection

Selection of the study sites

This study was carried out in Kilte Awlaelo woreda (district), situated in eastern zone of Tigray. The district is one of the most drought affected areas in the region and the vast majority of its people are exposed to abject poverty and hunger.

Small scale irrigation is among the pillars of the regional government policies currently under implementation in drought prone areas including Kilte Awlaelo aimed at addressing rural poverty and food insecurity. Further more the woreda has various experiences of both the large-scale and the household level irrigation practices in which this research is interested to study.

At the beginning, I had the idea to concentrate my research in one *tabia*¹ of the woreda. Before the start of the fieldwork, I met and discussed with senior staffs of the Tigray bureau of agriculture and rural development (BoARD) and office of agriculture in Kilte Awlaelo district on the purpose of my research and the plan for the research site. Following the discussions, I conducted a reconnaissance assessment in three sites in Kilte Awlaelo district to gather more information for the study site selection. Finally, I selected two communities namely Abraha Atsbaha *tabia* which has introduced diversified irrigation practices and Mahbreyeyni *tabia* with limited types and scale of practices. The purpose of selecting communities with different practices was to capture a better knowledge on how policies are realised in different local contexts.

Data collection

The fieldwork was conducted for four months from September to December 2009. Data collection methods included informal and semi-structured interviews, focus group discussion, and document analysis and participant observation. Interviewing was used as the main data gathering technique. This method allows a free exchange of information between the researcher and the informants. The interview is a strategy for getting people to talk about what they know (Sarah, 2002).

Semi-structured interviews

Semi-structured interviews were conducted with individual farmers and farmer representatives in both study sites. First, an initial checklist of key of topics and issues that guide the interview was prepared by the researcher based on a literature review and informal conversations with regional

¹Tabia- a local name for the lowest administration unit in Tigray

and district informants. Before the start of the interview, I spent few days in each study site to introduce myself, got in contact with tabia administrator, extension workers and some ordinary farmers to understand more about the community profile, irrigation practices, and other related information which helped to me to develop a more detailed checklist for the individual interview. Individual households were selected based on simple random sampling from the population list of those practicing household level irrigation. However purposeful selection was decided on respondents from the categories with small number of population particularly female headed households and innovator farmers who introduced irrigation by their own initiatives before the launching of the policy. The purpose of this decision was to create a balanced make up of informants representing all social groups practicing household level irrigation. A total of 36 respondents (18 from each tabia) were selected for individual interviews (table 3.1)

Table 3.1 type of respondents in Abraha Atsbaha and Mahbereweyni

Type of respondents	Abraha Atsbaha	Mahbereweyni
Before new policy:		
Male headed	2	1
Female headed	1	
After the new policy:		
Male headed	13	16
Female headed	2	2
Total	18	18

Source: the author

The researcher interviewed individuals through face-to face interaction with the consent of the respondent. Data generated through such interviews focused on farmers' access to land, experience in irrigation, factors that influenced adoption of irrigation practices, their perception about the household level policies, types of interactions and relationships with other actors, source of information and knowledge, most influential actors in their day-to day irrigation activities, credit facilitation, market access and problems in irrigation development.

In addition, Semi-structured interviews were conducted with various individuals at district and regional levels including senior and middle level government experts, NGO representatives and from the private sector. Respondents were purposefully selected from the major organizations and entities who are involved in household level irrigation program.

These interviews focused on issues related to policy development processes, roles of different stakeholders, influential actors in policy decisions, the types of interactions they practice, and problems they encounter.

Focus group discussion (FGD)

A focus group discussion of seven participants was organised with a particular group at tabia level for a more in-depth exploration of key issues identified from the semi-structured interviews. The group members included the tabia leader, an extension agent, representatives of farmers' associations and cooperatives, and a church leader who are all farmers except the extension worker. The criteria for selection was based on their common interest on irrigation development, their experience on how policies are practised at local level and their knowledge about farmers' views and reactions in the irrigation practices.

Gibbs (1997) states that the main purpose of focus group research is to draw upon respondents' attitudes, feelings, beliefs, experiences and reactions in a way in which would not be feasible using other methods, for example observation, one-to-one interviewing, or questionnaire surveys. The discussion was facilitated by the researcher guided by semi-structured and open-ended topics to encourage a free interaction among participants, and draw up their experiences and feelings about the issues. The group discussion focussed on topics that included timelines for irrigation development and who the key players were, identification of actors currently involved in the area, strengths and weaknesses of interactions, and finally mapping linkages. They identified strong, weak and missing linkages. The focus group discussion was very useful in complementing the semi-structured interviews particularly in analysing the role of actors and their linkages. However, it has critical limitations. For instance, participants were prevented from reflecting a depth of information which they thought were sensitive such as discussing the weaknesses of the tabia leader and the extension agent.

Although the researcher had initially planned to conduct similar FGD at regional level with senior experts and NGO representatives, this was not realised due to time limitations.

Key informant interviews

Key informant interviews were conducted with individuals at community level and regional level. At community level key informant farmers were identified in the course of semi-structured interviews and participant observation. These farmers include elders who have a broad knowledge on history and farming practices of the community, self organized group coordinators and individual farmer entrepreneurs. Other key informants were tabia and village leaders, farmer

organization coordinators (farmers' association, youth association, farmers' cooperatives) women association coordinator, extension workers, tree nursery technicians, school teachers, and local traders. Various data were collected through face-to-face interactions using a checklist developed based on their particular experiences.

The regional key informants were mainly policy makers who provided data through a list of topics and open-ended questions focussed on macro level policy issues. The main purpose was to get more in-depth information on irrigation policy objectives, approaches, pressing issues and relationship with stakeholders.

Participant observation

Participant observation was undertaken by documenting events and informal conversation with farmers in different circumstances throughout the fieldwork. I observed relationships between farmers and local leaders by attending meetings and discussions. Observations were made to understand relationships among neighbour irrigators by visiting their fields and observing their interactions. Through participant observation, I was able to understand how farmers adjust their activities when they encounter unexpected critical problems. In October 2008, which is the main harvesting month the study area, there was unexpected rain causing serious crop losses. Other events where participant observation was carried out include farmers' collaborative interactions such as labour and input exchange, conflicts related to water allocation practices, and division of labour among family members in irrigation practices.

Secondary data

The research work started by reviewing relevant documents gathered from various governmental and non-governmental agencies. Published and unpublished policy documents, development plans (such as five-year strategic plans, extension package manuals), statistical information and reports were studied for data collection.

Table 3.2 Summary of all actors consulted for data collection

Actors	Abraha Atsbaha	Mahbereweyni	<i>district</i>	region
Farmers	37	33		
Farmer representatives	6	4		
Tabia government representatives	5	3		
Government experts			5	11
researchers				2
NGO staffs				5
Policy makers				4
Private sector	1	1	1	2
Sub-Total	49	41	6	24
Total	120			

Source: the author

3.3 Data Analysis

Data collected through interviews and observation is carefully narrated systematically to analyse the following indicators of innovation capacity:

- 1) actors and their roles
- 2) patterns of interactions
- 3) attitudes and practices
- 4) infrastructures and finance

Hall et al (2007) state that interaction between actors and organizations are central to innovation systems, hence the first step in analysis should understand these interactions. Biggs and Matsuert (2004) similarly recommend the first stage in analysis to identify the key actors who bring about or prevent change in an innovation system, i.e. identification of the actors who are the

actual drivers or presenters of change. According to them, understanding patterns of interactions include:

Identification of the key actors,
Mapping the linkages,
Identifying the purpose and extent of links,

For analysing patterns of interactions the commonly used tools are interaction matrices and typologies (Hall et al, 2007). Biggs and Matsuert (2004) have developed actor-oriented tools which is similar to what Hall et al (2007) named interaction matrices. The first tool is the actor linkage matrix which shows all relevant actors in the sector innovation system listed on both the first row and first column of the matrix. Each box in the matrix then represents the linkage between them two actors or organisations. The second tool is a typology of linkages that includes both the type of link and the purpose of linkage.

Data collected through the open-ended and semi-structured interviews as well as actor linkage exercise by FGD is analysed to evaluate the indicators mentioned above. The interaction matrices and typology tools are employed to analyse patterns of interaction at local level (Biggs and Matsuert, 2004) and regional level. Quantitative data collected through semi-structured interviews was organized and analysed using SPSS 16.0 to compliment the qualitative evidences.

3.4 Strengths and limitations of the study

The researcher learned that qualitative methods have many advantages in gaining an in-depth understanding of the context of the area under study. They allowed understanding complex issues such as perceptions and attitudes of people which would have been difficult to capture through other methodologies. Qualitative methods are flexible to re-design which enabled the researcher to collect data from emerging issues during the discussions, new events during the fieldwork such as public meetings, religious festivals and new project interventions.

The methodology has also helped to form a balanced mix of respondents in order to include relevant social groups such as women, and religious leaders.

Furthermore, the researcher had enjoyed full cooperation from all respondent individuals and groups to access any useful data and information which was very useful in ensuring the credibility and reliability of the research output.

Nevertheless, there were methodological and logistical constraints that had negative effects in the quality of the research. These include lack of openness by some respondents to discuss policy issues, time constraints exacerbated by untimely rains during peak harvest time, and difficulties in analysing some components of the collected data.

CHAPTER FOUR: THE CASE OF LARGE SCALE (MICRO-DAM BASED) IRRIGATION INTERVENTION

This chapter presents the case study of large scale irrigation intervention. It starts with a brief discussion of the current agriculture and food security situations in the region. The chapter focuses on the policy of the large-scale irrigation approach, its planning and implementation processes and how these processes influenced the innovation capacities of actors. Further more, it attempts to draw the major lessons in order to understand how the experiences of this intervention were considered in the new irrigation policy which focuses on household based (micro-scale) strategy.

Figure 4.1 Administration map of the study area

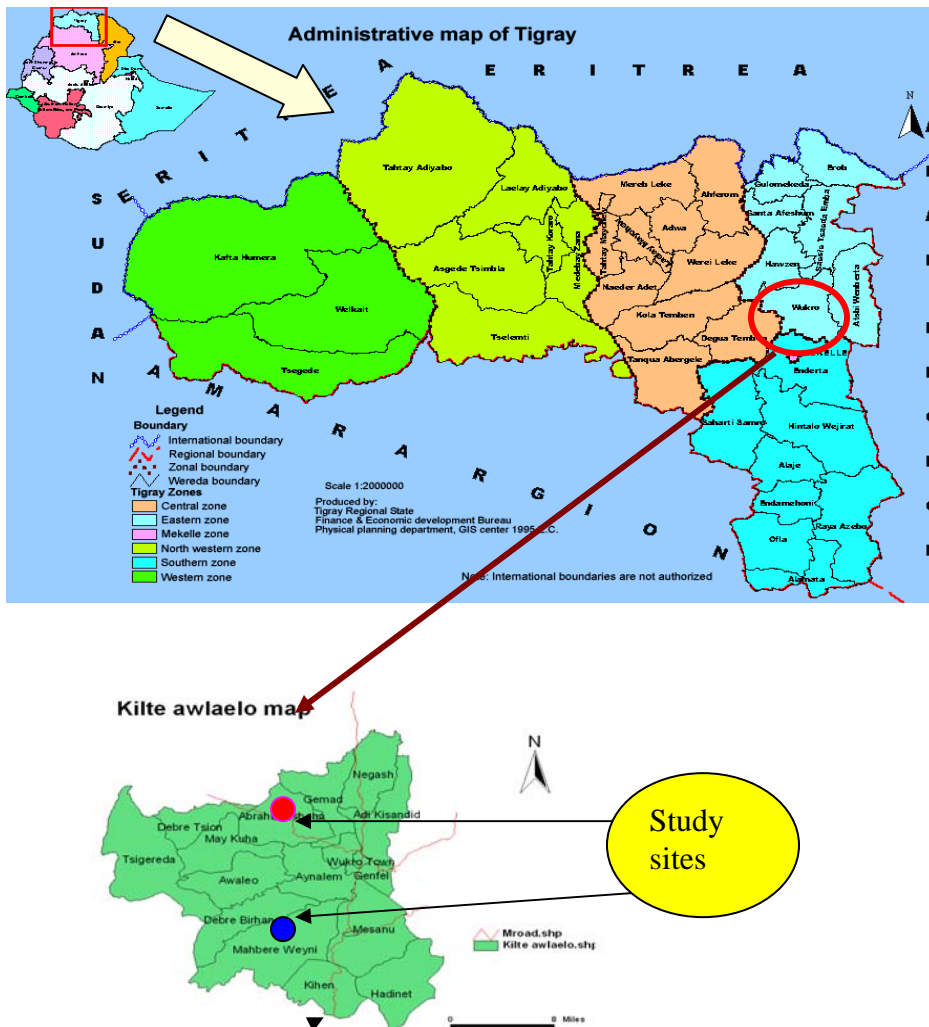
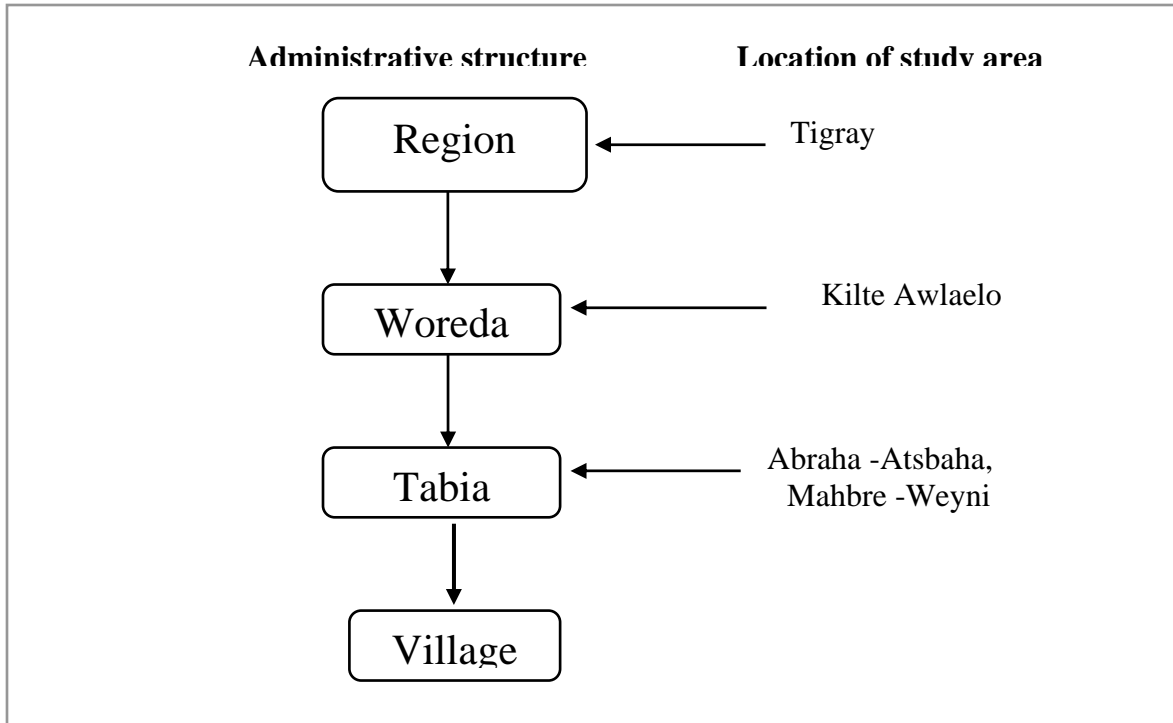


Figure 4.1 Tigray administration structure and study area location



Source: the author

4.1 Agriculture and poverty in Tigray

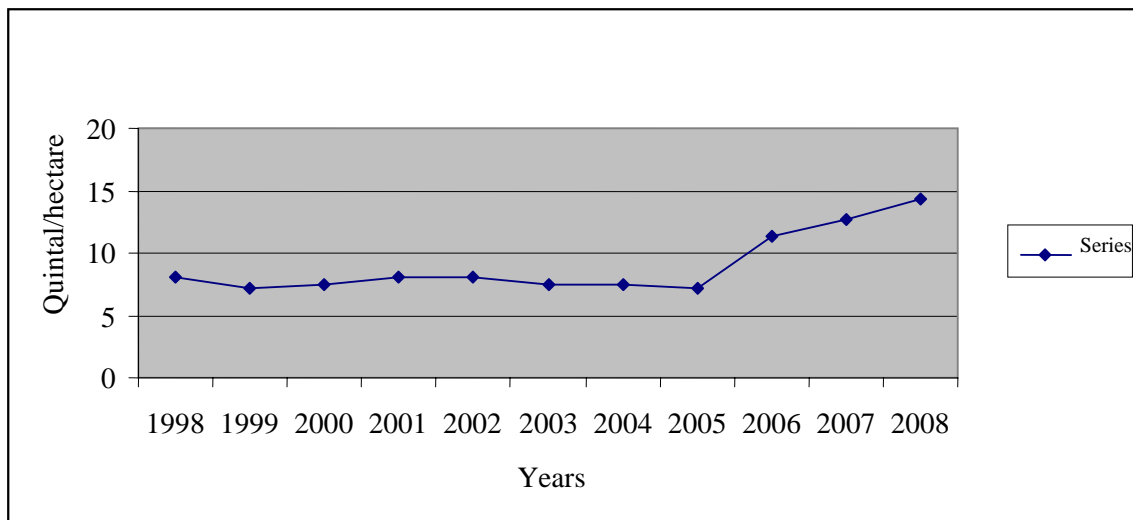
Tigray is the northern most region of Ethiopia bordering the Sudan in the west, Amhara region in the south, afar region in the east, and the state of Eritrea in the north. It covers an approximate area of 54,000 square kilometre comprised of diverse agro-ecology most of which is highland and mountainous plateau ranging between 1500-3500 meters above sea level. The climate is mainly semi-arid with the mean annual rainfall ranging from 350 in the eastern escarpments to 1200 mm in the south-western (BoANR², 1997). In most parts of the region, the rainfall season is short which lasts three months from mid- June to mid-September. The total population in Tigray is about 4.31 million of which 3.47million are rural inhabitants (CSA, 2008). According to a survey by

² Bureau of agriculture and natural resources (BoANR) was later restructured to the bureau of agriculture and rural development (BoARD)

BoANR (2003), there are about 750,000 rural households in the region and close to 30.5 percent of this number are female headed.

Agriculture plays a key role in the overall economy of the region. It is the principal source livelihoods for more than 81 percent of the population and contributes about 44 percent to the regional gross domestic product (BoFED, 2006). However agriculture suffers from structural problems resulting in low level of productivity. Recurrent drought due to low and erratic rainfall, soil degradation, less adoption of production enhancing technologies and shortage of arable land are the major causes for low outputs(BoANR, 2003; Gebremedhin ,2003). The overall performance of agriculture has remained almost stagnant for decades showing a positive trend only in more recent years as a result of favourable rains and some policy improvements

Graph 4.1 Crop productivity trends



Source: BoARD (2009)

Recent socio-economic surveys (BoANR, 2003; Fitsum et al., 2005) revealed that poverty in rural areas is massive and deep- rooted with more than 70 percent of the total rural population living below poverty line. According to BoANR survey (2003), close to 46 percent of households have less than 0.75 hectare of farmland and more than 70 percent of farmers produce less than 50 percent of their food requirements of the year even under good weather conditions. Data from the regional food security coordination office indicate (Food Security Desk, 2009), close to 32.5 percent of the rural population depends on food aid on food-for-work basis under a regional program known as 'productive safety net'. The number of chronically food insecure people has

been dramatically increasing during drought years, phenomena which have become persistent overtime.

Based on the national economic policy, the government of Tigray has adopted agriculture centred development strategy to achieve economic growth needed to combat extreme poverty and hunger. The major components of the strategy include conservation and development of the natural resources, improving rain-fed agriculture, and irrigation development. In order to transform agriculture, the policy recognizes the development of rural services such as agricultural extension, credit, rural infrastructures and the supply of agricultural inputs.

4.2 The micro-dam based irrigation policy

Since the new government came to power in 1991, various development strategies have been initiated to transform the smallholder and subsistence agriculture in Tigray. In the mid 90s, the agricultural intensification strategy, through the Sasakawa Global (SG) 2000 program, was introduced to boost rain-fed crop production. The program focused on improving the productivity of major crops through the adoption of chemical fertilizers, pesticides and selected seeds (BoANR, 1996). Respondents explained that although this approach helped to increase the yields of some major crops, the scaling up was limited to only 10-20 percent of the regional cultivated land. Because most districts are drought prone which suffer from recurrent moisture stress, the external input based crop intensification is not an appropriate strategy and hence an alternative development intervention was urgently needed to address food insecurity and hunger. Based on this experience, the regional government came to realize that irrigation should be promoted as a key strategy to foster agricultural development and economic growth.

The micro-dam irrigation approach was chosen as a strategy, considering the existing water resource potentials in the region. Preliminary assessments revealed that in Tigray, there are huge water resource opportunities for irrigation that can be harvested from run-off draining from the basins. It was estimated that with the available land and water potentials, about 300,000 hectares of land or about 30 percent of the total cultivated land can be developed to irrigation. Realizing this opportunity, in 1995, the government requested the Economic Commission for Africa (UNECA) and the Food and Agriculture Organization of the United Nations (FAO) for assistance to jointly develop an irrigation program. The aim was to boost production by developing a comprehensive water harvesting strategy with well designed micro-dams for the storage and utilization of seasonal run-off water for irrigation. Following the request, a multidisciplinary team of Ethiopian and FAO professionals carried out several studies and designed an irrigation

development project later approved as regional program known as "Sustainable Agriculture and Environmental Rehabilitation in Tigray (SAERT)".

4.2.1. The objectives and targets of the SAERT program

In Tigray, the dominant irrigation practices are farmer initiated traditional irrigation systems which include river diversions, spring development and flood spreading (BoANR, 1996). Farmers have been using these practices for centuries (Solomon and Yoshinobu, 2006) to supplement rain-fed agriculture and to produce cereals mainly maize in the dry seasons (BoANR, 1996). Traditional irrigations depend on weak diversion structures which are easily washed by flood during the rainy season. According to BoANR (1996), the total area under full irrigation in Tigray during the start of the new SAERT intervention was about 4,500 hectares of which more than 90 percent was under traditional practice.

The main objective of SAERT was to promote extensive and modern irrigation development through micro-dam construction that ultimately enables to fill the food deficit gap in the region (UNDP, ECA, FAO and TRG, 1994). SAERT aimed at developing modern technological bases in irrigation management systems and production through large-scale infrastructures and improved agronomic practices.

The micro-dams are earthen dam reservoirs that collect and store runoff water draining from upper catchments during the rainy season for irrigation utilization in the dry period of the year. In order to implement the SAERT program, in 1995, the government of Tigray established a specialised regional irrigation agency known as "Commission for Sustainable Agriculture and Environment Rehabilitation in Tigray (CoSAERT)". The regional government approved a development plan target of the project (table 4.2) and CoSAERT was mandated for its implementation.

Table 4.1 A Ten year plan of the SAERT program

<i>Project phases</i>	<i>No of micro-dams</i>		<i>Land to be irrigated, ha</i>	<i>production, tonnes</i>	<i>Number of beneficiaries</i>	<i>Remarks</i>
	<i>Each year</i>	<i>Total</i>				
Preparatory phase year 1-3		60	6,000			capacity building phase
Implementation phase year 4-10	62	440	44,000			
Total for ten years		500	50,000	200,000	930,000	

Source: UNDP, ECA, FAO and TRG (1994)

The target setting was based on several assumptions. The number of micro-dams was planned based on the amount of food needed to feed about 1 million people who were suffering from food shortage. Each micro-dam was designed to irrigate 100 hectares of smallholder lands for an estimated life span of 20 to 25 years. Other important assumptions include the availability of sufficient land and water resources, and farmers' readiness to participate and adopt the innovation.

While the key component of the project was irrigation development, there were other interventions planned as integral elements of the program.

These include:

- developing the extension service to support farmers adopt new technologies of irrigation
- catchments treatment to protect dams from silt,
- monitoring of social consequences such as water borne diseases and environmental issues,
- land tenure arrangements in project intervention sites
- empowering smallholders to manage the irrigation schemes

The SAERT program was the biggest and government top priority intervention of the 90s in Tigray in which many government officials including high level policy makers had been extensively involved throughout the processes hoping the massive targets will be achieved. Various attempts were also made to mobilize a large number of farmers to 'accept' and support

the project. The program had enjoyed various supports including financial, technical and material resources from different donor agencies believing it will enable the poor achieve food security. However, the SAERT program which concentrated on micro-dams was completely discontinued in 2002/03 earlier than the project period and was replaced by a new irrigation policy. According to regional respondents, more recently, the micro-dam irrigation approach was again reconsidered by the regional government as an important component of the irrigation strategy to supplement the new policy of household level approach. Based on these decisions, the bureau of water resources development (BoWRD) is currently under taking the construction of new micro-dams in eastern and north western zones.

The central issues are who played the key role in decision making processes ,and how were farmers' demands addressed in the planning and implementation of the program? What attitudes and practices had influenced the key actors? The next section attempts to examine these and related issues.

4.3. Actors and their roles

According to regional respondents the design process of the SAERT program was carried out jointly by government and donor experts. The project planning started with field studies that covered a wide range of issues including technical, socio-economic and organizational subjects conducted by a multi-disciplinary team composed of senior experts from government sectors, FAO, and private consultancies. The study findings were discussed through consultative meetings between policy makers and experts and the SAERT project framework was developed and presented to stakeholder workshops organized at regional level and finally approved by the regional government. Respondents indicated that the planning and target setting was decided at regional level and the influence of grassroots stakeholders specially farmers were not beyond feeding information and data. After the project components were decided the interactions that followed were orientations to intermediary implementers with the aim of awareness rising about the project objectives and approaches. The responsibilities and participation of stakeholders became more visible during the implementation processes. One of the regional respondents stated:

The problem of participation was not only during the planning phase, but also during the implementation phases. Had there been the willingness to accept the ideas that were coming from farmers, the SAERT approach could have been different. Instead of one solution approach, it could have considered many solutions but there were not ears that were ready to hear such ideas. The respondents explained the SAERT program had

involved different actors that include policy makers, the hierarchies of public sectors, woreda and tabia administrators, farmers and donor agencies.

Regional government

Key roles include approval of project targets, coordination of activities carried out by different sectors, resource allocation, and a support to mobilization of farmers 'accept' the project and 'participate' in implementation. The government was highly motivated in the beginning of the program and provided wide range of support including assigning a full time high level political official in order to assure the realization of the project. However, such motivations and focus to the project declined overtime and finally the regional government decided to stop the project.

The Commission of sustainable agriculture and environmental rehabilitation (CoSAERT)

Since 1996, the CoSAERT was responsible for the study, design, construction and maintenance of micro-dams and water distribution systems. The commission also involved in large-scale irrigation policy making, farmers' capacity building particularly in operation and maintenance, designing and monitoring of soil and water conservation activities around the dam sites. CoSAERT is one of the key actors in selecting project sites, planning and construction of the dam and estimating the irrigable land size.

Bureau of agriculture and natural resources (BoANR)

The bureau of agriculture and natural resources (BoANR) was the other major actor responsible for the overall extension services of irrigation development and soil and water conservation activities. According to the respondents, the irrigation production package was designed to transform the farming systems of smallholders quickly after the construction of the dams into market oriented production through adoption of new technologies such as chemical fertilizers, selected seeds and improved water and land management practices. The assumption was that irrigation infrastructure is costly and can only be profitable under modern production systems and thus farmers were expected to shift quickly from the cereal-based rain-fed practices to new and improved production systems. Based on the strategy, the BoANR designs production plans and technology selection and are transferred to extension workers where farmers are expected to accept and apply the predefined solutions.

Farmers in Korir stated these approaches were pushed immediately after the completion of the dam in which they hardly matched farmers' practices and preferences and as a result the BoANR employed various enforcements including water allocation decisions. According to them farmers

were preferred to produce maize than vegetables because they also wanted to secure livestock feed for the dry season. Similar top-down decisions by BoANR were also observed in other project sites. For instance a case study conducted in Hintalo Wajirat woreda by Teshome (2003) states the power to allocate water in the Gum Selassa irrigation dam was in the hands of woreda experts of the BoANR and the extension agent.

Cooperative promotion bureau (CPB)

The key tasks of CPB are to organize farmers to form irrigation cooperatives for market linkages and input supplies. The informants stated several farmers' cooperatives have been formed in dam irrigation sites. For instance , in the study area alone (Kilte Awlaelo) ,there are in he study area, there are 60 irrigation- based cooperatives who have organized 565 members with the aim of facilitating input supply, credit provision ,marketing of outputs and empowering of members in decision making processes. Farmers in Korir stated they have an irrigation cooperative but its role is limited to input supply such as fertilizers. They indicated marketing of vegetables is a critical problem especially in tomatoes but there is nothing the cooperative can do in solving such challenges.

Woreda and tabia administrations

Their major task is to mobilize farmers for dam construction. The dams are labour based with some support of machineries and many villages both beneficiaries and non-beneficiaries participate in construction on food-for-work basis. Woreda and tabia administration coordinated the land redistribution activities in the project sites which was one of the complex and sensitive components of the intervention. Informant farmers in Korir revealed there are not major complains on the fairness of the redistribution processes but the main problem they mentioned was that the redistribution took place before any experiences of the dam irrigable capacity. As a result, about 50 percent of the land which was redistributed for irrigation had never been irrigated due to the poor estimation of the dam capacity.

Donors and NGOs

Several donors and NGOs have provided material and technical resources in different ways at different stages of the program. Among them include: UNDP, FAO, ECA, IFAD, CIDA, Irish Aid, WFP, GTZ, ESRDF, USAID, REST, and CRS.

For instance, the design process of the SAERT program was funded jointly by UNDP, ECA, and FAO and the regional government.

Farmers

The new intervention requires complex social re-organizations which are new and directly related to the livelihoods of farmers. The construction of dams compete with existing land use because they take place on either communal grazing lands owned and managed by villages or on cultivated lands of individual farmers. The project policy aimed to redistribute the land holding in the command area which directly affects the existed land use rights. Further more, the irrigation program aimed to change the farming practices by introducing innovations of irrigation management. However, farmers were not involved as they key actors in decision making processes of the SAERT program which was the most critical constraint of the intervention. This constraint is recognized by all respondents and several justifications were pointed out during the discussions.

One of the regional respondents stated:

SAERT had bypassed the farmers in the planning stage, again there were several evidences during the implementation period that indicated farmers' resistance to the approaches of the project but there were not listening ears from policy makers that could consider these views. Had the views been heard and discussed, the SAERT program would not have been a single solution approach but a different one.

Farmers in Korir pointed out they were not consulted about their preferences in irrigation and most discussions started when the dam was ready for irrigation. One farmer stated:

The extension agent wanted us to plant early, to grow vegetables and use fertilizers but we were busy with harvesting our rain-fed crops in other places and were not ready for the time he had planned. The extension and the administration were pressuring to the extent that if we do not prepare land on time, we will be prevented from getting water for irrigation. There was also a time when all farmers were told to start ploughing on a date fixed by the extension agents and if someone does not fulfil this instruction the right of land use will be put under risk.

According to the farmers, the Korir has been a fighting place between the extension workers and farmers because experts pushed farmers to implement what they have defined as a better solution in achieving higher production. For instance the early planting of vegetables was one of the causes such conflicts. Farmers stated that when they plant onion and tomatoes in December-January, they will be attacked by diseases and frost hence they delayed early planting. According

to them, the plan by experts did not consider these problems and were pushing to adopt according to their recommendations.

But some farmers disagree with the idea of planting period and argued it is more beneficial to plant earlier in order to exploit the market before surplus of supply is available.

Further more farmers stated the handing over of the dam to farmers and the formation of water users associations was not decided with the full participation of beneficiaries. They pointed out, that the water users' association was formed because the government wanted to transfer the responsibility of maintenance and other activities of the dam to farmers before creating the needed awareness among farmers. However farmers explained the intended objectives have not been achieved due to the failure of the dam to benefit the expected number of farmers and the low capacity of the water users' association. According to them, there is now little attention given to the dam irrigation from above and the enforcement measures practised earlier by the external agencies have also declined.

Farmers state currently, there is limited number of irrigation beneficiaries, the water users' association is weak and the irrigation system is poorly protected.

Recent case study findings from other dam sites revealed similar trends in relation to farmers' participation in decision making. Yohannes (2004) indicates the location of command areas to be irrigated and the dam sites were decided by CoSAERT engineers. According to Teshome (2003), water allocation priorities and package beneficiaries were determined by extension workers in Hintalo Wajirat woreda.

This case study shows that the intervention process did not recognize farmers as the key actors to negotiate and influence over decisions during the SAERT program formulation and implementation. The key decisions which directly and indirectly affect the livelihoods of farmers in the project sites were made by external agencies and farmers were assumed as 'passive recipients' pre-defined solutions. This has impacted in the creativity and innovative capacity of farmers. The case of Korir demonstrates this fact. The ultimate objective of the project was to empower beneficiary farmers to manage and decide on the irrigation systems. However, most of the intended practices have not yet been practical in Korir. For instance, even under favourable bio-physical conditions, most farmers did not plant until February when the fieldwork was conducted. Only few farmers some of them who rented in lands were actively engaged in irrigation. Farmer respondents also explained that the irrigation systems such as the infrastructures and the water are not properly managed due to the low capacity of farmers.

4.4 Attitudes and practices

Over-ambitious targets affected implementation capacities of actors

SAERT was designed with good intentions perused? In the name of achieving food self-sufficiency as quickly as possible to secure the food demand of close to one million people. This has led the regional government to adopt the largest and extensive water harvesting project which planned to build 500 micro-dams and to irrigate 50,000 hectares within ten years. Policy makers and development planners were in high spirits and positive attitudes when the program was launched, believing this was the best and achievable solution to fight hunger and poverty, and to rehabilitate the severely degraded natural resources of the region. However, the reality has proven differently. It was realized that the target was unachievable and the SAERT program was discontinued in 2002 earlier to the target. During the whole implementation period between 1996 to 2992, CoSAERT had constructed only 44 micro-dams (BoWRD, 2003; Eyasu, 2003; Teshome, 2003; Awulachew et al., 2005) with a potential of an irrigable area 2983 hectares in total (Eyasu, 2003). According to an evaluation report by CoSAERT (1999), the project has encountered various technical and social problems which include:

- low implementation capacity due to shortage of professionals and technical facilities resulting in low quality and quantity performance,
- technology is costly and requires high level professionals ,
- economic displacement of farmers due to loss of land for dam reservoir,
- competing claims between upper and down stream farmers,
- loss of water in dams due to seepage
- weak extension service in irrigation production
- low participation of farmers,
- environmental impacts such as soil salinity and sedimentation,
-

The report recognizes that due to inherent limitations of the approach, it would be impossible to achieve the intended objectives of food self-sufficiency in the region through micro-dam expansion. Based on these lessons, some amendments were made in the approach to include other strategies of irrigation such as river diversion, but this was not a basic shift in policy rethinking which continued to be a 'top down' and a large-scale oriented approach.

The decision of adopting over ambitious plan targets had unintended consequences on the capacity of stakeholders especially in the CoSAERT, which were reflected in different aspects.

Respondents stated such targets created high expectations among the policy makers, experts, and farmers in the region. It became clear that the plan was unachievable, the morals and motivations of stakeholders were highly affected and negative attitudes towards the program were developing. For instance, policy makers were not ready to accept new ideas and suggestions that aimed at improving the program approaches, resource allocations to CoSAERT including incentives that were part of the established system were cut-off.

Finally a policy decision was made to stop the program without having adequate communication with respective stakeholders. The policy changes created frustration among experts in CoSAERT and as a result many of them left and organizational instability became a problem. A respondent stated 'the SAERT project started with high interest and motivation but ended with frustration and confusion'. The technical and organizational capacity of the organization which had demanded to build a lot of resources and efforts was thus critically weakened and was hard to recover easily. Respondents stated the overambitious targeting had negative contribution to the quality of the dam construction by focussing more to the numbers of outputs.

A single, standardized and blanket intervention undermined irrigation innovation alternatives

The SAERT program designed a single innovation of micro-dam irrigation with a capacity of irrigating 100 hectares as a blanket solution for all project areas. The plan was based on straight forward assumptions and ideal predictions such as water resource potential, irrigation productivity, the number of people to be addressed, and the possibility of 'persuading as many farmers as possible to accept the model' and be mobilized for implementation. One of the regional experts stated:

The policy of micro-dams was rigid which lacked flexibility. It was a one option approach rather than a holistic strategy. Its one option approach was not an agreed strategy by many. Despite being challenged every time, the strategy continued unchanged.

According to them the expected feasible sites soon became rare during field assessments. In places where there is potential for runoff harvesting, it becomes difficult to find the expected land area for irrigation and similarly where there is sufficient land potential, that location lacks sufficient volume of water to irrigate the intended land size. This means the standardized and fixed intervention approach could be appropriate to few communities and a limited number of

beneficiaries. According to data from Kilde Awlaelo of agriculture and rural development, the woreda was the top priority area for the SAERT program but micro-dam construction was carried out in only in three out of the sixteen tabias with an actual irrigation capacity of less than 120 hectares or about 300 households.

The irrigation development program of the region was shaped by the micro-dam intervention approach. The priority of the extension service regarding irrigation development was focused in micro-dams and other large-scale schemes and other alternative strategies especially household level irrigation potentials were neglected. According to the regional informants, the BoANR had assigned additional extension workers to micro-dam sites with an irrigation capacity of 50 hectares and above to strengthen the extension services in those areas while non project sites were not receiving the service.

The case study of Abraha Atsbaha indicates despite its potentials, there were not any supports from government to develop irrigation during the micro-dam policy period. It was only after the irrigation policy change from large-scale to household level approach that irrigation became the pillar of food security program in the area. After the new policy irrigated area increased from 2.5 hectares in 2003 to 79.6 hectares in 2008 (this research), which shows that this potential was neglected due to the single and large-scale oriented irrigation policy.

Data on regional irrigation development trend similarly indicates the household level irrigation potential was overlooked during the large-scale approach and emerged only after the policy shift (table 4.2).

Table 4.2 Household level irrigation under different irrigation approaches

Irrigation development approach	Year	Irrigated land, ha	No of beneficiary households
Large-scale	1998	NG	NG
	1999	NG	NG
	2000	NG	NG
	2001	NG	NG
	2002	NG	NG
Household level	2003	269	2,144
	2004	2,023.5	16,184
	2005	5,641.5	45,132
	2006	7,271.5	58,172
	2007	8,028	64,224
	2008	9,551	76,408

Source: BoARD (2009) NG-negligible

Top-down approaches excluded the role of key actors

Regional respondents agree that the policy formulation and the planning processes were dominated by the views and interests of policy makers and experts which limited the participation of farmers. Informants explained the implementation processes both the infrastructure development and the irrigation extension services had many aspects of top-down approaches. Farmers in Korir explaining the selection of the dam site stated 'we do not know if discussions had been conducted with administrators about this dam, but we were not involved or asked about it'. They mentioned there were pressures and enforcements from experts and administration to adopt the planned packages such as shifting from cereals to vegetables and fertilizer application. According to them, water allocation priorities were decided based on package acceptance. They said 'these practices were common some years ago but today, there are not such enforcements, and the focus of experts to the dam irrigation is not like what it was during the past years'.

Some of the regional respondents stated the relationship between policy makers and executing agencies had top-down decision making aspects. They mentioned the way the regional government decided to discontinue the program was not based on interactive communication. According to them experts had proposed various irrigation alternatives to diversify the single intervention approach but these recommendations were not accepted and a final decision to stop the program was made by policy makers.

The top-down approaches had little room to learning and building the innovative capacities of actors. During the fieldwork in Korir, it was observed that the intended capacities the intervention had aimed to achieve such as the successful integration of improved irrigation practices and a strong beneficiary organization for a sustainable management of the system do not seem to be yet practical.

Intervention undermined indigenous knowledge

Although traditional irrigation is widely practised in different parts of the region, the large-scale approach undermined the existing potentials and did not incorporate in its strategy. Respondents stated developing and exploiting the small scale traditional irrigation started after the SAERT program. According to the bureau of water resources development, many traditional irrigation schemes which were not considered as important potentials by the previous strategy have been developed by the bureau in more recent years. They stated farmers in those areas have better irrigation experiences but they lacked permanent infrastructures that guarantee access to water. Experts in Kilde Awlaelo explained there are many tabias practising traditional

irrigation but the focus of the extension support until recently was limited to large irrigation schemes such as the Birki valley, Genfel River and the micro-dams. They stated after the policy shift from large-scale to household level irrigation, the scope of the extension support became widened and the attention to traditional knowledge improved. According to them, the interest to maximize the existing knowledge of farmers is growing. They mentioned the case of Adikinsaded tabia. This tabia was not in the priority of the woreda extension program during the previous approach although farmers in that area were practising traditional irrigation. In the past few years, the attention to support farmers' existing efforts have improved and irrigation promotion in Adikinsaded is expanding.

What these cases indicate is that irrigation system development both the infrastructures and the extension supports in the past were influenced by the large-scale approach and the extensive traditional practices which are scattered and small in scale were not considered as important potentials. The Adikinsaded experience reveals that farmers who practised irrigation have developed useful knowledge and skills but the scaling up was restricted by unfavourable irrigation approaches.

The top-down approach restricts developing effective extension services

In Korir, the researcher learned that there is big difference between the role of farmers, their creativity and maximizing benefits in irrigation production. These farmers can be categorized into three groups.

The first group refers to farmers who are well aware of the market information and they were nearly to harvest their products earlier than others. They stated they want to make use of the market during the scarce supply of tomatoes. These farmers include some entrepreneurs who produce vegetables by renting in lands from other farmers. They are semi-urban and have the knowledge and capability in market oriented production. They utilise inputs such as pesticides and fertilizers. They have a network for accessing improved seeds and they stated they grow varieties which are having better demands in the market. Their main skill is penetrating the market before excess supply of tomatoes reach the market. This is interesting because others were arguing that it is risky to grow vegetables until mid- of January. These innovative farmers know very well the best planting time.

Similar activities were observed in few and young individuals who were growing tomatoes before the majority farmers. These farmers have better knowledge in irrigation. They stated they have an

irrigation plot outside the dam site around their homes. They have a small spring and a collection tank which they have been using for years. They stated they have planted fruit trees and vegetables and they aim to reach the market earlier than others.

The second group refers to the majority of farmers who were just starting to plant their crops, some with vegetables and others with cereals. Their production schedule is not related to market information. They think it is risky to grow vegetables earlier, they are engaged in rain-fed agricultural activities until January hence they plan first to deal with it and then continue with irrigation.

A third group can be explained those who have not started any significant activity in their fields during the peak time. They explain different problems including shortage of oxen for ploughing, labour and engagement in other activities. Farmers agree that late planting has many disadvantages. They stated the prices for late produces get cheaper, they may face the risk of water shortages, and the land preparation for the next round cropping can be delayed,

Farmers explained the extension agents visit them and sometimes provide them with trainings. The differences are not related to lack of or differences in accessing the extension services. Majority of farmers have accesses to extension services but their practices have not changed much. The innovators have developed their knowledge through their own networks and background. What the case demonstrates is that the extension service in Korir has been functional for about 10 years but the outcomes are still limited and the majority of farmers are not maximizing the benefits of irrigation.

Hence the project objectives that aimed to build effective extension services seem to be not materialized.

4.5 Patterns of interactions

According to the key informants, the type of interactions during the planning and implementation processes had various forms and strengths.

Partnerships

The CoSAERT, BoANR and the cooperatives promotion bureau (CPB) had formal and informal interactions to deal with problems related to water users associations and cooperatives, operation and maintenances of dams, and extension activities. Through these interactions, guidelines, workshops and other learning activities were carried out jointly to solve practical problems. Similar activities were also practiced at woreda level between the administration, CoSAERT and

BoANR to address problems such as irrigated land re-allocation, mobilization of farmers for dam construction and maintenance. Such interactions served as learning opportunities by searching feasible solutions to practical problems.

The partnerships had various complaints and tensions between participating actors. According to respondents the tension was especially between BoANR and CoSAERT. Respondents in the bureau of water resources development stated CoSAERT was complaining on BoANR for not following the recommendations developed in the feasibility study of project as a guiding strategy for the extension service program in the intervention sites. These recommendations included adoption of production technologies such as selection of vegetables types, production schedules, water management and other techniques. CoSAERT was also complaining on BoANR for not coordinating the operation and maintenance of the irrigation infrastructure, delay in organizing the water users' association to manage the irrigation system and problems related to protection of dams from silt.

BoANR was also disappointed on the delay in completion of the project, poor quality performance, and exaggerated estimation of dam capacities which had negative implications on the farmers' land redistribution. Such tensions had existed through out the program period and were obstacles to learning and integrating filed level activities.

Similarly the interactions between policy makers and experts particularly during the last years of the intervention had tensions and contradictions. As was stated earlier, key policy decisions regarding such as resource allocations and the discontinuing of the program were not welcomed by other stakeholders.

Networks

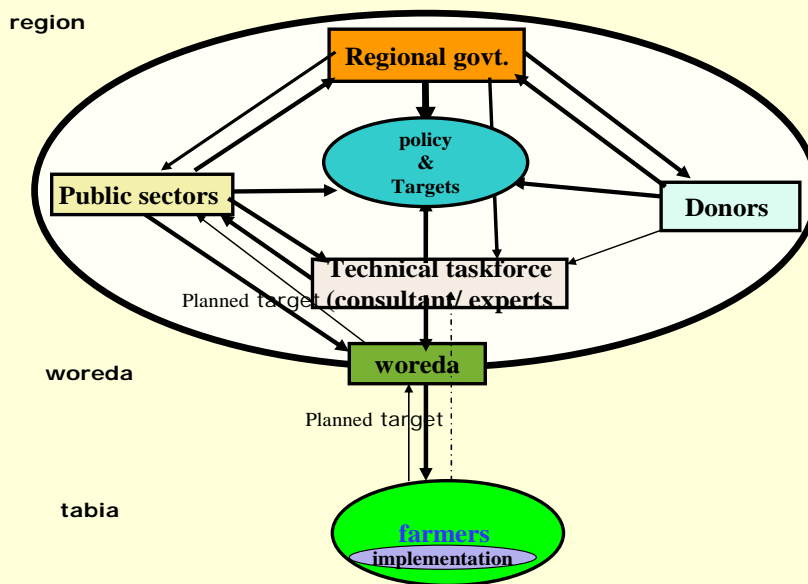
Interactions with wider range of actors including policy makers, public sectors, NGOs, woreda representatives were conducted through workshops, seminars, and field days to exchange information and experiences of irrigation activities. Nevertheless, they were occasional events and had limited contribution to learning.

Paternalistic

This type of interaction was the main form of relationships practiced within the hierarchy of the public sectors and with farmers (figure 4.1). Pre-defined plans such as irrigation production packages were formulated at the region, transferred to districts and finally to farmers with little

regard to their preferences and priorities. Farmers in Korir pointed out they were blamed for ‘slow’ progress in adopting improved irrigation practices as designed in the package such as a shift from cereals to vegetables, adopting fertilizers, selected seeds and water management. The implementation processes follow ‘instrumental and one way communication approach’ with little room for interactive learning. Informants stated the main methods of interactions and information flows were annual performance evaluations, plan orientations, reporting and field level project supervision and monitoring. Formal training programs conducted to experts and farmers to improve the knowledge of irrigation

Figure 4.1 Pattern of interactions



Source: the author

4.6 Enabling environment: Infrastructure and finance

Most dams are located in the woredas of Enderta, Hintalo Wajirat and Wukro which are accessible to the main high way and market centres. Despite their locations however, price of vegetables highly fluctuate from season to season and from place to place depending on the

supply and demand situations. Farmers in Korir stated the price of tomatoes was 8.00 birr³ in September and October 2008 but suddenly declined to 1.00-0.50 birr in January 2009 and this had been the trend in the past 3-4 years. According to them, lack of market incentives are causing huge losses in vegetable production of the area.

With regard to sustainable financing of the program, different assumptions were considered during the feasibility study. These included expected production plans, feasible investment costs and a cost recovery system to be implemented by beneficiaries. Respondents stated there was a big gap between the planning assumptions and the results in practice. The investment costs in many sites were high beyond the initial estimations, the actual production was lower than what was expected during planning and the cost recovery system was not implemented due to various reasons

Much lower performance of the project against the planned targets and high investment costs had discouraged policy makers to continue financing the construction of micro-dams. However, government and donor support to improve the productivity of farmers has continued and was not affected by the policy change.

Farmers in Korir highlighted they have access to credit for purchasing agricultural inputs such as fertilizers, selected seeds, pesticides and water pumps. Credit is provided by farmers' cooperatives and Dedebit Credit and Saving Institute (DECSI), a micro-finance enterprise. They expressed access to credit is not a major problem but the expensive prices is restricting most farmer to utilize appropriate inputs which results in low yields and limited diversification of products.

4.7. Innovation outcomes with special attention for the smallholder situation

How the SAERT program was ended up

CoSAERT had constructed only 44 micro-dams in 6-7 years of the project implementation period (less than a one year planned target) with an irrigable capacity of about 2,970 hectares Eyasu, 2003; BoWRD, 2003; BoARD, 2009). However the actual total irrigated land with these micro-dams is only 1400 hectares (Eyasu, 2003) which is less than 50 percent of the irrigable capacity (table 4.2). This is what SAERT has contributed to the total irrigated land of the region (graph 4.2). Among the constructed dams, 18 are non-functional and 9 schemes have problems such as

high seepage (Awulachew et al., 2005). The non-functional dams have various negative consequences in the livelihood of farmers. One of the major problem is the land occupied by the dam reservoir becomes swampy and unproductive and farmers become economically displaced due to loss of their land. In well functional dams, such displacement is addressed by the land reallocation program in the command area.

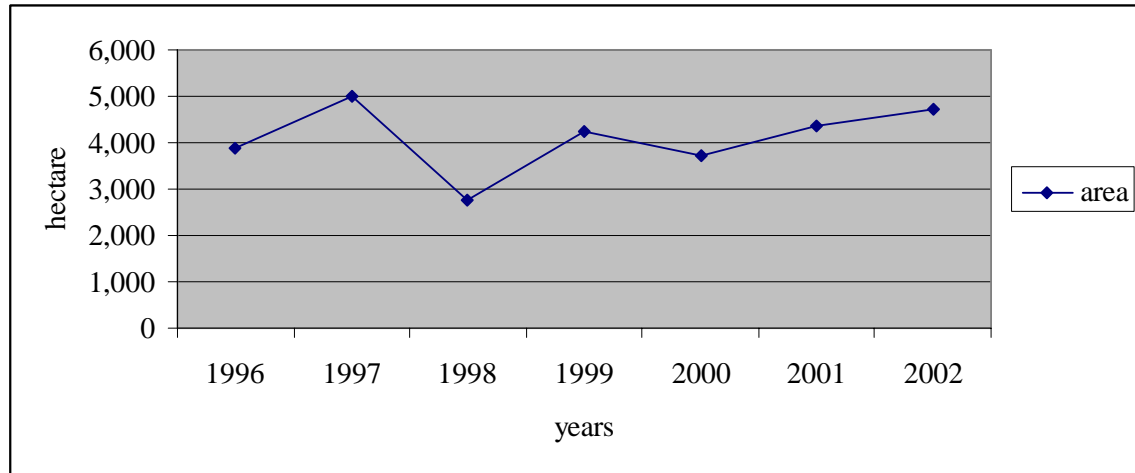
With this achievement, it can be said that the SAERT program has minimal contribution to the overall irrigation development program of the region. The failures of the program forced the regional government to discontinue the intervention earlier than the planned period and an alternative strategy to the large-scale irrigation approach became into picture

Table 4.2 Achievements of micro-dam irrigation

<i>Zone</i>	<i>Quantity of constructed dams</i>	Area irrigated in ha	
		Potential capacity	Actual
Southern	33	2,163	925
Eastern	8	508	298
Central	2	194	128
Western	1	100	67
Total	44	2,965	1,418

Source: Eyasu (2003)

Graph 4.2 Total regional irrigated land during the SAERT program, ha



Source: BoARD (2008)

Why did the SAERT program fail to achieve its goals?

Many agree that the SAERT program had failed but opinions and views on the causes of the failures are divergent and there is no yet consensus.

The failures of the SAERT program have provoked many questions and it is one of the widely debated issues among policy makers, experts, researchers, and farmers in Tigray. respondents think the major problems as follows:

- human and material resource limitations in CoSAERT ,
- lack of integration among stakeholders ,
- weak capacity of water users' associations
- weak extension support
- lack of farmers participation

The capacity limitations in CoSAERT were explained as lack of skilled manpower and technical equipment. Shortage of these resources had resulted in low quantity and quality outcomes. According to them, CoSAERT was a newly established organization which lacked experienced manpower and necessary equipment to carry out its tasks of study, design and construction of irrigation infrastructures. The integration issue was mentioned in relation to the problem of silt in dams due to unprotected catchments. Similarly the extension program in irrigation was expected

to introduce improved production practices with efficient utilization of water but in practice the technology transfer is slow resulting in low productivity of farmers. The program had initially planned that the water users' associations will take over the responsibility of operation and maintenance of the dams. According to the respondents, this capacity is still weak and the dams are at risk. Further more, the issue of over-ambitious planning and high expectations were mentioned as the main problems compounding the constraints.

According to the respondents, the micro-dam technology is an important strategy to Tigray. They stated the problem is not in the technology itself but in the planning and implementation approaches. One of the regional policy makers stated the following:

In Tigray, the main irrigation strategy should be a combination of various technologies including household level and large irrigation infrastructures such as micro-dams, river diversions and ground water systems. There fore water harvesting through micro-dam structures should continue by learning useful lessons from SAERT and carefully correcting the mistakes of the past.

This research argues that the key factors that caused the failures are the outcomes of the top-down culture that dominated the policy formulation and implementation processes. This culture pushed to design a standardized regional solution with a massive scale target without considering the diverse local contexts that require diverse solutions. This approach restricted the learning and interactive processes by undermining farmers' views and priorities, feedbacks of experts, and other stakeholders. As farmers in Korir explained, due attention was not given to consult beneficiaries in the selection and approaches of the intervention. Because the focus was on a single solution, all attempts were made to find suitable areas for the intervention by neglecting other alternatives.

The SAERT program adopted a plan that focused in one-size fits all type of technical solutions, it undermined the diversity of socio-economic factors in each locality, and it followed a rigid approach that prevented flexibility and local level adaptations. The case of Kilde Awlaelo demonstrates that the different potentials and alternatives of irrigation were neglected during the micro-dam approach because the focus was in limited tabias that were assumed suitable for large-scale irrigation. After the change in the approach, areas such as Adikinsaded and Abraha Atsbaha proved they have different alternatives than the micro-dam type solutions.

In general the problems mentioned by the respondents indicate that a top-down and linear approach can not yield in integration of various activities because it restricted free interactions and feedbacks, empowering the water users' association was not achieved because farmers were marginalized in decision making processes. Similarly, the capacity of the implementers and the expected goals did not match due to the over-ambitious planning that undermined the reality in the ground.

Some positive outcomes of SAERT

The SAERT program was implemented in purely top-down approaches which finally led to complete failures. However this does not mean there were not any positive achievements. Some positive outcomes were mentioned by respondents.

They stated the program has helped to strengthen the knowledge and skills of modern irrigation systems among the implementing organizations and smallholders which was almost absent before the intervention. According to the respondents, the BoWRD⁴ has gained the capacity to study, design and construct large-scale irrigation schemes such as micro-dams and river diversions during the implementation of the SAERT program. It was from these experiences that the bureau was able to implement various river diversion schemes. Some useful lessons from the SAERT experience have contributed to the current capacity in which the bureau has recently started to undertake the construction of few micro-dams.

The extension system has also gained some useful experiences in improved irrigation practices from the well functioning micro-dams. Furthermore, it has been observed that well functioning micro-dams can be useful means to address the problem food insecurity in drought prone areas of Tigray, where agriculture is extremely vulnerable to moisture stress. A case study finding by (Behailu and Nata, 2004: 13) from *Haiba* micro-dam states:

Even though poor water management and low irrigation efficiency characterize the scheme, the scheme made much contribution to the nearby villages. There is a marked improvement on the moral and capacity of the farmers; able them to send their children to school, paying for school fees and medicines, and construct their own houses. More importantly, water related hardships of women and children have been resolved. The farmers, who were not self-sufficient before the construction of the dam, now are able to

⁴ CoSAERT is now merged with bureau of water resources development

sell their surplus agricultural products. More farmers are also now experimenting cash crops in their plots that were not used to it before.

However, it is important to note that, not in all well functioning dams, are all farmers active and benefiting as expected. The case of Korir demonstrates that a small number of farmers have developed the technical and marketing knowledge that enables them to improve the productivity and income of irrigation production. The majority of farmers have limited capacity to exploit the irrigation potential available in the dam system.

Respondents stated in some well functioning dams, farmers' organizations such as irrigation cooperatives and water users' associations are facilitating interactions and information flows, experience sharing, access to credit and collective actions in maintenance and operation activities which are important elements of innovation capacities.

In the case of Korir, such positive contributions are very limited because of the weak capacity of the organizations and expensive prices of inputs. However, the opinion of the respondents is backed by a case observed in Hizaeti Wedicheber, a dam site which was visited by the researcher. Farmers pointed out they have an active cooperative which facilitates access to market to its members in the regional capital, Mekelle. It was observed that most members transport their potatoes and cabbages with the support of the cooperative. They stated the cooperative has secured a store in Mekelle with out which could have been difficult to access the Mekelle market.

Picture 4.1 Korir dam



Source: the author

Micro-dams constructed in better quality have positive impacts on enhancing ground water potentials and replenishing aquifers and some communities were able to promote irrigation through shallow wells and spring diversions. Such advantages are easily observed in many well functioning micro-dams. For instance the micro-dam in Hizaeti Wedicheber has enhanced the springs around the dam and in the gorges of down streams such as a place known as Chelekot.

4.8 Conclusions

SAERT was the biggest development program in 90s, designed to address food insecurity in the most drought affected areas which is the key problem of the rural poor. It developed a unique and new intervention, the micro-dam was believed to be the best solution to fight drought by maximum utilization of available resources: labour, water and land. The goal of the program was to achieve a breakthrough change in ten years period by producing surplus food and creating a sustainable environment for agriculture.

The program has attracted many stakeholders including policy makers, senior experts, donor agencies and public sectors who participated with good intentions and high expectations. During the policy formulations, intensive studies that covered wide range of issues were carried out by various experts including senior development planners and consultants. Project planning was based on these studies and professional assumptions.

The SAERT program until a certain level enjoyed strong policy supports including resources, and political backing and the state machinery such as the woreda and tabia administrations were made ready to provide a full support by mobilizing and ‘convincing’ the community to accept and participate in the program.

Despite all these supports and arrangements, the SAERT program has achieved very little and became a failed project which at the end disappointed and affected the moral of the stakeholders. The program failed not because of lack of resources or policy support as is common in many projects but because of attitudinal problems that persistently dominated the processes. The culture of the top-down approach which is one of the major killers of innovation has led to failure the program which was once the most popular intervention in the region. the top-down approach was reflected in many aspects including marginalizing farmers’ participation, adopting a single and standardized solution, undermining other potentials of irrigation, and lack of flexibility in reading and accepting other opinions and feedbacks. It is important to mention that while the top-down approach does not enable a major change in development, some of the cases mentioned

above indicate that certain incremental changes and economic advantages can be achieved. However, these vary from location to location and from farmer to farmer. The case of Korir indicates the changes are minimal even under the top-down approaches opportunities.

After the failures, the regional government has shifted to a new irrigation approach which is household based strategy. This has been the policy priority in all parts of Tigray since 2003.

The key issues are to what extent are the lessons of SAERT intervention learned and considered in the new approach? How far is the attitude of top-down in policy making avoided in the new approach?

The next chapter discusses how the new approach has evolved and how the policy is being transformed into practices.

CHAPTER FIVE: ABRAHA ATSBABA: COMMUNITY CREATIVITY IN HOUSEHOLD LEVEL IRRIGATION INNOVATIONS

This chapter focuses on a case study of household level irrigation innovations in Abraha Atsbaha tabia. It starts with a brief introduction of the household level irrigation policy in Tigray. Detail discussion is presented on how the policy was translated into practice by the community. The study concentrates on the processes of planning and implementation of irrigation strategies and farmers' response and creativity in local level adaptations and innovations of irrigation alternatives. The chapter ends by drawing key lessons and conclusions.

5.1. Introduction

5.1.1. The household level irrigation policy

In 2001/02, a 'renewal movement', initiated by the ruling party, the Ethiopian People's Revolutionary Democratic Front (EPRDF), was carried out in Ethiopia which aimed at accelerating the socio-economic development of the country (TPLF⁵, 2001). During the 'renewal movement', the party and the government conducted in-depth reviews on major policy implementation approaches and outcomes and concluded that the progress towards poverty reduction, food security and overall economic growth was very slow due to inappropriate development strategies (TPLF, 2001).

In agricultural development, some of the identified problems include:

- Top-down implementation approaches and lack of genuine participation of farmers,
- Focussing on large-scale interventions which are difficult to adopt at massive scale,
- Interventions are slow and changes are invisible
- Blanket recommendations that do not consider agro-ecology potentials and constraints
- poor implementation capacities

Following the reviews, the agricultural development policy was reformulated with focus to achieving food security and poverty reduction through household based packages and massive scale-intervention approaches. As the experiences of large-scale water harvesting schemes such

⁵ The Tigray People's Liberation Front is one of the political parties that make up the ruling party coalition, the EPRDF

as the micro-dams were found expensive and difficult to scale-up at massive scale, the new strategy emphasizes on simple, low cost and household managed technologies that can intensively use locally available resources such as land, labour, water and skills. Furthermore, the policy stresses on farmers' participation (FDRE, 2001:135) and states:

When we say people's participation, it can only be that which is based on believing and willingness. If the people have to participate willingly, they have to discuss and debate on the options presented to them. They must be able to get reasonable arguments on things which are not clear to them. They must also be able to present better alternatives, if they have, and debate on them. They must also have the right to choose only which they think will benefit them and be able to decide and implement it. In other words, participation must be based on a fully democratic way. The first thing to be fulfilled to make the farmer participate is to present a development alternative which highly ensures the benefit of the farmer. Without an alternative which highly ensures the benefit of the farmer, it is unthinkable to persuade him.

The shift in policy paths has required regional governments to revise and develop specific priority programs and medium term (3-5 years) action plans. Since 2002/03, the regional government of Tigray has adopted a food security program based on integrated and massive scale household packages and water harvesting is a main pillar of the program to minimise the vulnerability of agriculture to recurrent drought. In order to promote the water harvesting strategy, experts designed household managed ponds with a storage capacity of 110-180 meter cubic and irrigable potential of 0.1 hectares. The design and plan of a pond considers selection of a proper site in order to harvest maximum runoff from rain, plastic or clay lining to protect water losses and water lifting devices such buckets or treadle pumps.

In 2003, the bureau of water resources development planned 30,000 ponds as a pilot program to be implemented in 22 most drought affected woredas. In the following years, the regional government decided to promote ponds with its own resources and donor assistance on a larger scale and a plan target of 560,640 ponds with an estimated irrigable area of 56,000 hectares was set for 2004-2006 program period (BoWRD, 2003).

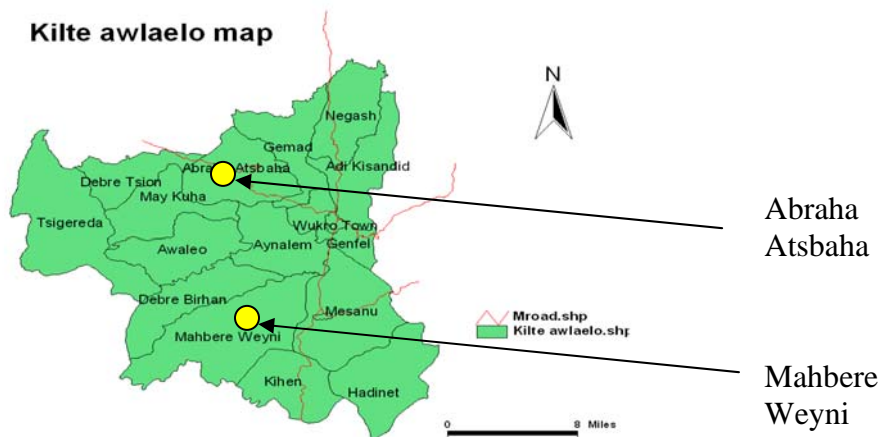
Picture 5.1 A typical design of a pond



Source: BoARD (2006)

5.1.2. Socio-economic context of the study area

Figure 5.1 Map of Kilde Awlaelo woreda and tabias under study



Source: BoFED (2006)

Kilde Awlaelo woreda

The research was conducted in Kilde Awlaelo woreda located in the eastern zone of Tigray, about 45 kilometres north of the regional capital, Mekelle. It has a total population of 99,688 with 95 percent living in rural and only 5 percent live in urban (CSA, 2008). The woreda is divided into 16 administration units known as tabias or peasant associations. A tabia is the lowest administrative unit and is composed of 3-5 villages.

The cultivated land in Kilde Awlaelo is about 21,100 hectares with an average landholding of 0.8 hectares per household (BoANR, 2003) which is relatively higher than the most densely populated areas of the region. Crops are the main sources of food and livestock such as cattle and small ruminants play important role in income earnings. The major crops grown include wheat, barely and teff.

Kilde Awaleo is one of the most drought affected areas in Tigray suffering from high levels of food insecurity. Several poor consecutive rainy seasons have affected most parts of the woreda resulting in severe crop failures. The annual rainfall is low and erratic fluctuating between 300-700mm. According to the woreda office of agriculture and rural development it has become a common phenomena that the rains start late after the main planting period and end too early which is severely affecting the cropping systems and yields. Crop yield in the woreda ranges between 0.4 to 0.9 tonnes per hectare and is lower than the regional average.

Addressing food insecurity of smallholders and rehabilitating the degraded natural resources are the top priorities of the government and NGOs in the woreda. Development programs are focus on three interrelated interventions: community based soil and water conservation and afforestation, household packages of crop and livestock production, and promoting irrigation activities Household packages were originally designed to specialize each area primarily in market oriented crop and livestock production. For instance, the package recommended farmers in Abraha Atsbaha to focus and specialize in honey production by adapting modern beehives and other beekeeping management practices. According to the woreda office of agriculture and rural development (2008), until 2007 a total of 13,894 households have received credit to purchase agricultural inputs under the household package program out of which 32 percent is said to have reached the food security income level of 1\$ per person per day.

Since 2003, household level water harvesting schemes, primarily ponds are promoted at larger scale in all tabias including the study sites. Woreda reports indicate that irrigated area has significantly increased after the change of irrigation strategy from the micro-dam approach to household based strategy. The total land under irrigation in 2004 was 752 hectares owned by 4865 farmer beneficiaries. In 2008 this has increased to 1,555 hectares practised by 9,595 farmers of which 74 percent depend on household level irrigation such as shallow wells, pump irrigation and river diversion schemes. According to the woreda office of agriculture and rural development, the pond strategy has been unsuccessful in many tabias due to technical and social factors and the focus of the woreda is now shifting to the other alternatives.

Abraha Atsbaha

Picture 5.2 View of Abraha Atsbaha



Source: the author

Abreha Atsbeha is one of the 16 tabias of Kilde Awlaelo woreda situated 15 kilometres northwest of Wukro, the woreda capital. The tabia is composed of three villages with a total population of 4921 inhabitants. There are 915 households of which 262 (28.6 %) are female headed.

The total land area of the tabia is estimated 7724 hectares and cultivated area is only 1047 hectares. The total area under irrigation in 2008 was 80 hectares. About 47 percent of the non cultivated area is under area closure management for reforestation. Abraha Atsbaha is characterised by hilly and rugged landscape which is unsuitable for cultivation. Crop production is rain-dependent with only 10 percent of the total land under irrigation. The major crops grown are wheat, *teff*, and finger millet and the average yield for 2008 was 7.3 *quintal* per hectare. The area receives low and erratic rainfall between July and August which amounts 350-600 mm. The community has been vulnerable to repeated droughts in the past decades.

According to the extension office report (2008), shortage of cultivated land, lack of oxen, poor soil fertility and moisture deficits are the major challenges in agricultural production. In Abraha

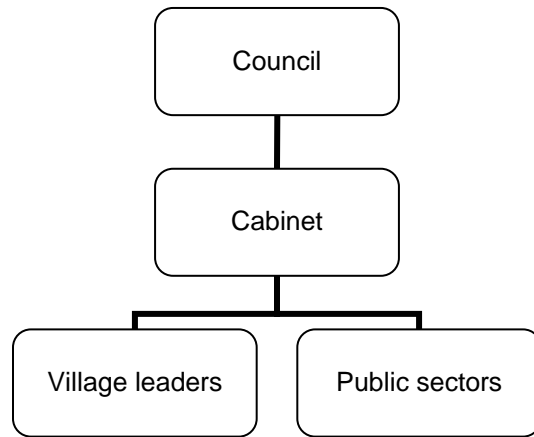
Atsbaha, 350 households do not own cultivated land, and 270 have not oxen for ploughing. Food-for-work program is an important source of food for majority of farmers specially the poor.

Local level organizations and groups

Tabia council

The tabia council is the highest legal body in the tabia established by elected members of the residents. It has 112 male and 112 female members. The tabia council has elected a 13 member of tabia cabinet or tabia administration body. The cabinet chairman is elected by the council and is the tabia administrator and is responsible for overall coordination of political, social and economic activities. He is assisted by village leaders and tabia cabinet members. Tabia government representatives of the extension, education, and health services are members of the cabinet and are answerable for their work to the administrator and the council.

Figure 5.1 Tabia political structures



Source: Abraha Atsbaha tabia administration (2008)

The extension service

Farmers are organized in farmers' cooperatives and mass associations. There are three development agents (extension workers) permanently assigned in the tabia. All farmers of the tabia are organized into small groups for the purpose of extension services. There are 36 groups each with 25 members and each group has 5 representatives who serve as the contact farmers of the extension worker. There is one farmers' training centre (FTC) with a training hall, a show room, offices and a demonstration plot. The extension worker organizes a meeting with the

contact farmers every week and discuss on seasonal activities. The contact farmers are assigned with planned activities to be implemented by each group.

Farmers' organizations

There is one farmers' cooperative functioning at tabia level with 504 members. It provides agricultural inputs in kind such as water pumps, fertilizers, and selected seeds. Other farmers' organizations include three separate mass associations of women, youth and farmers whose major tasks are motivating member participate in various development activities including in household level irrigation. The women association has 620 members and is stronger than the farmers' and the youth associations.

5.2. Household level irrigation policy in practice in Abraha Atsbaha

Data sources for the in-depth study

As discussed in the data collection methodology 18 households were selected for semi-structured interviews and 7 people participated in the focus group discussion .A summary of descriptive statistics for both groups is presented in table 5.1.

Table 5.1 Descriptive statistics of household respondents

characteristics	Semi-structured interviews	Focus group discussion
Mean age (years)	53.5	56.4
Mean family size	4.9	6.7
Mean land holding (ha)	0.88	0.97
Male (%)	83.3	86.7
Female (%)	16.7	14.3

Source: the author

5.2.1. Actors and their roles

Identification of organizations, groups and key individuals involved or missing in the household irrigation development was carried out through the focus group discussion. The group was asked

first to list all actors and then formulate an Actor Time Line (ATL) by mentioning the sequences of key events and their drivers related to household irrigation practices. Finally based on the ATL, the group identified the key actors and their interaction mechanisms in the processes. This information was further confirmed through semi-structured and key informant interviews at the community, district and regional levels.

According to the respondents, household level irrigation practices were first introduced to the area by individual farmers long before any formal extension service started. In 1974, an individual farmer who had migrated to Eritrea and was employed in an irrigation farm started a shallow well based irrigation on his own plot. Nevertheless, only three farmers had followed his experiences until 2003 when the government initiated ponds were introduced to Abraha Atsbaha. Although various policy initiatives including land tenure reforms, establishment of extension services and different agricultural development interventions were undertaken by different actors (table 5.2), they were not in favour of household level irrigation and what these few farmers practised were self initiated without any external supports. Most irrigation activities and the involvement of different actors started after the adoption of household irrigation strategy by the government in 2003. Respondents stated, since then, the implementation processes has involved a diversity of actors which include the public sectors at regional and woreda, farmers and their organizations, NGOs and international donors and the private sector.

The role of public sectors

Planning -The technical design and the implementation approaches of the pond program was decided at regional level by a steering committee established from the regional government, the bureau of water resources development (BoWRD) and the Relief Society of Tigray (REST). The committee determined the plan targets for each woreda based on the number of vulnerable households and passed onto woreda ad hoc committees for implementation. During the first two years, BoWRD was responsible for the overall coordination and supervision of the pond program. Since it did not have field level staffs, it recruited new technicians, and were assigned at each tabia to handle the construction of ponds. The technicians were high school complete students who never had any background experiences in ponds and coordinating public activities. They were given technical training in pond construction by BoWRD and supervised by woreda experts at field level. The mandate of household level irrigation coordination was later transferred to the BoARD and field level supervision became the responsibility of development agents. According to the respondents, detail implementation arrangements were also determined by the public sectors particularly by the regional actors. In the first year of the program, all farmers were organized into

small groups which were responsible for the construction of ponds of each group member. The groups were supported with grain as food -for -work to motivate the accomplishment of the targets.

Credit-The public sectors are also the main players in credit facilitation. The BoARD has provided cement, plastic sheets, and treadle and motor pumps and fruit seedlings in kind to the farmers' cooperative in the tabia and were distributed to individual households on credit basis. The regional government has made a subsidy of 70 and 60 percent for cement and plastic sheets respectively to support farmers in the promotion of ponds.

Technology diffusion- Farmers stated they participate in experience sharing events such as field days in their area organized by the extension service. All farmer respondents indicated they got the first knowledge about pond based irrigation from the public agencies and individual farmers explained they were trained in treadle pump operation.

Motivating model farmers- some farmers stated they were rewarded through material incentives such as treadle pump for their adoption of improved irrigation practices.

Linking with private sector-small and micro-enterprise were given a contract by BoARD to manufacture treadle pumps which were purchased by the government and distributed to farmers. Respondents from the private sector stated this was the first time they manufactured treadle pumps with the technical support from the government and this has created better business to them because their market was secured through the contract. However the contract was stopped in 2006 after two years of work and they do not produce treadle pump any more due to lack of markets.

Farmers and their organizations

Tabia and village administrators

The community administrators are an important conduit for government policy translating into action, community mobilization, resource management, networking and skill transfer.

Implementing the pond strategy- they received plan targets from the woreda for the number of ponds to be constructed in their tabia and mobilised the tabia community to construct ponds.

Their responsibility included: selection of individual beneficiary, group formation and resource administration (grain for food -for- work).

Shifting to other strategies-After one year of implementing ponds, farmers started to demand their leaders allow the groups to construct shallow wells instead of ponds. The leaders realised ponds were not appropriate to their area and shifted the food for work to shallow wells construction. According to the leaders, the plan for ponds had continued to come from the woreda but they abandoned implementing them in their tabias after they evaluated that the strategy of ponds had failed to serve its objectives. The leaders convinced farmers to construct large structures of percolation ponds in upper sites of the shallow wells in order to guarantee the sustainability of the wells by enhancing the ground water potentials. Other important roles of the tabia leaders included developing alternatives for household irrigation in sites where shallow wells are not feasible and scaling up of new systems of irrigation introduced by GTZ.

Coordinating collective actions- one of the key tasks of tabia leaders is mobilizing community members and coordinating intensive activities of integrated watershed management which includes terracing catchments, area closures, forest development, grazing land management , gully rehabilitation and large structures of runoff collection. These activities have direct impact in enhancing surface and ground water potential for irrigation. Developed gullies are redistributed to landless farmers for vegetable production and beekeeping activities.

Working with church leaders-church leaders are highly respected by community members and are influential in different social interactions and activities. Local leaders have strong contacts in order to buy in positive support in their development endeavours. One of the church leaders stated 'we have close collaboration with the tabia leader in his efforts of helping the community to fight poverty, we teach the community to work hard in development, we teach them to solve any conflict that arises among community members'. Farmers also stated the number of holydays that restricted working have decreased due to flexibility of church leaders. For instance, the tabia leader has stated the following:

A large gully protection check-dam built by the community was damaged by flood during Saturday. We believed if it is not maintained on immediately on Sunday, it will be completely washed away by flood during the night rains and therefore we decided to mobilize the community to maintain it on Sunday. Fortunately the community members were with us in a meeting and asked them if they are ready to take action. They replied that

if the church leaders allow them to work on Sunday, they are ready to maintain the gully. Then we approached the church leaders and convinced them to allow us. The church leaders said they will not tell the community to go and maintain but we will not create any obstacle during their work. With this positive support, we were able to maintain and save the gully on Sunday which is uncommon given the religion restrictions.

Attracting NGOs-local leaders are actively working to attract NGOs and for more resource support.

Pushing the bureaucracy- local leaders make a lot of pressure to get the backing of the woreda public sectors in their self initiated activities. They have been successful in overcoming various obstacles in recognizing their plans and resource allocations.

Focus group participants and interviewees were asked to rank the first, second and third key actors whom they consider are the top players in the irrigation development. The result of the ranking was the tabia leader, the development workers (extension workers) and village leaders respectively.

They stated the prime mover in all these activities is the tabia leader. They explained his role in technical support, organizing community towards focussed programs that are appreciated by farmers, allocating land to the poor and fair distribution of development programs among the three villages. According to them, he demonstrates most of the best practices on his own plots and invites farmers to learn from his experiences, he makes tours once every two months to each household, and farmers have given him a nick-name with '*the father of development*' for his successful achievements. Farmers stated his roles are sometimes restricted by some officials in the bureaucracy and unsatisfied individuals within the community.

Farmers were asked to explain what factors influenced the tabia leader to be inspired and committed. One of the respondents stated:

In the 80s when the TPLF led the armed struggle, he was an active member of the youth association. Later he was elected as a tabia leader when he has still young and he had coordinated various political and social activities in the tabia including mass mobilization in soil and water conservation, land redistribution program, security issues and routine administration. Since that time, he has developed managerial skills and strong relationships with the tabia people. He took his own initiative to protect a forest area around his village

which has today become a learning model site. In 2001/02, the government and the party initiated program of an evaluation forum where we were invited to evaluate the tabia leaders about good governance that focussed on corruption, favouritism, and commitment of leadership. We were told to remove those bad leaders such as corrupted by stealing grain from the food for work program. There was a hot debate about the current leader where some farmers suggested replacing him while others supported to maintain him in his position. Finally we agreed to give him one chance and see his leadership but this was with strong warning. At the end of the meeting, he promised that he will compensate the lost years by working hard in the coming years. Now he has proved that he is delivering what he promised to the community. Before 2-3 years, there was a small group of farmers who did their best to remove him from his position. They even committed some bad things in his private property. The community refused their arguments and gave their support to the tabia leader to continue his responsibility. There are few people specially those who at one time were members of the tabia administration who are not happy with his current position but the majority is his strong supporter.

According to the farmers, the public evaluation that was conducted to asses the good governance situation in the tabia had great contribution but such forums have not continued with the same momentum and objectives. They noted the previous forum was conducted under a special initiative of the ruling party which was known as the 'renewal movement'.

Picture 5.3 Farm of the tabia leader



Source: the author

A leader, an innovator and an entrepreneur

Dairy, a shallow well, irrigation farm, beekeeping and a café in one farm

Farmers' cooperative

The cooperative facilitates the credit for agricultural inputs and equipment to such as treadle pumps, motor pumps, selected seeds and fertilizers. The cooperative is young and does not have the capital and the access to purchase them but receives them from the BoARD and manages the distribution and the credit processes.

Farmers' associations

Representatives of the farmers', women's and youth associations are members of a joint committee formed by the tabia cabinet and village administrators. The major role of the association representatives includes awareness creation among their members to 'accept' and implement government policies such as the pond strategy and other food security programs. Further more, the women association occasionally provides training and credit and to its members.

Farmers

In Abraha Atsbaha 47 percent of the total households are engaged in different types of irrigation practices (table 5.1). In 2003, the tabia administration received a plan target of 214 ponds (214

households) including a time frame for implementation from the woreda. This target was distributed to each village on quota basis by the tabia administration to reach the decided target. All community members were grouped into construction crews of 20 to 25 people and received a target from village leaders to be accomplished within a fixed timeframe. The group was paid grain for the construction of each pond on contract basis and the food-for-work program in watershed management was shifted to the pond construction.

The site and farmer selection were carried out by different people including the technician and the village leader individually or jointly. Farmer respondents explained that pond was new to them and they never believed in it as a beneficial technology. Despite this perception, they accepted to construct ponds on their plots because that was the only alternative of water harvesting package allowed implementing. One of the respondents stated 'when a government is pushing to all to do something, it is risky to confront with your leaders until the wind of such push goes'. Farmers who adopted wells earlier to the policy were also instructed to build ponds in spite of their demands for allowing the construction crew in their group to maintain and improve their wells. Further more, it was stated that the time when the pond introduced was a drought year and the only way to get food aid was to join the pond construction crew and be engaged in the food-for-work program.

In 2004, the role of farmers had significantly changed. The community members and the tabia leaders did not follow the plan from above which according to them focussed on ponds. Based on the interest of farmers, they shifted the task of the working teams and the purpose of the food aid to well construction. According to the tabia leader, the change was triggered first by a group of farmers in a sub-village known as Mendae. This is the site where the first innovators practised shallow wells and the area is relatively potential for ground water. When some farmers were digging the ground for ponds, there was water in few meters depth and they started to learn that site can be developed for shallow wells similar to the early innovators. With this experiences, they approached the tabia administration to allow the construction crews develop shallow wells by maintaining the incentive that was fixed to ponds. On the other hand there was a growing complains by farmers that the ponds were not storing water and that they have wasted their lands. Considering the emerging issues, the tabia administration organized meetings and agreed to shift to shallow wells.

NGOs and donors

The World Food Program (WFP) provides the largest resource to the watershed management program through the food-for-work activities. The watershed development has direct impact in

irrigation development by enhancing water resources potentials and expansion of irrigable lands such as the gully rehabilitation and putting into productive use.

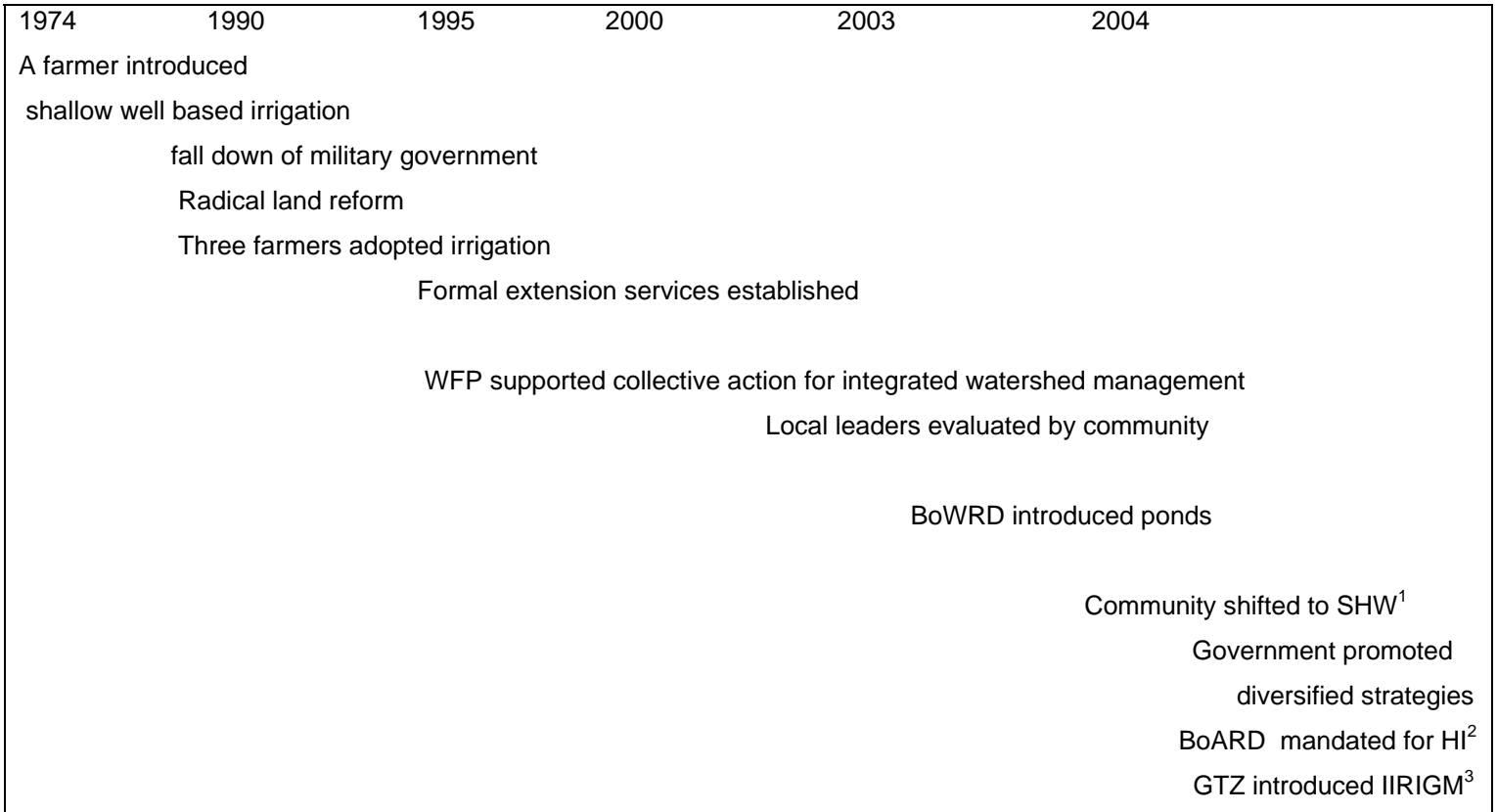
The role of GTZ in promoting household level irrigation is considered as one of the model innovations and was instrumental in consolidating interactions and learning among farmers. Farmers stated the intervention was based on interests and needs of farmers and included integrated activities of developing farmer managed schemes such as underground tanks, technical supports, planting materials and organizational capacities of beneficiaries. It was implemented with good interactions between tabia administration, farmer beneficiaries and the GTZ staffs. Furthermore the project has supported gully development which was distributed to poor and landless families with different technical supports including irrigation infrastructures. In the second phase of the project, it concentrated on poor women households who lack asset endowment to develop schemes by their own. The experiences of the GTZ were scaled up to another site successfully by the community itself under the coordination of the tabia leaders. According to farmers, the GTZ supported intervention was effective because it included all the components that enable farmers to develop irrigation into productive use. However, some social issues such as conflict resolution in water allocation are still constraints that are not yet well managed by the beneficiaries and the intervention is encountering obstacles particularly conflict between users.

REST is another NGO which has recently started to support collective action programs such as gully protection and water harvesting activities.

The private sector

Farmers stated the role of the private sector is only through a small number of informal traders who trade vegetable products from farmers. Most farmers sell their products directly to consumers hence the link with the private sector is not visible. Similar view is stated by the small and micro-enterprise representatives who manufactured treadle pumps. They stated they have not created any direct linkage with farmers in the region and believe they have the technical capacity to manufacture various irrigation equipments.

Figure 5.2 Actor Time line of major events



Source: the author (1-SHW-shallow wells; 2. HI- household level irrigation; 3. IIRIGM- integrated irrigation management)

5.2.2 Attitudes and practices

1. Restrictive attitudes and practices

Interventions restricted the inclusion of key actors and the demand side

The pond strategy is a policy triggered intervention which has continued to be the main focus of the household level irrigation intervention of the region.

According to regional experts, the new design of pond was developed mainly from literature studies with little evidences of adoption in farmers' fields. The relative advantages of pond in terms of economic and social benefits over other existing practices were not studied in the context of different locations of the region. Thus most of the justifications in the guidelines were based on expert assumptions and limited practical evidences. Recognising these constraints, the

initial idea of experts was to experiment and learn more about the impact and acceptance of the technology in specific locations before a massive scale intervention is planned and implemented. However, the attitudes of policy makers underestimated the different and complex social factors that influence the successes of the intervention, and dominated the decision on the scale and approaches of the intervention.

According to key informants, pond was perceived as a simple technical intervention that can easily be supervised and monitored through the existing government and community organizational structures. Moreover, it was argued that pond is a simple technology for the region given its experiences of the large-scale micro-dams and it is not worth to waste time for experimentation while the people are suffering from hunger and droughts. The outcome of these attitudes had resulted in adopting a predefined and a standardized design of a single solution at massive and fast scale of intervention (figure 5.3). In practice however, even in a single village, the problems and the potentials are highly diverse. For instance, farmer respondents suggested different water harvesting alternatives for the three villages of Abraha Atsbaha due to differences in topography, land availability, water potentials, and traditional and cultural backgrounds. Furthermore, farmers have different social and technical perceptions of ponds and their evaluative frames are related to its effect in land competition, water evaporation due to high temperature of the area and human and livestock safety issues.

Development planners and policy makers identified pond as a technology worth promoting to address hunger and poverty without involving the rural communities and intermediary stakeholders such as the woreda and the tabia staffs. Farmer respondents have asserted that the intervention did not consider their priorities and demands and were imposed through different means such as the linking of the food aid to ponds and instructions to 'participate' in the program. For instance three farmer respondents stated that they wanted to dig wells and requested the technician to allow them use the construction crew in developing a well but the reply was 'well is not in the list of the plan approved by the woreda'. Similar attitudes were also practised by woreda experts. For instance the tabia administrator explained a case as follows:

We initiated a spring development scheme for irrigation by learning from a GTZ experience and started the construction of a water diversion check-dam and a canal by our own resources. We requested the woreda to support us with cement for lining the canal but they rejected our request by saying it is not in our plan. Thanks to GTZ, they gave us enough

cement and we successfully constructed the diversion with a canal of 1500 meters long and today this scheme is helping many landless farmers to improve their livelihoods.

Other farmer respondents who have cultivated lands along the Suluh River side have also stated their priority was to get government support in developing river diversion infrastructures that can help them to promote irrigation.

In 2003, the top-down approaches throughout the hierarchies have excluded farmers' participation in any decisions including the site selection and the construction of the ponds on his private plot. As farmers realised that they can not change the approaches of the implementation, the objective of their participation became not in the pond itself but on fulfilling the orders of the leaders by simply achieving the quotas given to each group.

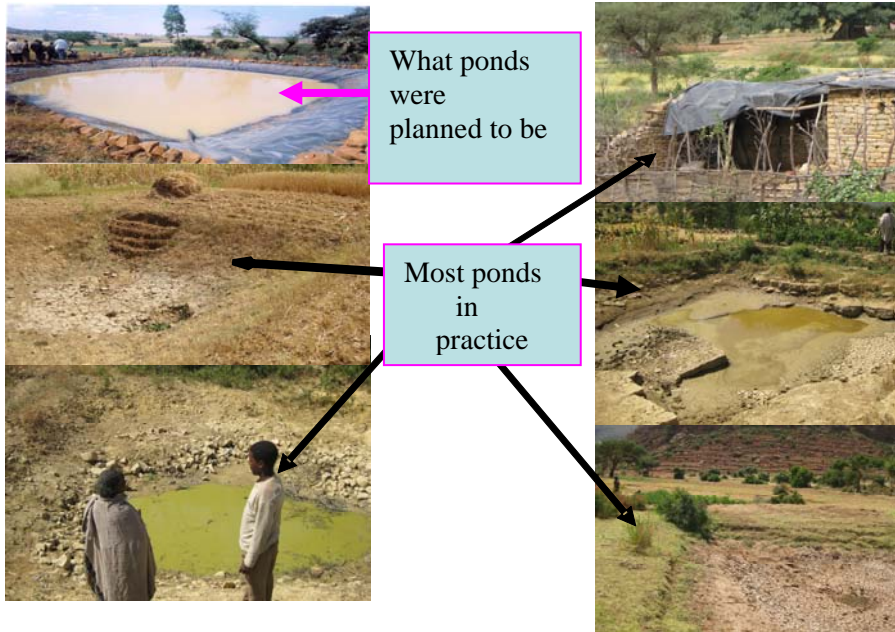
Finally the approach of the working groups became campaigns aimed at satisfying the technicians and getting more food without any considerations to the quality of the construction. For instance, 72.2 percent of the respondents stated their ponds did not store water from the beginning and are no more functional, and 27.8 percent have utilised ponds for 1-3 years since 2003 (table 5.1).

Table 5.1. The outcomes of ponds in Abraha Atsbaha

<i>years</i>	<i>Number of respondent</i>	<i>Percent</i>
Not functional from the beginning	13	72.2
Functional for one year	4	22.2
Functional for two years	0	0
Functional for three years	1	5.6
total	18	100.0

Source: the author

Picture 5.4 Ponds in practice



Source: the author (2008)

Intervention leading to mistrust and conflicts

According to the tabia administrator, almost all farmers have been organized in the construction crew of the pond implementation and ponds have been built in 275 households. Farmer respondents have indicated that they did not believe in ponds but they participated fearing they will be excluded from the food for-work opportunities. Furthermore they stated the instructions given from above were mandatory that any farmer must be a member in either of the construction crews and participate in the program. Farmers thought rejection or confronting such instructions will put them into risk from government representatives. One farmer respondent has pointed out:

When there is an order coming from government to everybody to do something, there is no way that you can escape but to fulfil the order until God avoids this wind.

The quota based target setting had exacerbated the top-down approach by creating pressures on the technicians and village leaders to employ any mechanism to achieve the plan. For instance, well owners were instructed to allow the construction crew dig a pond despite their demand for well maintenance, some of the pond sites were selected without consultation of the

plot owner, and some farmers were rejected when they attempted to change the location. The problem of imposition on accepting ponds has affected not only the ordinary farmers but also the tabia and village leaders and association representatives. One village leader explained as follows:

All village leaders and association leaders were told from above that in order to convince others, we have to be exemplary by being the first to implement ponds in our plots. We did not believe in it but as leaders and as party members, we could not reject the plan and we simply implemented it. However, neither we nor the people have gained anything from this intervention and we still regret the things we did.

These actions developed mistrust and conflicts during the pond implementation period between farmers and village leaders, farmers and technicians, and individual farmers and the group.

The culture of covering up failures

The region has rich experiences for learning. Nevertheless, the factors that led to failures in the micro-dam strategy were repeated during the implementation of the new approach. The culture of top-down planning, over ambitious targets, and blanket and fixed solutions are among the key factors that led to failures in both the micro-dam and household level irrigation policies. In addition to this, the pond strategy was adopted after the policy reform which had aimed to avoid past mistakes including imposing farmers accept pre-defined decisions from above. However, this case study indicates that it is not what the formal written policies or the 'hard institutions' that have great influences in shaping the approaches of the interventions in the real world, but the culture and practices such as openness to new ideas and willingness to correct own mistakes or the 'soft institutions'. Hence the culture of unpacking own mistakes and developing institutional learning seems the key policy related impeding factors to the innovation of household level irrigation development.

Food-for-work as a pressure for credit loan collection

Farmers have indicated the food-for-work is used as a tactic for pressuring farmers to pay back loans. They stated this was strongly announced in 2008 that if a farmer fails to pay his loans he will be excluded from the food-for-work program and this has created fears among farmers specially the poor who highly depend on the program for their living.

Farmers' dependency syndrome

While food-for-work activities have positive contribution in employment generation, asset creation and enhancing collective actions, they also have various disadvantages. Some farmers including the well off expect food aid for various private activities such as maintaining private wells, underground tanks, canals and other activities. Farmer respondents stated that some community members delay their critical farming practices such on time planting, weeding and harvesting because they engage themselves in food-for-work activities.

Lack of transparent procedures in selection and motivation of model farmers

Some farmer respondents think there is favouritism in selection practices of farmers for awards, trainings and exposure visits conducted outside the tabia. One farmer stated 'I sold my heifer to buy a treadle pump but my neighbour was awarded two for free, and this can never be a healthy practice'. Farmers also mentioned that most of the time, visitors who come for experience sharing visit and motivate the same people while there are other new models who can share even better knowledge and practical lessons.

These trends have negative influences specially on emerging model farmers who think their innovations are not recognized by the tabia administrators and extension workers.

Being recognized as model has some negative trends

While recognizing as a model has many stimulating advantages, it also has some unintended trends that can restrict the development processes of innovations. Such trends include lack of transparency and openness to speak about weaknesses and shortcomings of the tabia. These were clearly observed during the focus group discussion in which participants were hesitating to unpack weakening factors to household level irrigation in Abraha Atsbaha. Another negative trend is the perception towards the neighbouring tabias who have some conflicts with Abraha Atsbaha. There are attitudes that undermine positive achievements and this can be an obstacle for conflict management between Abraha Atsbaha and the other tabias.

1 Supportive attitudes and practices

Some of the policy components have positive contributions

According to farmers, credit facilitation for irrigation equipments such as treadle and motor pumps, farmers' trainings and experience sharing, food-for-work programs and the improvements in implementation approaches have positively contributed to irrigation developments. For

instance, some landless farmers used the pump credit to rent in lands for irrigation development. However, the most important aspect of policy that stimulated community creativity is a trust building process that was developed by recognition the tabia as the best model and learning site in the region.

In Abraha Atsbaha, irrigation development, integrated watershed management and positive aspects of good governance were recognised as bets achievements and the tabia was rewarded for its successes by the regional government. Senior regional and federal government officials including the prime minister of the country have visited Abraha Atsbaha and expressed their appreciation about the development activities. Some farmer respondents stated ‘we are glad that finally our tabia is appreciated by the heads of the government’.

Key informants at regional and woreda level indicated that the experiences of the first innovator farmers were the entry points for Abraha Atsbaha to be recognized as a model. This opinion was also backed by farmer respondents who explained the first visits by government officials were concentrated around the farms of the innovator farmers. Explaining how the recognition of a model site was developed, one of the key informants stated:

In 2004, the Prime Minister and several higher officials of the federal government came to Tigray to visit some practical field results of the pond program. During that time, there was not significant site where pond was effective in irrigation. The best alternative site to visit practical change was in Abraha Atsbaha where a priest farmer has been successful in irrigation. This farmer had developed a shallow well and has a well developed irrigation field. The officials visited the irrigation farm of the priest farmer and were glad by his successes. The media had also given a wide coverage to including interviews with the owner of the farm. The visit of the Prime Minister and his officials might have added more motivation to the community.

Farmer respondents explained, the tabia had already started promoting irrigation before the visit of the officials, however, this visit opened for more visits by officials and gradually realized the tabia was making better achievements than other areas, hence was recognized as a model site. The government’s recognition as a best model site has influenced for many others to visit and share experiences with the tabia community. For instance, all woreda representatives and many model farmers have visited and interacted with the models and local leaders of Abraha Atsbaha. Similarly, various visitors including farmers, experts, NGO representatives, researchers, teachers and students from Tigray and other regions of Ethiopia have come to this place to observe the

activities. Local leaders explained that since 2005, intensive guest visits were observed and such opportunities have helped them to gain different benefits. These include confidence building, feedbacks for correcting mistakes, better access to policy makers for resources and other supports, the interest of NGOs to work in the tabia, minimize the pressure and risks from the bureaucracy, respect and acceptance of their work from the community and government staffs, build network with visitors, and access to information about other model areas for better learning and knowledge exchange.

Regional respondents stated the regional government had organized an experience sharing program in Abraha Atsbaha for many tabia leaders and extension these visits had positive results in gaining some practical experiences such as water harvesting techniques, watershed management approaches and managerial skills in community mobilization and interactions.

Local innovations recognized at policy level

According to regional respondents, the successes of local level innovations in Abraha Atsbaha and in other similar model sites of the region have positively influenced the regional household level irrigation strategies. While the main strategy is promoting ponds, other different water harvesting alternatives such as shallow wells, underground tanks, and pump irrigation became important components of the strategy.

However, it is important to note that, the changes are mainly limited to technical interventions and thus the top-down intervention approaches have not changed except for some incremental improvements such as the facilitation of field visits to model sites which had enhanced farmer to farmer learning.

Community creativities reversed the processes from crisis to take-off

After 2005, the community members and local leaders have developed creative attitudes that have encouraged the success of irrigation in the area. Farmers and specially the tabia leader have developed higher technical skills which have enabled them to work with confidence and independently from external agencies. According to them among many activities that were independently performed include large water storage structures, gully check-dams, wells, grazing land development, land redistribution to farmers, protection of forests, conflict management, negotiation with partners, and coordination of the community in collective actions (table 5.3). The key actors that played central role in achieving the successes are the tabia cabinet, village leaders and the community at large.

Table 5.3 Attitudinal changes that helped local actors to successful interventions

Challenges	Actions
Failures of ponds had negative interactions	Overcome institutional failures by building trust through discussions and implementation of demand driven activities, learning by doing
Farmers' demand for support in shallow well construction	Based on willingness of farmers, working crews shifted to shallow well construction, incentives were maintained, the plan for ponds was stopped,
Ground water depletion due to competition between wells, experts recommended to abandon some of the wells,	Self initiated large structures of water harvesting ponds constructed on the upper catchments of the well fields to enhance ground water, wells protected from drying,
Interventions focussed on wells, excluded other villages from benefiting	Diversifying water harvesting alternatives such as water storage structures along gullies, spring development, intensive watershed terracing to develop springs and water potentials,
Landless needed support	Supporting landless and the poor through land allocation, technical and input support in developing irrigation by the poor households, a strong partnership with GTZ in helping the landless and the poor, 230 plots distributed to landless and unemployed students, where land is scarce, landless households were supported to introduce modern beekeeping activities in communal forest lands,

Maintaining healthy interactions and participation	Organizing forums for consultations, farmers' field days, encouraging farmers' associations/groups to actively communicate with their members, visiting individual households, networking with church leaders, NGOs
Watershed needed protection	Awareness raising, agreed bylaws on protection, fair mechanisms of benefit sharing (all households have access to cut grass for livestock feed)
Some innovation initiatives discouraged by some woreda officials	Strong resistance to the decisions, open debate at woreda council meetings, searching other sources for budget support, GTZ supported some of the initiatives
opposition and damaging activities by group of people against the leadership	Community invited to intervene, negotiations conducted, regional government intervened and supported the leadership,
Conflict with neighbour tabia	Negotiations, requesting higher officials to support and mediate
Keeping the image of the tabia as a model site	Getting feedbacks from visitors and attempts to show progress in innovation promotion, a spirit of forward looking to new ideas and interventions

Source: the author

Farmer respondents stated the prime mover of the change was the tabia leader who gradually was supported by the tabia cabinet and village leaders. During the change process, model farmers, farmer group coordinators, priests and lately extension workers played active role in various activities.

Picture 5.5 Harvesting water wherever it is possible



Source: the author (2008)

Farmers have indicated that today there are significant changes in relationships between community members and local leadership including government staffs in Abraha Atsbaha. There are not visible impositions in major activities both in individual and communal programs. The major problem mentioned by most of the respondents was an issue related to credit repayment. They stated they were imposed against their interest to take credit loans for household packages such as beekeeping in 2003-2005 and today they are forced to sell their cattle to repay these loans that did not produce meaningful results.

5.2.3 Patterns of interactions

Self evaluation as a tool to improve interactions

During the first phase of the new policy intervention, particularly in 2003, the patterns of interactions followed purely top-down approaches characterized by imposition and coercive measures. In 2004, public meetings were organized to assess problems of interactions, and were important entry points to improve interactions and learning from own mistakes.

Following the public meetings, the tabia cabinet including village leaders had conducted continuous self evaluations which were instrumental in understanding the consequences of top down approaches. Through a gradual process, the culture of listening to demands of farmers and problem solving approaches became well recognized practices among the local leaders.

Other key factors that enhanced interactions

Farmers have indicated that the intensity of interactions and the diversity of actors have grown with the expansion of irrigation in the area. Farmers who had developed spring irrigation in two sites have formed groups that manage jointly water allocation, maintenance of schemes, guarding and other activities through discussions and interactions.

The role of early innovators was very important in the expansion of shallow wells to new adopters. They transferred the skills and knowledge on the design of wells, irrigation management, new technologies such as the treadle pumps and the experience of guava production. The knowledge transfer had followed different forms but the main aspect was farmer-to farmer routine interactions which was first observed between close neighbours and the early adopters.

According to farmers, irrigation has triggered new interactions with consumers and traders in the local market and in Wukro town pump maintenance shop owners, seed and pesticide suppliers, and knowledge sources such as orchard owners around Wukro. The collective actions carried out in Abraha Atsbaha have been diversified and expanded with the gain of more knowledge in irrigation. Collective actions in public works mobilized the working force of all able adults including women and are one of the main opportunities for information exchange and learning different skills. The tabia leaders use them as an opportunity to pass messages and motivate farmers to fight poverty using by participating in different development activities. They also inform them to visit model farmers for experience sharing.

The watershed development program which was previously focusing on soil and forest conservation has integrated water development as a central component of the strategy to promote irrigation development. The local leaders stated 'since the potential for wells is limited we have to create water for those who do not have this resource'. After 2005, improved techniques of soil and water conservation that harvest more runoff water have been intensified in the upper catchments and along gullies with focus to spring development and ground water enhancement. These activities have positive impacts in expanding irrigation to new farmers and hence increasing the intensity of interactions.

The tabia leaders had attempted to re-orient the watershed strategy towards meeting tangible economic benefits. Farmers were continuously informed on how to make collective actions productive and poverty reduction oriented. They were also continuously informed to do their utmost efforts to utilize the food security packages of the government that has created access to credit for agricultural inputs. This knowledge has to some extent stimulated more interactions with credit providers, extension agents, NGOs, and among farmers. However, the strengths and type of interventions vary with the roles of actors and organizations (figure 5.4). More dense and strong linkages are practised within the local networks of community organizations and groups. Community groups and farmers have weak and one-way type of communications with the private sector some other external actors. Farmers have mentioned various technical problems related to pest control, water management, selection of suitable fruit varieties, and marketing issues, nevertheless, however the interaction with the regional research institute is missing in all aspects of the innovation processes.

Interactions during top-down of pond intervention

Figure 5.3. The role of actors in planning and implementation processes

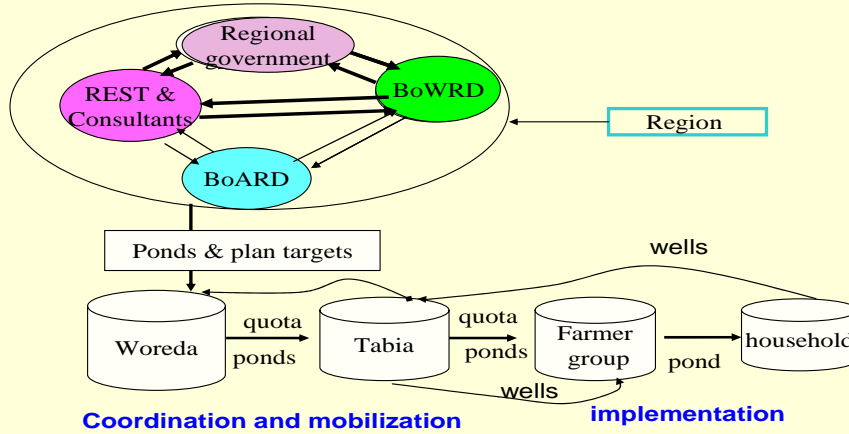
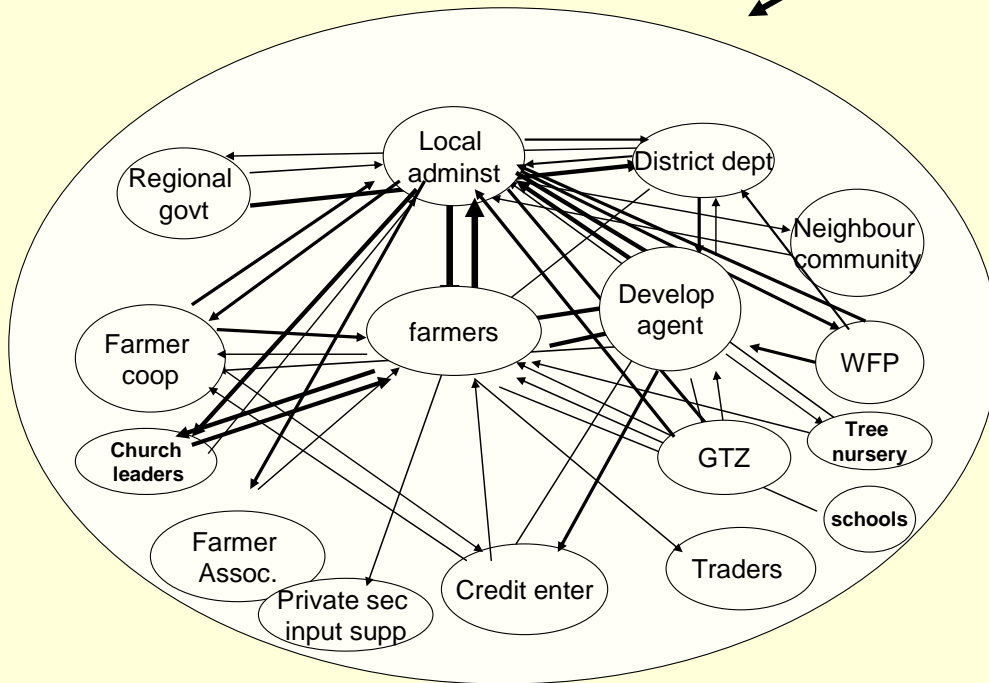


Figure 5.4 Actor linkage maps

Top-down approach transformed to innovation supportive interactions



Source: the author

Purpose and forms of interactions

Not all interactions have tangible impacts on learning and innovations. The purposes of interactions between actors include technology transfer, experience sharing, administrative, managing administrative issues, credit and input supply, allocation of resources and managing administrative issues (Table 5.4). According to the respondents, farmer-to-farmer relationships and interactions are the most useful in promoting irrigation practices. In the case study, the experience and knowledge of the early adopters in shallow well irrigation was recognized and was one of the factors that triggered the shift from ponds to wells in 2004-2005. The first initiators of this change were a small group of farmers who are neighbours of the innovators. They were better aware of the benefits of the shallow wells than other farmers. They were asked why they were not able to develop the wells prior to 2004. They stated:

It was not easy for us to develop a well by our own, the stone for construction is not available in short distances, the labour for digging is beyond ours but we became aware that the construction crew which was digging ponds can develop a well if allowed to quit the ponds. In addition we learned that the ponds we dug in 2003 were not storing water.

Thus the experience of the innovators, the negative outcomes of the ponds and the incentive mechanisms (the grain support to group work) were the main factors that opened the way to shift to new water harvesting alternatives.

In Abraha Astbaha, irrigation production in most farmers' fields is dominated by guava fruit which was introduced and well adapted by the early innovators. Further more, some knowledgeable farmers who are risk taking and investing are those who had been employed in irrigation farms during migration, or participated in exposure visits to model sites elsewhere in the region or the country.

The case of priest *Hagos* demonstrates how farmer to farmer learning is important in the area.

I am 71 and we are 8 in my family. I did not practise irrigation until 2003. the tabia administrator came to my house and said: "father if you dig a well under the big tree here in your plot, I am confident you will find water and try to do it, we will support you 7 quintals of grain for labour". I accepted his advice and dug the ground. I found water at a depth of three meters. I was surprised and said to myself, this man was sent by God as a Saint not as ordinary person. I built the well but I did not have the means to extract the

water to my field. I did not also have any knowledge about irrigation. There were two people who owned a water pump. They are returnees from migration in Eritrea and I knew they have experience in irrigation. I rented out my plot together with the well to them. They produced tomatoes. I learned how they managed it. I took back my land to continue myself. I bought a water pump from the money I got from them. When they left, one of them planted 7 guava seedlings for me in my plot and showed me how to manage them. In the first years, I produced tomatoes based on the lessons I gained from the two farmers. After sometime I was sent to Nazret, a place near Addis Ababa by the tabia administrator to visit an orchard. I learned from there how to manage orange, papaya, and mango. But in the beginning, I did not know the distance between two fruits and planted them in 2 meters instead of 5 meters. Today I have all these fruits in my field. I know how to operate a pump, how to produce tomatoes, how to manage fruits, I am one of the beginners and many farmers are learning from my farm. I show them how to plant. My wife is also very wise; she is trying to treat pests using ash and salt. But we could not control all pests. I have become self sufficient, I am expanding my farm to the next plot, my guava fruit is very popular than others and I have clients in Wukro But I have many problems. My children are students and they left us alone, now two old people that are me and my wife can not win the work. The problems of pump maintenance, pests, birds and sometimes theft are headache for me. I need more support.

The interaction and linkages between the GTZ and the community has helped to expand innovative irrigation system management. For instance the pilot intervention by GTZ which included irrigation infrastructure development, improved water management, gully and land redistribution has been expanded by the community itself to other sites.

Table 5.4 Actor Linkage Matrix between

Actors	A	B	C	D	E	F
Receive → Provide ↓	farmers	local leaders	coops	church leaders	extension	GTZ
1 farmers		information, consultation	Input needs		Credit needs	
2 local leaders	coordination, skill transfer, selection for FFW*, extension packages,		information, selection	information, consultation	coordination, information,	labour, Technical, Beneficiary selection
	credit facilitation, facilitating learning		loan collection			
	selection of models					
3 coops	credit and input	information			information,	
4 church leaders	awareness creation	information				
5 extension	Skill and technology transfer, credit facilitation	information	credit facilitation,			technical
	Facilitating learning, Selection for packages		loan collection			follow-up
6 GTZ	resource, technology transfer	information			skills, information	

Source: the author

Flows from the actor on the vertical axis to the actor on the horizontal vertical axis,

* FFW-food for work

Both formal and informal types of interactions are practised in the irrigation intervention. Formal relationships are the vertical communications and interactions conducted along the public sector structures that extend from the village contact farmers to tabia and finally to the region through

the extension service and political administration channels. They are characterised by paternalistic types of learning and administrative management mostly with top-down communication and conducted through formal trainings, plan orientations, monitoring and supervision, workshops and council conferences. The main purposes of these linkages are ensuring policy implementations by the processes of awareness creation, technology transfer, resource allocation and input supply.

The formal interactions are supported with some informal ways of learning such as organizing farmers' field days, exposure visits for selected farmers and experts. The dominant ways of learning as discussed above are farmer-to-farmer informal interactions that take places in the processes of routine communications. Table 5.5 summarises some of the key types of linkages and their purposes.

Table 5.5 Typology of linkages and type of learning

Types of linkages	Purpose	Type of learning
Partnerships Demand driven collective actions	Community/village or group level problem solving	Learning by doing
Well owners and pump owners, land owners rent out land to pump owners, GTZ, local leaders and community	combining different assets of irrigation for joint venture problem solving combining labour, industrial material and technical support to solve problems of the poor	Learning by doing, learning by interacting Learning by doing, learning by interacting
Farmers who depend on the same irrigation infrastructure (gullies, spring) work on agreed bylaws	Joint problem solving	Learning by doing, learning by interacting
Women farmers and male farmers transforming religious groups into self-help groups	Flexible credit for members, joint problem solving,	Learning by doing, learning by interacting

<p>Paternalistic Extension agents and contact farmers, Woreda and extension agents</p>	<p>Technology diffusion, Policy implementation,</p>	<p>By learning by training, Learning by interacting and feedbacks (reporting),</p>
<p>Networks Innovator farmers and traders, Innovator farmers and input suppliers, Pump owners and maintenance workshops</p> <p>Innovator farmers and knowledgeable sources elsewhere (Wukro St. Mary school, Genfel guava orchard owners)</p>	<p>Marketing, input access, purchase of services</p> <p>Gain knowledge in fruit management</p>	<p>Learning by interacting, learning by doing</p> <p>Learning by interacting,</p>

Source: the author

Picture 5.6 Farmer to farmer interactions and learning



Source: the author

5.2.4 Infrastructures and finance

Abraha Atsbaha has an all weather road connecting to the woreda town and weekly transportation is available. However, the product of irrigation is too small to attract business enterprises hence most of the marketing is conducted locally with farmer consumers. Lack of available market is one of the major constraints limiting the promotion of the sector. For example, a farmer who produced vegetables by renting in land has stated that in 2007, he could not even harvest his tomatoes due to cheap prices in the local market and expensive transportation costs to sell in Wukro town.

The issue of financing privately owned irrigation schemes is one of the greatest concerns and the most widely debated issue in the study site. Farmers stated that the schemes such as private wells and GTZ introduced underground tanks require bulky of local and industrial materials, labour and skills. The main problem is that the family labour of most households is engaged in food-for-work programs carried out in communal areas. According to them, if they are to construct a well or other irrigation infrastructures, they have to spend most of the year and this means they will miss the food-for-work program in which they depend much for their living. In addition to that disadvantaged groups have limitations of family labour and other investment capabilities. GTZ had helped women headed households to finance irrigation schemes but since the government policy does not support financing individual households for free, the program was forced to discontinue. The withdrawal of incentives to individual household schemes had negative effect in the promotion of wells and underground tanks and the current irrigation development strategy is focussing more on collective actions based alternatives and pump irrigation along rivers.

Most farmers suggest that the current food-for-work program should not only focus on community based asset creation but also on individual households to develop their own irrigation system alternatives. According to them, the main limiting factor in expanding irrigation today is lack of investment capabilities including shortage of food in most households of the study area.

5.2. 5. Innovation outcomes

Participant farmers are benefiting

The number of beneficiaries and area under irrigation has increased after the new intervention. In 2003, there were 15 households engaged in irrigation and this number has grown to 427 in 2008 which is close to 46.7 percent of the total households in the tabia. Similarly the irrigated area in the tabia has increased from 2.5 hectares in 2003 to 79.6 hectares in 2008. Farmers stated irrigation has been introduced only recently and the knowledge and skills specially on newly adapted fruits is yet to be learned. On the other hand, most farmers who have introduced irrigation systems other than the ponds have explained they have started to gain some economic benefits which stimulate them to further learn and strengthen their activities. According to farmer respondents, some of the early innovators and few among those who introduced shallow wells during the first years of the intervention have become successful in terms of economic benefits and gaining technical skills.

In the following are the cases of three farmers who are believed to represent the most successful group, those with some successes and others who think have not yet benefited respectively.

Tesfay is 69 years old with 10 family members. He has 1 hectare of his own and additional 1.5 hectares rented in land which is used for irrigation and rain-fed production. Tesfay owns a pair of oxen. His irrigation started in 1974 and today has developed 4 wells. He is the top among the successful farmers. He stated:

I have repaid all my credit loans and now the water pump is mine. I have diversified my products from vegetables to fruits and ground nut. With the income from irrigation, I a dairy cow which is a cross breed. I have bought a house in Wukro town and I have recently bought a flour mill. In addition to this, I am saving cash in banks. All my incomes have come from irrigation. My future aim is to expand irrigation by renting in more land.

Farmers in the second group refer to those who expressed the contribution of irrigation to food security. Most of these farmers stated prior to the irrigation intervention, they were selling grain to cover different expenses including spices such as hot pepper, fertilizer and school expenditures. Further more, they were not eating vegetables or fruits. They explained that today income from irrigation has saved their grain from sell and are able to use it for own food.

The case of Hagos can represent this group. He is 57 and has 6 family members. His land is 2.4 hectares of which 0.9 hectares is from sharecropping. Hagos's well was constructed in 2004 with the assistance of food-for-work. He explains his success:

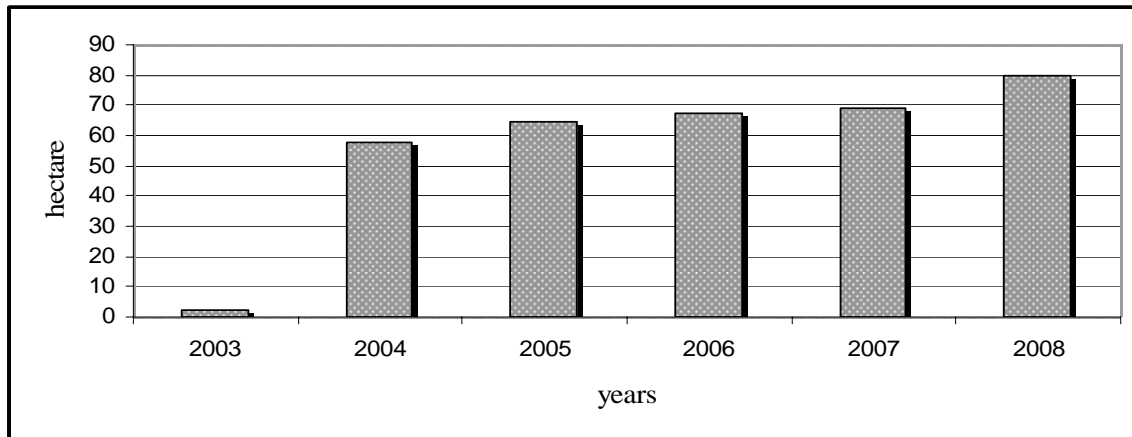
My well was located far from my houses which made guarding and follow up of my farm very difficult. I had great interest to continue irrigation and I exchanged one of my plots with a plot of another farmer located close to my house. This was not easy but my plot was more fertile than the other farmer. Then I developed a well in the new plot and started producing vegetables. Today, I do not sell any of my grain to cover other expenses. I use my grain to feed my family. I am able to cover the cost of fertilizer, school expenses and the cost of grinding in flour mill from the sell of vegetables. I am self sufficient in hot pepper and coffee from my farm. My family is eating vegetables which were not common in the past. All of us in my family are always busy working in the farm. In the past most of us in this tabia did not have work during the dry season and we were spending our time under a tree shade sitting. Now it is good we are using our time for productive purposes.

Although the extent of benefit varies from farmer to farmer due to different factors, it can be said most have gained positive benefits that is also encouraging them to be more innovative in adopting improved practices. Hence most farmers engaged in irrigation are in the second group. Some farmers have stated they have not yet gained benefits from irrigation. Major reasons include shortage of water in their wells, conflicts and competition of water in spring irrigation particularly in a site known as Ankel. Further more, the study found individual farmers who faced crisis due to market problems. The case of a farmer by a name Kidane demonstrates this fact. He stated:

I am a landless farmer. I was too young to be eligible to get my own land during the land reform period. I was in migration where I was employed in an irrigation farm. This gave me a good opportunity to gain knowledge on pump operation. When I returned back here to my place, I applied for a water pump credit to the farmer's cooperative and was given in kind. Last year I rented in land from a farmer along the Suluh River and started to grow tomatoes. Unfortunately, the cheap market prices of r for tomatoes, high fuel and land renting costs left me in crisis. I even did not collect the tomatoes from the field. I do not know how to continue for the future because of uncertainties. Land renting has advantages and disadvantages. Landless households like me have not other options to access land except by renting in from other farmers and in this sense it is advantageous. But it has a lot of risks. If you are renting

a land that uses a well and if you face shortage of water in the middle, you are not allowed to dig the well deeper for searching water. Most of land renting agreements are possible only for one production season and you are forced to move after one harvest and search another plot for renting. all these create risks on the lessee. The increase in number of participants was high during the beginning of the intervention and the progress was slow in the following years. The main reason for this is in 2003 and 2004, farmers carried out massive construction of shallow wells on group-based approach supported with the food for-work- program and after the withdrawal of this incentive, the groups dissolved and farmers were expected to work by their own resources. As it was discussed above, most farmers are unable to afford the investment costs and the increase of irrigated land after 2005 is mainly through pump irrigation and collective action programs (spring development, etc). Currently two trends are emerging. Few well-of farmers are expanding their irrigation either around the old scheme or by renting in lands from other farmers in water potential locations. The poor households who are not engaged in irrigation expect supports through the collective action programs carried out under the food-for-work activities.

Graph 5.1 Area under irrigation, ha



Source: Extension office of Abraha Atsbaha (2009)

Picture 5.7 Farmer producers in Abraha Atsbaha local market



Source: the author

Technological innovations

The knowledge and skills on water harvesting and production systems have improved with the promotion of household level irrigation strategy. Until 2002, there were only four wells introduced by individual farmers and irrigation practice was insignificant in the study area. Currently diversified and locally adapted water harvesting alternatives are being promoted by the community. In Abraha Atsbaha , the community collective actions has helped to develop high level water harvesting skills that include of groundwater wells, large ponds, stream bed flood collection structures, underground tanks, spring development and pump irrigation along rivers(table 5.6). Technological innovations are also observed in adopting water lifting technologies particularly treadle pumps, production inputs such as better yielding varieties of fruits and vegetables and fertilizers.

Table 5.6 Farmers' adoption of household level irrigation schemes

Year	Number of schemes and technologies introduced				
	Ponds	Shallow wells	Underground tanks	Treadle pumps	Motor pumps
2002	-	4	-	3	-
2003	214	152	-	12	5
2004	55	292	-	15	4
2005	-	33	5	80	5
2006	-	-	7	9	1
2007	1	-	5	140	4
2008	5	3	11	-	6
Total	275	481	28	250	25

Source: Abraha Atsbaha extension office (2008)

Picture 5.5 Management of fruits and vegetables improving



Source: the author

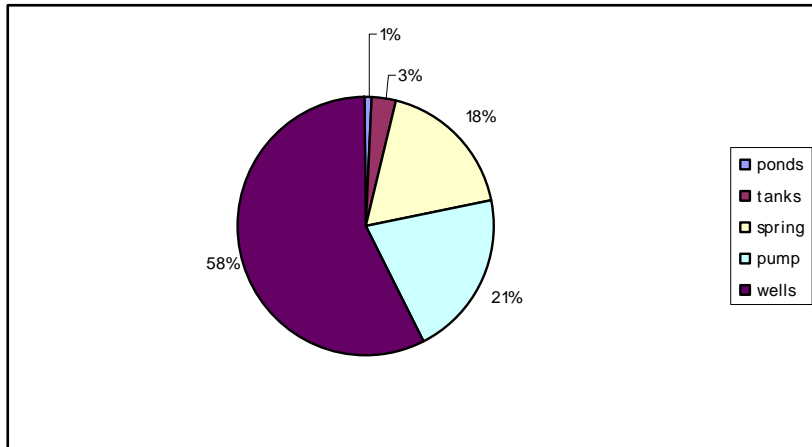
In Abraha Atsbaha, three technological innovation drivers are observed: farmers, the public sector and NGOs and the market. Farmer driven innovations include water harvesting schemes such as the shallow wells and percolation ponds, indigenous commodities such as hopes and spices.

Government/NGOs or ‘technology push’ innovations are different water lifting technologies such as treadle and motor pumps, water harvesting schemes which include the underground tanks and diversion structures, production commodities such as new fruit varieties. In more recent years, market driven innovations are being introduced by few innovative farmers. The groundnut production was recently introduced by one of the early innovator farmers who believe that this crop has better market prices. Groundnut is a new crop to Abraha Atsbaha farmers.

Demand driven interventions have better outcomes

The locally adapted water harvesting strategies have better outcomes than the pond which was initiated by the policy (graph 5.2). Data collected from the extension office in Abraha Atsbaha indicate that shallow well based irrigation is the most widely practised by farmers and contributes 57.5 percent of the total land under irrigation. Although 61.3 percent of the total irrigation beneficiaries had built ponds during the first phase of the intervention, its contribution to the total irrigated land is almost nil with only about 1 percent. Statistical findings from the interviews have also similar results where 61.1 percent of respondents stated after realizing that the ponds were non-functional, they immediately shifted to shallow wells during the time the local administration was supporting construction crews with food-for-work to build individual wells. The 38.9 percent stated they did not shift because of various reasons among which the limitation of investment capabilities and the unsuitability of their plot locations were mentioned.

Graph 5.2 Percent of irrigated area by type of water harvesting schemes



Source: Abraha Atsbaha extension office (2008)

Institutional and organizational innovations are emerging

The most important outcomes of the innovation processes in Abraha Atsbaha can be stated as the institutional and organizational changes (system changes). Discussions with focus group participants, tabia and village administrators and elders revealed that there is an attempt to develop intervention plans based on key problems identified by the community members. For instance, they stated the following problems have been identified in public meetings as the common challenges in the tabia in which development interventions have to primarily address.

- high vulnerability to repeated droughts and flood erosion,
- limited water potential for irrigation development,
- a significant number of landless households,
- Self initiated activities not welcomed by some officials in the public sectors,
- different forms of conflicts within the community and with neighbour tabia, mainly related to resource competition and attitudinal problems,
- Market problems,

According to the tabia leaders, their intervention strategy is a multi-dimensional approach of problem solving. He explained:

we focus on integrated watershed management, to create water where there is not water, to halt erosion by using the water to our advantage, this will help us to achieve two goals:

enhancing creating water for irrigation and saving our land from erosion. We have created a good understanding with our people to carry out this strategy and we will strengthen this relationship through evaluations and through actions of development practices. We will continue to distribute land to landless in developed gullies. When we receive plans from above that are not suitable to us, we will try to convince them to accept our proposals. We have protected almost all the catchments from free grazing and cutting trees by agreeing with the community. Our grazing land is protected and we use cut and carry system. People are happy with these changes. We have also developed the skills of water harvesting. The case of Adikulala is a good example.

Abraha Atsbaha has achieved remarkable changes in its strategy of water centred natural resources development and this is one of the major lessons being shared to other communities of the region. Almost all areas in the watersheds are protected and rehabilitated, potential grazing lands are developed and farmers use cut and carry system, several gullies are treated and have become potentials for irrigation. Focus group participants and most of the interviewed farmers appreciate these changes and perceive them as their own achievements. Against these views, are arguments by some farmers who stated the expansion of protected areas have brought wild animals such as hyenas and humans into close contact and this is creating risks.

The experiences of collective actions and problem solving approaches have helped the local actors to develop the culture of innovations such as learning by interacting, trust building between leaders and farmers, risk taking and investing in prioritized interventions, and close monitoring to achieve successes. The culture of innovation enhanced by the prime movers specially the tabia leader is the key factor that has enabled the community to manage complex social issues that include land allocations, resource sharing in grazing lands and protected forests, attempting expand irrigation to remote locations of the tabia, dealing with internal conflicts in benefit sharing, an overcoming external pressures.

Picture 5.6 Innovations in water development and grazing land management

Developing
new water
sources



Cut & carry
system



Protected
forests



Source: the author

Some traditional and religious groups are transforming into development actors

Farmer groups who were originally organized for religious gatherings have started to transform into saving and credit groups. They have originated very recently and are fully self-initiated by the farmers themselves. There are two separate women groups who had organized themselves to observe the month of St. Mary's day. The groups have started to save capital and provide credit to their members. Similarly, there is a male group which was originally organized to observe St. Michel's day and this time is providing small credit loans to member farmers.

One of the women groups has established a saving and credit group known as Hadinet. Hadinet was formed three years ago and has 11 members who have saved 4500 birr. It has adopted its own saving and credit procedures and so far has provided loans to four of its members. The credit is flexible and can be used for any purpose. The interest rate is 2.5 percent per month and

the repayment period is less than 5 months. The members stated the repayment rate so far has not encountered any problem because it is based on the interest of the members. The other groups have similar procedures and performance. The farmer group stated their members use the credit mainly to purchase agricultural assets such as sheep and goats.

Group representatives were asked how and why they formed these groups while there are credit and saving service providers in the area. They explained traditionally, they were contributing small amount of money for church gifts. Gradually, they increased their amount of contribution in order to support their members with cash loans. Today, they have developed detail procedures of credit management by their own and it has become one important objective of the groups. They stated they wanted to have flexible and easily accessible credit services which are owned and controlled by the members in order to minimize the dependency on the formal credit providers. However, they will still use this credit because their groups are small and can not cover the credit for major inputs such as water pumps.

All groups stated they have not yet encountered any problems, the saving and credit processes are continuing based on agreed procedures, they did not have any drop outs of their members. The farmer groups stated they carry out auditing and inform members every detail progress. It can be said that the emergence of such voluntary groups will have many advantages. Firstly they are functioning within a group which has sustained for decades and had proved to build strong bondages among the members. For instance the male farmers stated the St Michel day group has existed since their grandfathers and so on. Secondly, they stated such credits can save members from the exploitation of private money lenders. Thirdly, the existing formal credit and saving services are not flexible and easily accessible hence the new approach can compliment different needs of the farmers.

5.2.6 Problems and constraints

Irrigation promotion in the study area has several problems that need to be addressed. The problems can be grouped into two categories:

1. Intervention is not reaching many of the poor households. The main reason is lack of investment capabilities of the poor and disadvantaged groups. One poor woman headed household stated:

I am not benefiting, my plots are small and also located far from my house, and I do not have oxen and labour so I gave it for sharecropping to others. Because I do not contribute

farm inputs for the production, my share from the harvest is only one-fourth. I do not even get straw. I do not think I will take it back and use it fully by myself in the coming few years. My trust is in the food-for-work program. I took credit for beekeeping but I have not yet benefited from it.

How to reach such disadvantaged groups is the key challenge in Abraha Atsbaha. Farmers suggested the policy of the food-for-work program which is currently limited to public works should be revised to include private irrigation scheme development in order to help the poor benefit from the intervention outcomes.

- 2 The local innovation development is implemented within a top-down macro-policy environment. The tabia receives priority plans from above and if it is not able to convince decision makers, its self-initiated activities can be considered secondary in prioritization. Thus local plans have to match and be adjusted to plans transferred from the government. Focus group discussion participants identified top-down approaches that undermine local initiatives as one of the weakening factors to the ongoing innovation development. They stated locally prioritized programs receive less priority by woreda authorities in budget allocation and this can affect the continuity of important activities such as water resources development through collective actions.

5.2.7. Conclusions

The case of Abraha Atsbaha provides several valuable lessons to the knowledge of innovation processes.

The key lesson of this case study is that community creativity can promote and achieve significant successes of innovation capacity development; however, its successes will be limited and restricted if the macro-policy is not an enabling environment. This indicates that local level innovations are highly influenced by external factors specially the policy environment and thus enabling environment both at local and macro-level are crucial for the successful development of innovation capacities. In this regard, successful local innovations can have positive influences on some components of the macro-policy

Another important lesson of this case study is that a committed and visionary coordinating body is crucial to innovation successes. This case study revealed that there are three sources of technology innovations: the farmers, the extension system and the market. However, existing farmers' improved practices are the most important entry points for an innovation to takeoff. In

addition to this, newly introduced technologies can not be successful without experimenting and learning processes.

In innovation processes, addressing the most disadvantaged groups is a key challenge even in situations where interventions are targeted towards poverty alleviation.

The conflict between public works and individual farmer based investments is another challenge in the study area.

Finally the lesson of Abraha Atsbaha has proved that attitudinal changes are central to the success of any innovation. This change is a gradual process and can only be consolidated through tangible development interventions which open more room for learning and interactions.

In summary, the achievements in Abraha Atsbaha are the product of struggles between different attitudinal trends which required strong and committed leadership with good knowledge of managerial and technical coordination. This capacity is missing in many tabias of the woreda and only few of them have been successful in achieving innovation capacity.

CHAPTER SIX: MAHBRE WEYNI, COMMUNITY RESPONSE TO HOUSEHOLD LEVEL IRRIGATION POLICY THROUGH CONVENTIONAL APPROACHES

The chapter analyzes the intervention processes of household level irrigation in Mahbre Weyni tabia. The purpose of this case study is to understand why certain communities develop creative responses and others continue on the conventional approaches while all function under similar macro-policy environment. First, a brief discussion is presented about the local context. The main discussion focuses on examining how the household level irrigation intervention was carried out in the tabia and makes comparison with the case study findings in Abraha Atsbaha. It concentrates on community level activities where the differences between the two are believed to be reflected. The chapter ends by summarizing the key lessons of the case study.

6.1 The local context

The tabia is situated to the south of the woreda, Kilde Awlaelo at a distance of 20 kilometres away from the Wukro town. It is composed of four villages with a total population of 5116. There are 1305 households of which 323 (24.8 %) are female headed.

The common forms of land use systems are farming, grazing, and community area enclosures. The tabia has a total cultivated area of 1503 hectares used for crop production. Farmland holding per household is about 1.2 hectares which is relatively higher than most tabias in the woreda. According to the extension office of the tabia, the number of landless households is only 48 or 3.7 percent of the total households. This is a much lower figure compared to 37.8 percent in Abraha Atsbaha. The tabia administrator explained that there were government efforts in the past few years to address the problem of landlessness by allocating arable land.

In Mahbere Weyni, 44 percent of women headed and 11.4 percent male headed households do not own oxen which is one of the most important production assets.

Agricultural production system is based on crop and livestock mixed farming. *Wheat*, *teff*, *kerkaeta* (a mixture of wheat and barely) and lentil are the major crops grown and cattle and goats play an important role in livestock production. Mahbere Weyni is one of the severely degraded and drought affected areas in Tigray. Majority of the people suffer from hunger and have been food aid dependent for decades.

Cactus is the only dominant green plant during the dry season which is widely introduced and developed by farmers to minimize the risk of drought.

Irrigation is practised in 7.9 percent of the total cultivated land and is concentrated along the Agulae River which passes through the tabia.

Farmers think the key problem for low production is shortage of rainfall and they suggest any intervention has to focus first addressing this problem. Due to the topographic location of the settlement and repeated drought, human and livestock water supply is also a critical problem in the tabia. Fortunately, the Tigray bureau of water resources development has constructed a new water supply project with the assistance of the Korean International Cooperation Agency (KOICA) which was just inaugurated during the research fieldwork.

Picture 6.1 View of Mahbere Weyni



Source: the author

Community level organizations and groups

Community level formal organizations have the same type of structures and functions in all tabias of the regional state. They are initiated and supported by external bodies mainly the government and the ruling party, the TPLF.

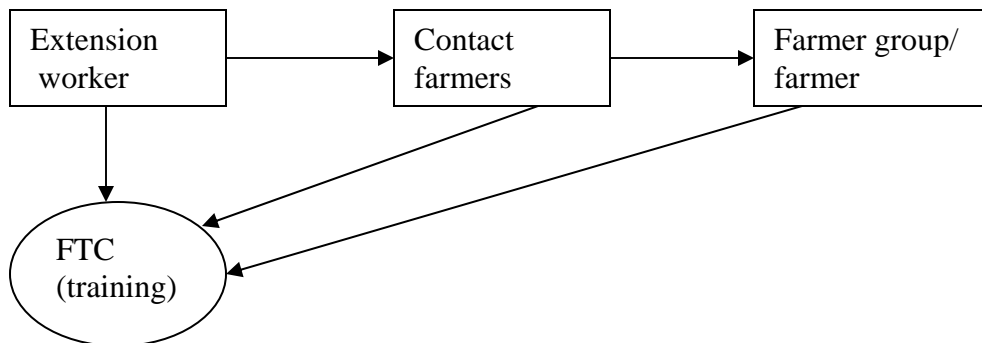
In Mahbre Weyni, the most important players in the socio-economic development processes are the political and administration bodies, public service providers, farmers and farmers' organizations, party member groups, and NGOs. The political administration and development affairs are coordinated by the tabia council, tabia cabinet and village leaders assisted by public service providers that include extension workers, health service staffs, and education service

representatives. Farmers' organizations such as the cooperative and the three mass associations play important roles in different activities.

Extension system approaches

There are three extension workers permanently assigned and placed at the tabia. Their major functions are technology transfer (technology package implementation), credit facilitation, and coordinating agriculture related public works. The system operates through contact farmers and farmers' training centre (FTC). In Mahbreyeni, the FTC is located at the tabia centre and was established 3-4 years ago. It serves as a permanent office of the extension workers, has a training hall and a demonstration field.

All farmers are grouped into small units of 20-25 members. This unit is called a development group and is formed for the extension purposes but can be assigned with additional tasks. It is coordinated by 5 people elected by the group and is the contact farmers of who serve as a bridge between the extension worker and the farmers. The extension worker transfers designed plan targets to each group through the contact farmers. For instance in the study area, the plans include number of farmers who will introduce modern beehives, water harvesting schemes fertilizers, selected seeds, compost making, and livestock fattening. There is a fixed package of intervention that each farmer needs to implement in order to achieve an income benchmark equivalent to US \$ 1 per person per day so that the package implementer is food secured. Credit services, trainings, and other technical supports are provided to implement these packages (Figure 6.1). Further more the extension worker depending on the type of inputs; link the farmers with the tabia cooperative or Dedebit Credit and saving enterprise for credit loans. **Figure 6.1** Extension structure and technology transfer approaches



Source: the author

6.2. Household level irrigation policy in practice

Data sources for the in-depth study

Two villages known as *Sherafo* and *Makabo* were selected for in-depth study of the research. The selected villages are easily accessible and have extensively introduced water harvesting schemes. Semi-structured interviews and focus group discussions were conducted with 18 and 7 selected farmers respectively based on the methodology discussed in this document. The data collection has also involved different people and groups of the tabia including representatives of women's association, youth association, important cabinet members, religious leaders and extension workers.

Table 6.1 a summary of descriptive statistics for both groups

<i>characteristics</i>	<i>Semi-structured interviews</i>	<i>Focus group discussion</i>
Number of participants	18	7
Mean age (years)	52.1	46.4
Mean family size	5.7	6.1
Mean land holding (ha)	1.8	2.5
Male (%)	77.8	85.7
Female (%)	22.2	14.3

Source: the author

Farmers' experience of irrigation before household level policy intervention

Most farmers in the tabia had two important experiences regarding water harvesting. River - based traditional irrigation and community ponds for human and livestock water supply were widely known before the intervention. Traditional irrigation has been extensively practised and has long history in a potential valley known as Birki, closely located to Mahbre Weyni. The Birki River, which is also known as the Agulae River, passes through the tabia and very few farmers have been irrigating their plots along this river. However, the river bed is deep and pump irrigation is the only means to lift the water and most farmers could not afford this alternative. A farmer stated 'we were simply looking at it although we knew it is gold for us'. According to the extension workers there were only 10-15 farmers who used irrigation in the area before the government initiated program.

An important issue regarding this river is its relationship to land access system. Around 1990, a radical land reform was carried out in this area by the Tigray people's Liberation Front (TPLF) who at that time had liberated the area from the then military regime in Ethiopia. The land tenure reform enabled every household located nearby the river to have access to a plot of irrigable land along the river. Despite this opportunity, the lack of capability to utilize the resource restricted most farmers from irrigation and the only option was to use it for rain-fed agriculture.

Farmers have been aware that relatively cheaper technologies such as treadle pumps are used elsewhere but are not suitable to use them in the Agulae River where their plots are located due to depth of the water.

Picture 6.2 Pump irrigation along the Agulae River



Source: the author

Community pond was the other important experience in water harvesting. The shortage of water supply for humans and livestock has triggered this knowledge to develop. These ponds are large earthen structures constructed by the communities themselves without any external support and their purpose is to collect run-off water during the rainy season for humans and to some extent for livestock use. Although there is a river passing along these villages, it is in deep gorges while settlements are on the top of the hills thus the topographic features restricted the access to water. The researcher visited a community pond which served for more than 30 years and is still functional. An elder farmer respondent stated:

We have a better knowledge about ponds than any of those experts. We have been using them since our childhood. We know how to collect the runoff from rain and store it for longer months in the dry season. We have our own rules on how to use the water in better years and difficult time. For example, if we think the water is small, we minimize the number of

cattle that use from it, when it becomes very critical, then we decide to use only for humans. But no one has asked us about our experiences. What we do not know is of course irrigation using ponds.

Components of water harvesting under the new intervention

The new policy of household level irrigation started in 2003 which is the same period like many other parts of Tigray. The first intervention was the pond introduced by the bureau of water resources development at a massive scale and is still among the priority in water harvesting strategy. Since 2005, water harvesting through underground tanks and pump irrigation has been promoted by REST, a local NGO and the bureau of agriculture (table 6.2). A household is expected to build either a pond or underground tank. Most households who own pumps are those who have also introduced a pond or a tank.

Table 6.2 Number of introduced water harvesting technologies

year	ponds	Underground tanks	Motor pumps
2002	-	-	NA
2003	115	1	-
2004	98	-	2
2005	73	26	28
2006	52	68	32
2007	29	23	10
2008	19	21	14
Total	386	139	86

Source: Mahbre Weyni extension office (2009)

The implementation arrangement of ponds during 2003-2004 followed the same procedure like in Abraha Astbaha. However, despite slow achievements, the planning and implementation of ponds has continued in Mahbere Weyni. Underground tanks have also been promoted by REST and the government. As it is discussed in the next sections, the contribution of ponds and tanks in irrigation is very little and the only effective method is the pump- based irrigation. This is one of the important distinctions between the case of Abraha Atsbaha, which quickly learned failures and moved to correct them and Mahbere Weyni is still continuing with inefficient outcomes of water harvesting technologies.

6.2.1. Key actors and their roles

Informants indicated the key actors in household level irrigation are regional bureaus of water resources development (BoWRD), bureau of agriculture and rural development (BoARD), woreda administration and woreda public sectors, tabia level organizations and groups, farmers and REST. The major activities of the new interventions include: information dissemination, selection of farmers, site selection and construction, credit, and productive use of the technology. These actors can be categorized into public sectors, administrators, farmers and farmer groups, NGOs and a credit enterprise (table 6.2)

Table 6.3 key actors and their roles

key actors	major roles
public sectors	
BoWRD	target setting, technology selection, construction,
BoARD	target setting, technology selection, technical support, beneficiary selection, resource control,
councils	endorsement of plans (formalization), follow up ,
administrators	
woreda	target setting, monitoring, resource control (decision of food-for-work prioritization
tabia	information dissemination, resource control (food-for-work), beneficiary selection
	coordination
village	beneficiary selection, coordination, 'exemplary roles'
farmer groups	
cooperative	credit in kind (pumps, cement, plastic, fertilizer, seeds ...)
associations	awareness creation to members, 'exemplary role'
party members	information dissemination,' exemplary roles'
farmers	adoption of technology selected by outsiders,
	imposed to accept for ponds 2003-2004,
	underground tank-their influence and decision restricted by REST
NGO	
REST	transfer of technology (underground tanks)
credit enterprise	
DCSI	Credit in cash for locally available inputs (goats, cattle,)

Source: the author

The role of public sectors

The role of these actors is not different from the case of Abraha Atsbaha. According to farmers and community key informants, the role of the public sectors include, decision on the type of technology without consulting beneficiaries, plan target setting, selection of beneficiaries, credit facilitation and technical support. In the case of Mahbre Weyni, the pond construction has continued under the responsibility of BoARD. Farmers stated the implementation of ponds during the first two years was purely through imposition and on campaign basis. They mentioned the

technicians and tabia/village administrators were the key actors in selecting the beneficiaries and even the sites for ponds. They mentioned this approaches had continued for two years and was the main reason for failures. However, since 2005 improvements were observed and impositions were gradually lifted due to some corrective measures by the regional government.

In Abraha Astbaha, the imposition was practised for one year and the leadership and the community discussed and immediately shifted to wells which were the demands of the farmers while in Mahbre Weyni, the imposition continued for two years and there were not learning interactions by local actors to avoid this practice.

The role of local level organizations and groups

The role of these actors is the same as Abraha Atsbaha that they are active in government plan implementation through information dissemination, farmer selection and resource control such as the food aid. However, an important point mentioned was that actors faced social problems in implementing ponds. A village leader stated:

We village leaders had faced problems from above. We were told to be people of action in order to convince others accept the policy. Based on this instruction we implemented pond when we never believed in it.

This issue was also mentioned in Abraha Atsbaha. The decision of these actors raises an important question that why do people while they knew the pond was not useful for them make such sacrifices? The farmers explained that the pressure from above pushed them to make the decisions. Additional reasons might also be attributed to securing positions and social status by accepting the orders of higher officials.

REST

The only NGO which actively participated in the intervention was REST. Its involvement was in the diffusion of underground tank, a technology similar to that of the GTZ in Abraha Atsbaha. Farmers explained while the technology of underground tank was demand driven the construction was decided by the NGO which totally restricted the opinions and corrective suggestions of farmers. A farmer respondent stated:

The tank was introduced in 2006 and by this time I have gained some knowledge about water harvesting from the experience of ponds. The tabia administrator asked me if I want to introduce underground tank. I told him that I am willing and REST people came for construction. I was told to collect stone and sand and I did accordingly. I was very eager to see water in my backyard for vegetable production. But what REST did is really sad and unforgettable. They contracted private technicians from town who do not know how to do the job. I tried my best to give comments how they should do it but they told me their agreement is not with me but with REST. They said they have finished the job and left. The tank cracked along all sides of the wall and never stored water. I showed the extension workers and asked them to help me maintain but they told me it is beyond their capability and said this is the responsibility of REST. But REST never appeared and helped.

REST had followed the same implementation approach with all beneficiaries who introduced tanks and informants expressed that all the tanks are not functional. Most farmers stated they had requested REST to leave the responsibility of construction to them and to support them with material and technical backstopping. Their request was rejected by REST.

In Abraha Atsbaha, the tabia leader, the beneficiary farmers and GTZ had close interactions and although some technical problems shared agreements and farmers influence and interest were maintained. The quality of the work was satisfactory and farmers are benefiting from the intervention. In Mahbre Weyni, the role of the tabia was only in beneficiary selection and all the decisions were left to the NGO.

6.2.2 Attitudes and practices

Farmers considered as passive recipients of interventions

Selection of technologies and implementation approaches were decided by outsiders. Farmers were not considered as the key actors who should make decisions on interventions that affect their livelihoods. Top-down approaches that restricted the participation of farmers from making choices or influencing the ways of interventions were a dominant practice in government agencies, local level organizations and in the NGO. Although this was the practice in Abraha Atsbaha, significant improvements in learning and interaction were observed since 2004 which enabled farmers perform better quality and demand driven outcomes. In the case of Mahbre Weyni, this approach was missing and interventions such as the REST initiated underground tanks had poor quality outcomes.

Impositions pushed farmers to wrong decisions of technology adoption

Farmers stated because of impositions to implement the pond technology, most people decided to save the best land they think and allocate marginal lands for the intervention. They explained:

When you are forced to choose between your plots, the backyard land is always the top priority compared to distant located plots. In the case of pond, most of us fought not to implement it in our backyard plots and deliberately allocated the distant and marginal lands. We had reasons to do that. We did not believe that the pond was important rather, we had the fear it can cause safety problems such as drowning of our children and the malaria disease. But when we see it today, our decisions were not right. We observe some few people who constructed around their homes have improved the quality of the construction by themselves and are making some benefits. The distant located ponds have remained abandoned.

What is different in Mahbre Weyni from that of Abraha Atsbaha is that 57 percent of farmer respondents believe that ponds, if properly constructed can be useful in their area. According to them this awareness was developed after the intervention by observing the experiences of few individual farmers who were able to improve their ponds constructed during the campaign. These farmers are now producing some vegetables around the ponds. However, farmers stated most people have not the capability to construct new ponds by their own. They explained that the implementation approach was not based on educating farmers by showing in practice how these technologies can be useful to them. This indicates how the top down

approach restricted learning opportunities and created an environment in which farmers deliberately work against the success of the technology.

Top-down attitudes are obstacles to the productive use of demand driven technologies

Farmers had expressed great interest to adopt underground tanks. The selection of each beneficiary was based on demand and willingness of those farmers who had developed positive attitudes from the experiences of individual farmers who transformed their ponds into productive use. Nevertheless, this opportunity was thwarted due to the top-down approaches of REST during the construction of the tanks which restricted each household from participating and improving the quality of the intervention. As a result, almost all the tanks introduced to the tabia became non-functional and the high motivation of farmers was negatively affected. These processes took place in 2006, when enough lessons could have been drawn from the failures of the pond intervention in the area. In Mahbere Weyni, learning from own experiences and correcting failures was one of the major limitations of the coordinating actors while this was one of the strengths in Abraha Atsbaha.

Picture 6.3 Water harvesting schemes introduced in Mahbere Weyni

The case of most ponds



Some making success



Underground tank is water empty



Incomplete pond

Source: the author

New innovations neglected farmers' local knowledge

Farmers have rich knowledge in community type ponds which could have been very useful input for the new intervention. These practices are well accepted and adapted by community members and have many similarities in purpose and technical designs with the newly introduced ponds. Farmers have stated there were not consultations carried out when the government initiated ponds were introduced to their area.

6.2.3 Patterns of interactions

The major differences between the two communities under study lie in practising learning and interacting processes. However, it is also important to highlight some contextual differences between the two that may stimulate or prevent such interactions. For instance, in Abraha Atsbaha, factors such as the existence of individual innovative farmers in shallow well irrigation, ground water potential sites, the continuous support of food by WFP which is more in amount and flexibility than in Mahbre Weyni, and the recognition of the community as a model have positive contributions towards enhancing innovations. Nevertheless, these opportunities were enhanced and maximized by the successes of the innovations carried out by the community. Hence, balancing these facts is crucial for a better understanding of the differences between the two study sites. Table 6.3 summarizes the differences in learning and interaction approaches due to the coordinating role of tabia cabinet specially the tabia leader (administrator).

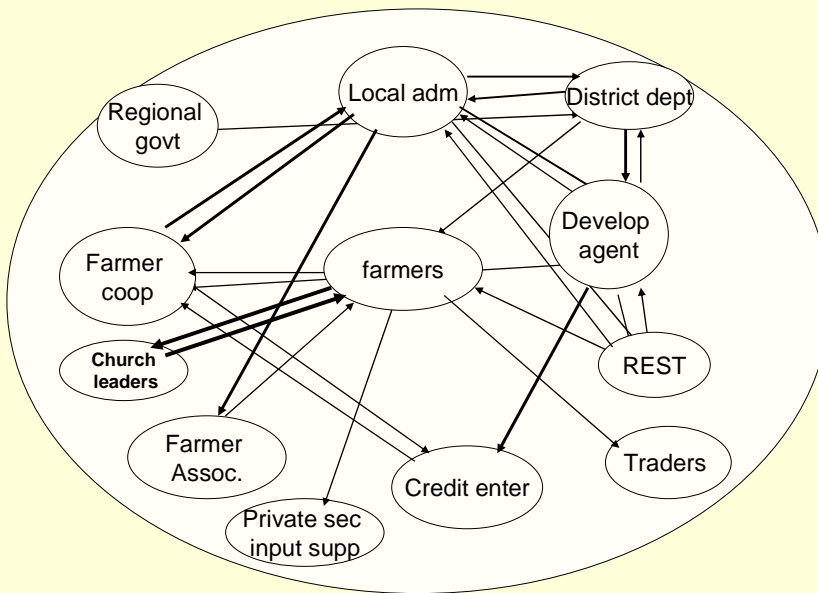
Table 6.3 interactions and learning approaches in the two study sites

No	Key aspects	Abraha Atsbaha	Mahbere Weyni
1	Recovering trust after the coercive interventions	Initiating open discussions, demand driven development actions to buy-in trust	insignificant,
2	Diversifying irrigation alternatives	Efforts to develop wells, spring, water harvesting along gullies, and community ponds	Limited to externally planned alternatives
3	Resource prioritization	A shift from ponds towards shallow wells based on interest of farmers	Very limited
4	Water development centred collective action	Enhancing wells, developing new irrigation potentials	Some supports to community ponds for water supply, collective actions not linked to production increase (conventional approach)
5	Development equity	Awareness and investment on less potential villages,	insignificant
6	Considering the poorest section	Land allocation and support for productive use to poor	Landlessness addressed, less support to make it productive use,

		households	
7	Interactions with NGOs	Strong interaction with GTZ, project outcomes became productive	Weak interaction with REST, unproductive project outcome, no support given to address farmers' complaints
8	Strong follow ups	Tabia leader reaches each household	System not introduced
9	Attempts strengthen networks	Strong relationship with WFP, GTZ; action plans based resource demands (cement, gabion, cash, etc)	Limited network building
10	Attracting influential informal actors	Positive influence to religious leaders and maintaining useful interactions	Religious leaders are active informal actors their role is not well recognised in the formal system

Source: the author

Figure 6.2 Mahbere Weyni Actor Linkage Maps



Source: the author

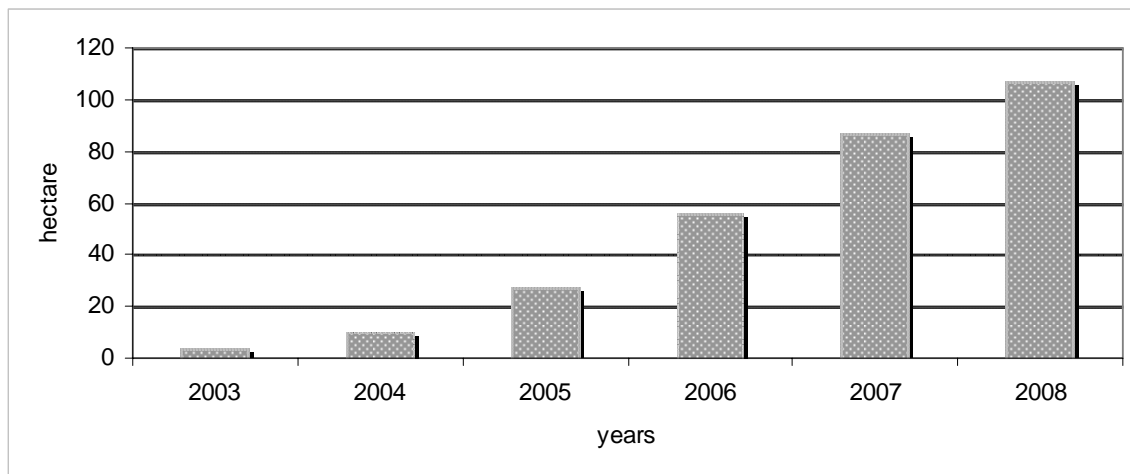
In Mahbere Weyni, the scope and strength of interactions are lower than the interactions in Abraha Atsbaha (figure 6.2 & figure 5.4).

6.2.4. Innovation outcomes

Irrigated land and number beneficiaries have increased

In Mahbere Weyni, irrigated land has increased from 2 hectares in 2002 to 106.8 hectares in 2008. Likewise, the number of irrigation practising farmers has risen from 15 in 2002 to 393 in 2008 (graph 6.1). This is the positive achievement observed after the new intervention

Graph 6.1 Area under irrigation, ha



Source: extension office of Mahbere Weyni (2008)

Table 6.4 Irrigated area and number of beneficiary households in Mahbere Weyni

Achievements	Motor pump	ponds	Underground tanks	Total
Area under irrigation in, ha	103	3.3	0.5	106.8
Number of beneficiary households	360	30	3	393

Source: Mahbere Weyni extension office (2008)

Limitations of innovation outcomes

In Mahbre Weyni, the innovation outcomes have several limitations (table 6.5).

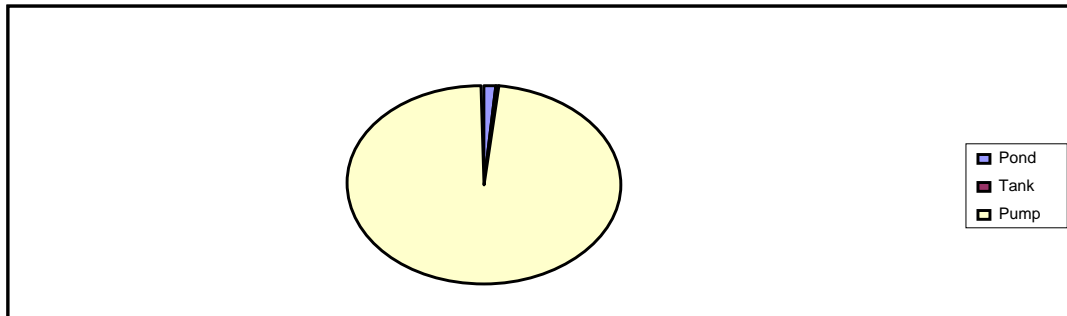
Table 6.5 innovation outcome limitations

Technological skills and knowledge	Irrigation expansion is based on a single technology which is the pump irrigation. This is an outcome of credit facilitation. other interventions have failed with only limited success observed in individual innovative farmers, Ponds can be appropriate options to many farmers but their investment capabilities have limited adoptions
Attitudinal changes	The culture of top-down approach, unlearning own experiences and limited interactions are still dominant in the processes
Distribution of benefits	Skilled farmers and better-off are more risk takers are making success in pump irrigation, poor households specially women headed are gaining limited benefits
Expanding and strengthening linkages	There is lack of continuous interactions and efforts to attract new actors
Maximizing collective action opportunities	Lack focus and integration with in addressing irrigation development, are not exploited as learning and problem solving means

Source: the author

In Mahbere Weyni, irrigation promotion is limited to single alternative. The pump irrigation covers 97 percent of the total irrigated land (graph 6.2). While this is a positive achievement, it also has disadvantages: not all villages have cultivated land along the river; pumps are expensive investment for most of the poor farmers, and women headed families stated it is difficult for them both to afford and operate them.

Graph 6.2 Irrigated area by type of intervention



Source: the author

6.2.5. Conclusions

Government initiated household level strategies and implementation approaches in Mahbre Weyni are similar to the case of Abraha Atsbaha. In Mahbere Weyni, most of the introduced strategies have yielded little success in promoting irrigation except the credit support to water pumps. There is an increase in irrigated area and number of beneficiaries which is at least a positive change. However, this achievement is based on a limited area which has a potential to pump irrigation and to specific strata of the community who have the capability to own and operate this technology.

The main reasons for failures were not due to inappropriate technology selection which makes the case study different from many other areas. Both the ponds and the underground tanks can be important irrigation alternatives to many farmers. The main factors for limited success were the top-down implementation approaches. thus, the case study demonstrates that the top-down and linear approaches are obstacles not only in selecting suitable solutions but also to technologies that could have been widely adopted and integrated to the existing production systems.

Furthermore the consequences of intervention failures are multi-dimensional that include restricting technological, attitudinal and organizational capacities and the misuse of material resources. The study findings indicate that local level actors have different innovation capacities in responding and transforming policy interventions into practices. In Mabere Weyni, the local actors are constrained by lack of capacities to develop local level adaptations and thus followed the conventional way, struggling to implement fixed plans initiated by external decision makers with out making necessary adjustments suitable to their context.

It was learned that majority of the tabias in Kilde Awlaelo have similar trends like that of Mahbere Weyni.

CHAPTER SEVEN: CONCLUSIONS AND REFLECTIONS

This chapter discusses the key findings of the case studies. The first section examines the study findings based on the conceptual framework this research was guided to analyse policy impacts on pro-poor innovation capacities. Further it summarises which components of policy interventions had positive contribution and which aspects had influenced negatively. The next section discusses theoretical reflections based on the findings and lessons learned. The final section presents tentative recommendations for improving policies in the study area.

7.1 Research findings

7.1.1 Innovation system and determinant factors for pro-poor innovation

successes

The initial question for this research was *what is the impact of agricultural policies on pro-poor innovation capacities and pro-poor outcomes of smallholder irrigation?*

Policy impact was studied based on four determinant factors: actors and their roles, attitudes and practices, patterns of interactions and an enabling environment in infrastructures and finance.

1. Actors and their roles

Ensuring the involvement of all key actors who are in the system of innovation has two major advantages: they can pool their resources mainly knowledge and material resources, it helps them to articulate their needs which can lead to demand driven policy interventions. However, innovation literatures suggest that attitudinal problems, power relations and access to assets and resources have great influences in shaping the participation of actors.

In the study area, major inputs of household level irrigation include: improved varieties of vegetables and fruits, labour, local and industrial construction materials, grain (for food for work), finance, land, markets, various knowledge and skills, supporting laws such as land reallocation, and organizational support. These inputs and support are beyond local actors' capabilities and thus the involvement and cooperation of various actors is critical to the success of the innovation. Study findings from both communities indicate that the key actors who have great contribution in the innovation processes include policy makers, public sectors who provide extension and other services, farmers and farmers' organizations, credit institutions, NGOs working in the area and the private sector.

However, the results show that some of the key actors had dominant roles while others specially farmers and other local actors were marginalized in key decision making processes. The main factor that limited the involvement of actors was attitudinal problem in policy making and implementation approaches reflected in different forms of practices as described in the following.

1. Because of top-down attitudes, household level intervention components such as the ponds were initially decided by decision makers at regional level and local level institutions and farmers had little influence in addressing their demands. Thus, the major intervention priorities and strategies were decided by policy making actors.

2 Involvement of local level institutions and farmers come mainly during policy implementation phase after the strategies including plan targets and resource allocations are decided by policy making bodies and the woreda public sector officials.

The role of local actors has significant differences in translating policies into practices. Most local actors attempt to implement policies without making significant changes, simply to meet the targets decided by external agencies and as an end result, they are challenged by unintended consequences of policy outcomes. In some communities, local actors implement policies in a creative way by attempting to shape and adapt the strategies towards their demands and priorities. As a result they minimize the risks of top-down approaches.

These differences are attributed mainly to the capacities and attitudes of local leaders.

3. Power relations had negative effects in pro-poor innovation capacity development. Research findings in both communities have shown that the influence of power is reflected through excluding local actors in priority setting of interventions by the public sectors including by policy makers, discouraging local innovations in resource allocation by woreda officials, and discrimination in motivating model innovators by tabia and village leaders.

4. The poor and disadvantaged groups are the most marginalized actors. Research findings from the two communities indicate that the poor and disadvantaged groups especially women headed and landless households have limitations in implementing irrigation innovations due to lack of asset endowments mainly labour, land (the landless households) and capital. This trend was observed in both communities. In Mahbre Weyni, the pump irrigation which is the main innovation in irrigation is practised by farmers who have better access to assets and better risk aversion opportunities. In Abraha Atsbaha, the wells and other water harvesting schemes have required

labour and investment materials which are not easily affordable by the poor. Thus the roles of farmers in the innovation processes were influenced by opportunities of access to asset endowments. In Abraha Atsbaha efforts have been made to reach the poor and involve them in the innovation processes by allocating land to landless households and by linking women headed households to GTZ for financial and material supports. These efforts had positive results in creating innovation capacities among the poor. However, most of the irrigation innovations in both communities are adopted by relatively better-off households.

5. The roles of the private sector are very limited due to mainly weak development of the sector in the study area.

6. The need for research involvement is emerging in more recent years after the innovation has shown some successes. For instance, in Abraha Atsbaha, there is a growing demand for improved varieties, cash crop diversification (ground nut), pest control technologies and water management related issues. However, the contribution of research is missing because of its limited capacities.

The study results revealed that the absence or restricted involvements of the right actors especially farmers and farmer groups had negative impacts on the successes of pro-poor innovation in both communities. This was demonstrated in adoption of unsuitable irrigation strategies at policy level such as the pond, undermining local innovations such as the shallow wells in Abraha Atsbaha, the failures of some feasible technologies such as the underground tanks in Mahbere Weyni, market problems in both community areas, lack of knowledge in conflict management, and lack of alternative technologies due to weak research support.

What these evidences show is that contemporary problems of agriculture including in the study area are complex that need collaborations and resource contributions of all key actors in the system. However, in the study area, the roles of actors are shaped by different factors. Attitudes and practices in policy making and implementation processes were the key factors that restricted their involvement. In addition, the weak economic development has also negative effect in limiting market opportunities and private sector involvement. Lack of asset endowments and low awareness on responsibilities had also reinforced low participation of actors.

2. Attitudinal changes

The innovation system framework stresses that attitudes determine the relationships and patterns of interactions between actors, the interest for learning and correcting mistakes and recognition of

cooperating with other partners. It can be said attitudes are the key factors that influence all principles of innovation development.

The case study findings proved that positive attitudes among local leaders in Abraha Atsbaha towards learning from failures such as the experiences of ponds and supporting demand driven interventions have resulted in successful innovations. On the other hand, attitudes that lead to highly centralised planning and pre-defined solutions lack flexibility to learn and adjust decisions and finally result in failures.

Understanding this knowledge has helped the research to learn which attitudes are supportive to innovations and which are obstacles that an innovation enabling policy has to consider.

However, the key issue is how to develop supportive attitudes which are pro-poor oriented within the system of the innovation processes. The innovation system framework suggests that these trends can be learned through different means including network building and interactions with various actors.

Evidences from the Abraha Atsbaha case study show, that ways of developing positive attitudes are many but public evaluations can open a room for learning, better interactions and responsive attitudes. However, they have to be supported with visible development outcomes in which the community can learn more practical changes.

Furthermore, the findings indicate that attitudinal changes might be easier at community level than at policy making level because local leaders, as members of the community, can easily interact and understand the problems and better solutions that fit to the local context. In addition to this, while they try to uphold the policies, they also have better sense of accountability to serve their community. This trend was observed in both communities including in Mahbre Weyni, where most of the innovations were not successful.

3. Patterns of interactions

According to the recommendations of the innovation system framework, denser and two way communications of actors are useful for innovation successes. This fact was observed in the case study of the two communities. Abraha Atsbaha has relatively more number of actors and better interaction practices both with local communities and external actors. These had positive contributions in resource mobilizations and intervention coordination.

Understanding the role of different forms of interactions in learning and knowledge sharing was useful in analysing the contribution of the policy intervention in innovation capacity building. From

policy perspective, more resources are allocated to paternalistic approaches of interactions while in practice, farmer to farmer learning has better contributions to promote pro-poor innovations.

4. Local level innovations and the role of macro-policy environment

The innovation system framework stresses the need to wider interconnectedness and the importance of enabling environment at macro-level. The experiences of Abraha Atsbaha revealed that local level innovations are constrained by unfavourable external innovation environment. For instance, local initiatives were discouraged by higher officials because they were not part of the pre-defined plans. There are several emerging issues in irrigation development in Abraha Atsbaha which need the input of various external actors. For instance, the issue of marketing, pest control, water related conflict resolution, managing conflicts in public works and private activities, more knowledge in water development and irrigation management, issues related to addressing the poor and disadvantaged groups. Some of these issues are beyond the capabilities of local actors and need policy support. Thus, while local level innovation successes are possible, their continuous development and more successes require inputs of external actors including facilitation of pro-poor policies.

7.1.2 Local level competences and commitment are vital to pro-poor innovation successes

Case study findings from the two communities demonstrate that the translation of macro-policies into practices can vary from community to community depending on the factors that dominate the local contexts.

The case of Abraha Atsbaha indicates that it has followed more creative pathways which can be said a multi-dimensional approach towards addressing problems. Gradually the tabia leaders were successful in developing an enabling environment for innovation through organizing public meetings which led to improved interactions and learning between the tabia leaders and the community as well as within village leaders and community members. Such changes have helped the tabia to achieve successful irrigation development which is instrumental to poverty alleviation at grassroots level. Institutional changes have improved technological innovations, managerial skills and the collaboration of different groups in the tabia. Today, it has become among the few well recognized best models of the region, and a good learning site for many other communities. The regional government had taken the initiative during the first phases in organizing field days in Abraha Atsbaha. Following this experience, the woredas have been active in organizing experience sharing for their extension workers and tabia leaders with model farmers in Abraha Atsbaha.

In Mahbere Weyni, most of the interventions were not successful, although irrigation has expanded after the new policy, technological innovations are very limited, interactions are weak and learning from own experiences by tabia leaders is rare. Thus institutional changes in Mahbre Weyni are insignificant.

The case study findings have shown that the key factors for the successes in Abraha Atsbaha were influential practices by the tabia and village leaders. These include supporting new initiatives of farmers such as the demand for shallow wells, learning from own experiences(for instance pond was suspended from the tabia plan after the first year of negative experiences), organizing public meetings and encouraging people to talk about the interventions, practicing innovation components in own farms and experience sharing to others, technical support to individual farmers such as developing shallow wells and fruit management, coordinating collective actions towards successful results and learning new things from visitors. Such processes of learning were missing in Mahbere Weyni.

The lessons from the two communities reveal that a committed and competent coordinating actor is one of the key factors to the success of innovation. The leadership capacity in Abraha Atsbaha has evolved through gradual processes in which some critical events had positive contributions

1. Continuous public and self evaluations

The public evaluations conducted in 2001/02 focusing on practices of good governance had positive influences in creating sense of accountability and commitment among the leaders to serve the community genuinely. Similar evaluations were conducted after the new intervention to identify weaknesses and interaction problems. These events were very useful in shaping the attitudes of the leaders and creating learning opportunities. There were similar programs in Mahbere Weyni but do not seem productive as it was in Abraha Atsbaha.

2. Flexibility to new ideas and alternatives

The failures of ponds pushed farmers to search for alternative interventions. A group of farmers who were better informed about the experiences and benefits of early innovators started to put pressure on the local leaders to support them in developing shallow wells. The local innovators were also instrumental in experience sharing and influencing their neighbor farmers. The local leaders responded positively to the demand of farmers and thus local experiences were utilized as an entry point to promote irrigation in the area. This experience has helped to develop the culture of flexibility in planning and interventions. This is more demonstrated in collective actions to address emerging issues. For instance, they encountered water shortage in shallow wells and

quickly responded by constructing large water storing structures near the wells to harvest rainwater runoff in order to enhance the potential of the water.

3. Technical and managerial skills of local leaders

Some of the leaders have served for longer time in administration which has helped them to develop technical and managerial skills. The watershed management activities which include various complicated technical and managerial components are mostly coordinated independently by these leaders. They effectively address various social issues such as land reallocation, forest protection and conflict resolution.

3. Learning by doing

The community based collective action program has become an important source of knowledge and learning especially in water development related activities. The second approach of learning by doing is related to individual experiences of the leaders.

The tabia leader demonstrates new practices on his own farm and invites farmers to visit and learn from him. For instance he has introduced a new design for a shallow well from his own experience, has developed an apiculture farm, grows better yielding varieties of fruits, and has introduced family drip irrigation. He educates farmers based on his own experiences and has become a model for technology transfer.

Other innovation supportive activities include: motivating individual farmers by rewarding agricultural tools and house to house visits,

7.1.3 The effect of specific policy components in developing pro-poor innovation capacities

Policy components that had positive contributions

The change from large-scale to household level irrigation strategy had some positive aspects. The strategy components are low-cost that can be easily managed and scaled up by the poor and subsistence farmers. Thus, after the introduction of this strategy, irrigation development, both in terms of area expansion and number of beneficiaries have significantly increased at community and regional levels compared to the period during the large-scale policy. This change was not because the new government driven irrigation components were easily accepted and promoted. The expansion of irrigation after the new policy was triggered due to the following factors:

When the government driven strategies such as ponds failed to address farmers' needs, this had created an opportunity for local leaders and farmers to search other irrigation alternatives. For instance, in Abraha Atsbaha, farmer driven innovations such as the shallow wells were recognized at this stage and the diffusion and scaling up took place quickly. These innovations have been there for decades but were only limited to very few individuals.

The second reason for the expansion of irrigation during this period is attributed to the awareness created among local level leaders and extension agents about the need to fight poverty and food insecurity. After the policy reform in 2001/02 the government has used various forums including the media to mobilize farmers and government employees towards fighting food insecurity by implementing the new policies including the household level irrigation.

The important elements that have positive contribution include: credit facilitation to all farmers without discrimination, extension support to farmer-to-farmer learning such as the experience sharing with the model tabia, and a general awareness among farmers, public sectors and NGOs on the need to intensify food security activities particularly irrigation development programs.

Another important aspect can be mentioned the initiative to conduct public evaluations that aimed at improving good governance at local level. Although these were not productive in the second study area, they had positive contribution in Abraha Atsbaha indicating if properly managed can open rooms for learning and interactions between local leaders and farmers and within farmers themselves.

Thus, policy contributions towards innovation development are technological innovations (pumps and new fruit and vegetable varieties), credit support and information flows and knowledge building.

Policy components that had negative effects

Regardless of the change from the large-scale to household level strategy, the linear or top-down approach has continued to dominate the policy throughout the processes. This trend was reflected through the following intervention approaches:

- The culture of highly centralised planning and decision making approach,
- Blanket and standardised technologies and program target solutions,
- Over-ambitious plan targets,
- Impositions to 'accept' interventions,

- Unlearning from own experiences and rather covering up mistakes,
- Undermining local knowledge

Most of the changes and innovations were planned at regional level without considering the diverse and complex local contexts. Targets for each woreda had been set and transferred following a linear model approach through the hierarchical structures down to the farmer level. The interventions focused on technical and standardized designs with over-ambitious targets assuming technological innovations are the best solutions to achieve food security and poverty reduction.

The outcomes of such interventions had multi-dimensional consequences. Farmers were assumed as passive recipients of externally decided solutions and were imposed to accept the planned interventions against their interests. Finally most of the planned changes and innovations were rarely achieved, rather unintended consequences such as misuse of resources, farmers' resistance and the culture of top-down practices were widely observed.

The study findings show that extreme practices of top-down approaches such as coercive measures and impositions were widely practised on farmers during the first phases of the new interventions to accept the pond technology. In more recent years, such practices have been avoided in the study area but still more genuine and transparent participation of farmers are lacking and the basic trends of the top-down approaches are the dominant practices reflected through the above mentioned policy implementation mechanisms.

As the research findings indicate, the main reason for maintaining a top-down model seems the lack of holistic approach in addressing problems. The intervention processes had focussed on simple technical solutions and not on system based approaches that recognize problems are complex and technology is only one part of the solution. In the contemporary agricultural context, solutions need to focus on collaborations of various actors, developing positive attitudinal changes and building technical and organizational capacities. These require more interactions and participation of relevant actors including the decision making power on their own demands and priorities.

Evidences from the case studies have proved that top-down approach is a major obstacle to innovation development because it undermines participation of actors particularly, the farmers, overlooks local knowledge and mostly rushes to introduce new technologies without adequate

learning on their outcomes. This approach restricts systematic learning and correcting mistakes due to lack of openness to feedbacks and new ideas. For instance neither the lessons of the micro-dams nor the case of the pond experiences have been seriously investigated and learned.

In summary, findings of the case studies have shown that policies in the study area follow top-down approaches which are dominated by centralised and blue print planning that are unsuitable and counterproductive to achieving food security and poverty reduction.

Top-down approaches lack flexibility and do not recognise farmers as the key actors in decision making of any intervention that affects their livelihoods. Such attitudinal trends in policy makers and the extension system at large are the key factors that are restricting innovation capacity development of smallholders. These trends have changed very little even after the policy reform which intended to ensure the full participation of farmers in all development processes. This indicates that practices can be different in the real world than what policy documents normally state and are mostly influenced by the 'soft institutions' which are strongly inbuilt in the culture of the organizations.

7.2. Theoretical and methodological reflections on the innovation system

The four determinant factors of innovation capacity help to gain a broad knowledge on policy-innovation capacity relationships which was instrumental for this research.

Hence this research believes that the analytical tools are major strengths of the innovation system. However it argues that the innovation system has several limitations in the context of the study area which is characterized by subsistence farming system, massive food insecure population, weak market infrastructures and the state functioning as the dominant development actor.

How can the state be made an 'innovation enhancing institution'

In the study area, many innovations and innovation inputs are policy influenced. The government is one of the key sources of information and knowledge for specific interventions (pumps and new planting varieties), is the key actor in rural infrastructure development, highly involves in credit provision, and has key role in mass mobilization for public works.

This indicates that government policies can be central to encouraging or restricting innovation processes.

Hence, the key question with regard to agricultural innovation becomes how to transform the government structures into innovation stimulating actors. In the study area, agricultural policies including irrigation programs are influenced by many government actors such as the political

administration, the media, farmers' organization promotion actors and the extension system. NGOs operate in limited areas and have limited influences. Therefore, the role of the state in overall development processes is central.

The innovation system recognizes the central role of the state in innovation transformation in weak market economies. Nevertheless practical experiences are limited on how to influence the government system towards innovation encouraging institution.

Innovation system and poverty reduction

The priority agenda of the government in the study area is addressing food insecurity and poverty reduction. While attitudinal factors play key role, meeting the MDGs is also one factor for rushing with over-ambitious targets by undermining 'time consuming' learning approaches such as piloting and learning innovations and conducting wider linkages and interactions.

The innovation system framework needs more research works to prove that it can best serve in achieving the MDGs which are the top priority of current development agenda in countries such as Ethiopia.

Recognizing the importance of local innovations

Although local innovations have their own limitations they can be useful entry points in promoting pro-poor innovations especially at the initial stage of interventions. Local innovations are useful in addressing food insecurity, help to gain more knowledge on innovation development processes, can be scaled up to similar contexts of neighbouring communities, and can serve as a means to influence macro-policies. In the context of the study area, farmer driven innovations were found more suitable and easily adaptable.

In developing local innovations, individuals and visionary community representatives can play leading role if they are well supported with necessary resources. The innovation system needs to give due attention to learning local innovations and encouraging and building the capacity of community institutions.

Investment capabilities

The case study of Abraha Atsbaha has indicated that even with positive attitudes towards reaching the poor, farmers explained the existing innovation interventions are difficult for the poor to afford them due to lack of investment capabilities such as labour, land and other resources.

Hence, in the context of the study area where majority of households are poor, developing innovation capacity has strong linkage with household level asset endowments. This means, the

existing irrigation alternatives create better innovation opportunities for the better-off than to the poor. In other words, technological innovations need to be diverse and related to household asset endowments.

Methodological constraints

Most of the study components are perceptions and attitudes which are not easily understood and captured. In addition, some respondents lacked openness believing some of this research issues are sensitive to comment due to fears of facing risks. In this case such research topics need more time in order to gain trust among respondents.

The researcher had encountered technical problems related to the categorization of the determinant factors of innovation. The three elements are very much related and were difficult to make separate data collection and analysis for each element independently. This had created some confusion in data collection and analysis.

7.3 Tentative recommendations

The current policy approach is dominated by linear model of thinking. The government needs to introduce new ways of policy thinking that take into consideration the contemporary context for agriculture and the innovation thinking approach. However, radical policy shifts can only be achieved through long term processes.

This research recommends the following steps of policy improvement:

- Start with systematic and holistic approach of learning from current policy strengths and limitations in enhancing pro-poor innovation capacity and practical outcomes
- Encourage continuous public debates on policy matters where communities and public sectors including policy makers can freely interact and exchange opinions,
- Revisit policy planning approaches and create mechanisms for enhancing local level development initiatives,
- Encourage more research works on innovation system perspectives and policy approaches in order to gain better understanding on system thinking, social learning and genuine participation of stakeholders.

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