AGRICULTURAL INNOVATION IN A CHANGING ETHIOPIAN CONTEXT: THE CASE OF DAIRY FARMING AND BUSINESS IN THE ADDIS ABABA MILK SHED, ETHIOPIA

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by

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DEDICATION

This dissertation is dedicated to my wife ELSA FISSEHA, who was extremely supportive in prayers and in managing family affairs during my busy study period

ABSTRACT

Ethiopia's economy remains largely dependent on agriculture, where smallholder farming is the main feature. Historically, a dominant smallholder economy came into existence during the communist regime (1974–90), when the government confiscated rural land from the aristocracy and redistributed it to the citizens. The communist regime paid more attention to state farms, with private agriculture being limited to smallholder farms. Following the change of government in 1990, private-sector agriculture developed quickly, although land remained state-owned. The land lease policy of the state allowed for the rapid growth of the private sector in agriculture, manufacturing and trade.

Livestock is an important subsector in the country. Ethiopia has the largest livestock population in Africa, but does not benefit sufficiently from this resource. Technical reasons such as genetic limitations of the indigenous animals for milk production, poor quality feed resources, poor artificial insemination (AI) and veterinary health services are as important challenges. However, important but less explored factors of interest in this study include interactional (linkage and communications) limitations, institutional issues, policy and scarcity of knowledge. Development actors, including the government of Ethiopia, need to pay attention to these issues. The role of government on the livestock sector is increasing in some areas. For example, the Growth and Transformation Plan of the Ethiopian Government considers live animal exports an important source of foreign exchange earnings. The plan also recognizes the contribution of small ruminants and poultry to household food security. Dairy development is at the crossroads as there is a growing interest and participation of diverse actors in production, processing and marketing, which has created impetus for innovation. On the other hand, dairy innovation is constrained because of several important challenges. Explaining this paradox and identifying the key leverage points that could help to transform the dairy subsector into a more functional system is, therefore, the main focus of this study. The Addis Ababa Milk-shed is used as a case study.

The Agricultural Innovation System (AIS) framework, an alternative to the Transfer-of-Technology (ToT), is the theoretical framework used in this study. The conventional ToT approach has limitations for understanding complex systems and functions. It only recognises the traditional actors in research, extension and farming, while undervaluing the private sector actors.

The AIS framework explains how innovation takes place through interactions of people, policy and institutions. It is used in this study to firstly outline important historical episodes in the dairy subsector, and analyse how policies and other factors affect innovation over different periods. Secondly, it analyses the dairy resources and how innovation is enhanced. The third dimension places emphasis on understanding the complex interaction of actors outside the mainstream ToT

model. Finally, the fourth area is on policy and institutional issues. This study is therefore premised on developing new insights into the innovation system framework by using concepts of resilience, leverage points, trust building and the implications of historical legacies in shaping contemporary innovation.

The innovation capacity assessment model is used to develop the methodology of this study. Data collection, guided by the key components of the innovation system framework, include sector mapping, historical evolution of the sector, resource base analysis, interactions between actors, the policy environment, habits and practices, and resilient features and leverage points. Both qualitative and quantitative methods were used for data collection and analysis within this framework. Key-informant interviews, questionnaire surveys, document review and consultative workshops were the main methods used to generate data. For quantitative data analysis, SPSS software was used, while the qualitative data were analyzed using tools such as systems drawing, linkage matrix, typology of linkages, habits and practice analysis, and content analysis.

The lessons learned from history were used to identify key leverage points and formulate recommendations for innovation. Analysis considered dairy resources such as land, feed, genetic resources and services. The current system was compared to the previous regime in relation to how dairy innovation was affected. This study has shown a reduction in milk productivity by smallholder farmers in the Addis Ababa milk shed. The policy of the current government, based on a free market economy, privatization and investment, is contributing to diversification and innovation, but mainly in the processing industry and commercial farmers.

The study has also identified productive interactions of dairy actors. These interactions are growing over time, but the impacts on the lives of the smallholder farmers have not been as beneficial as expected. For example, the critical problem of access to markets for smallholder farmers is not yet a main agenda item of any of the networks. This study, furthermore, found that four factors contribute to the existing market problems, namely the extended fasting season (196 days per annum) of the Orthodox Church believers; a limited tradition of milk drinking in Addis Ababa; high milk prices when compared to low incomes of the majority of citizens; and underutilization of the capacity of the milk processing industry, mainly as a result of a limited domestic market and the dominance of the informal milk market.

The initiatives to enhance innovation to overcome these challenges are few. Promoting smallholder dairy production without addressing the market problems inhibits innovation. The study also concludes that interactions of the actors in the dairy innovation networks and the economic policy measures taken by the government have contributed to the development of the sub-sector. The government needs to consider a “bridging policy” to support the dairy subsector to become competitive in the export economy. Developing the dairy subsector in Ethiopia is urgently needed because the population is increasing as is the emerging middle class. This

situation calls for urgent institutional innovation in research and extension agencies, NGOs and the private sector.

DECLARATION

I Amanuel Assefa Ezezew declare that:

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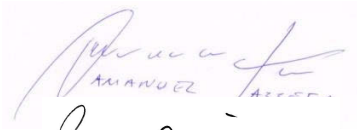
Signed:  Date: 20 October 2014

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LIST OF ACRONYMS AND LOCAL TERMS

AADI	Addis Ababa Dairy Industry
ABCD	Asset Based Community Development
ADLI	Agricultural Development Led Industrialization
AI	Artificial Insemination
AIS	Agricultural Innovation System
AKIS	Agricultural Knowledge and Information System
ARDU	Arsi Rural Development Unit
ASTI	Agricultural Sciences, Technology and Innovation
ATA	Agricultural Transformation Agency
ATVETS	Agricultural Technical and Vocational Education and Training System
BPR	Business Plan Re-engineering
BOAM	Business Organizations and their Access to Market
CGIAR	Consultative Group for International Agricultural Research
CSA	Central Statistics Agency
CTA	Technical Center for Agricultural and Rural Cooperation ACP-EU
DA	Development Agent
DDA	Dairy Development Agency
DDE	Dairy Development Enterprise
EEA	Ethiopian Economic Association
EIAR	Ethiopian Institute of Agricultural Research
EMDTI	Ethiopia Meat and Dairy Technology Institute
EMPPA	Ethiopian Milk Producers and Processors Association
EMT	Effective Microorganism Technology
ENA	Ethiopia News Agency
EPRDF	Ethiopian People Revolutionary Democratic Front
FAO	Food and Agricultural Organization
FTC	Farmer Training Center
FIF	Financial Intermediation Fund
GDP	Gross Domestic Product

Gott	Sub units of *Kebele* but not part of the official body of administration
GTP	Growth and Transformation Plan
HUNDEE	Name of a local NGO, which means “Roots” in Oromifa language (local)
IFPRI	International Food Policy Research Institute
IGAD	Inter Governmental Authority for Development
ILRI	International Livestock Research Institute
IS	Innovation Systems
Kebele	The lowest administration unit of the government
KIN	Knowledge and Information Network
Masl	Meters above sea level
MDG	Millennium Development Goal
MoA	Ministry of Agriculture
MoARD	Ministry of Agriculture and Rural Development
MoFED	Ministry of Finance and Economic Development
MoST	Ministry of Science and Technology
NAIC	National Artificial Insemination Centre
NARES	National Agricultural Research and Extension System
NARS	National Agricultural Research System
NGO	Non-Governmental Organization
ODI	Overseas Development Institute
PADeP	Smallholder Agriculture Development Program
PADETES	Participatory Agricultural Demonstration, Training and Extension System
PANE	Poverty Action Network Ethiopia
PASDEP	Plane for Accelerated and Sustainable Development to End Poverty
PID	Participatory Innovation Development
PROLINNOVA	Promoting Local Innovation
PTD	Participatory Technology Development
R&D	Research and Development
RAAKS	Rapid Appraisal of Agricultural Knowledge System
SDDP	Smallholder Dairy Development Project

SNV	Netherlands Development Organization
SPSS	Statistical Packages for Social Sciences
ToT	Transfer of Technology
UHT	Ultra Heat Treated
UNDP	United Nations Development Program
UNICEF	United Nations Children Fund
USAID	United States Agency for International Development
USD	United States Dollar
VAT	Value Added Tax
VOCA	Volunteers in Overseas Cooperative Assistance
Woreda	The second lowest administrative organ of the government that comes one level higher than "*Kebele*"
WFP	World Food Program

CHAPTER ONE: INTRODUCTION

The link between agricultural research and development has been viewed for many years in Ethiopia from a linear perspective (Tesfaye, 2003), using what is often called the Transfer of Technology (ToT) model (Röling, 2009a). In this model, research and extension contribute to knowledge and information on the supply side while farmers are on the receiving or demand side. This kind of institutional arrangement for research and development is common in developing countries. Over the years it has influenced policy makers, global financial institutions and the attitudes and habits of practitioners. The "Green Revolution" that took place first in Mexico and then in India and the Philippines is a manifestation of this model of development (Borlaug, 2000). Following the apparent success of the Green Revolution in Asia, many governments in Africa have shown interest in adapting the model. Many have also criticized the model: although it has helped to increase productivity in ecological contexts, which are less diverse and complex than in Africa, some of the concerns posed include- its negative impacts on environmental degradation, increased income inequality, inequitable asset distribution, ultimately worsening absolute poverty (IFPRI, 2002; Dano, 2007).

The work of Sasakawa Global 2000 in eleven African nations, including Ethiopia, using the ToT approach is an example of the implementation of the Green Revolution model in Africa (Borlaug, 2000). In support of some African nations, Western donors like Rockefeller and the Bill and Melinda Gates Foundation have formed alliances and developed programs to reduce poverty and hunger in Africa, using the same model (Holt-Gimenez, 2006). The establishment of the Agricultural Transformation Agency (ATA) in Ethiopia is a recent example of a donor-supported initiative, developed to contribute to the implementation of the five-year Growth and Transformation Plan of the Government (Council of Ministers Regulation, 2010). It is not, however, clear whether this initiative will adapt the classical ToT model or introduce institutional changes differently to facilitate innovation in complex circumstances. The ToT model focuses on technical solutions with, technology transfer considered to be a major function. An analysis of the focus and strategies of most of the development interventions over recent decades in Ethiopia shows the same trend. Constraints to development were seen primarily as

technical, and hence the efforts made have also emphasized the ToT and public provision of services (Tefera *et al*., 2008; Samuel, 2006).

1.1. Problem statement

The livestock sector in Ethiopia, in general, is not generating economic benefits that are commensurate with its size and potential (Figure 1). This situation remains the same despite the efforts of government and many other agencies in the past and at present to develop the dairy industry within its production and marketing dimensions. Numerous dairy actors are emerging and the interaction of actors in the subsector is becoming increasingly complex. The growing complexity of the dairy industry in the Addis Ababa *milk-shed* is raising hopes of the dairy actors for innovation because several new ideas of institutional arrangements and technologies are being tried and introduced. For example, the role of the private sector in the production, processing and marketing side is increasing, many NGOs are implementing dairy projects to support smallholders in the rural and urban areas, and several learning networks on dairy are taking place at different scales.

Nevertheless, little is known about the interaction of multiple actors for innovation and the benefits for dairy smallholders are uncertain. According to Land O'Lakes, a USAID partner agency dealing with dairy development, Ethiopia is one of the fastest urbanizing countries in Africa, with urbanizing growth rates of 4.3 percent per year. There is, they argue, a substantial unmet demand for milk and milk products (Land O'Lakes, 2008). Paradoxically, most of the rural-based smallholder farmers, not too far from Addis, have serious market problems (Asgedom, 2010) while the milk processing plants in the Addis Ababa *milk-shed* have been operating below capacity for decades (Hiskias, 1998; Haile, 2009). This paradoxical situation is a good example of how development challenges of this nature have systemic features and cannot be isolated from the relationship of the system actors and the factors that influence the important relationships. A thorough understanding of the relationship between producers, market actors, civil society actors and the research and extension actors in the dairy subsector may help to clarify the challenges of the smallholder farmers and to find appropriate pathways for important system-level changes.

Photographed by the author

Figure 1: Farmers in Berek struggling to sell their milk: small scale, limited institutional support

1.2. Aim of the study

The aim of this study is to understand actors' interaction and innovation in the Addis Ababa milk shed and to identify key leverage points that could trigger favorable changes in the smallholder dairy innovation system. A number of research questions arise from this aim and also lead to the study objectives.

1.2.1. The research questions

- What are the important historical legacies and policies that affect dairy innovation in the Addis milk shed?
- Who are the key actors in the dairy subsector and what are their responsibilities?
- What is the resource base the dairy actors are working with?
- What are the important linkages of the dairy actors that affect smallholder dairy innovation?
- What are the key policies, habits and practices that affect the dairy actors' interactions?
- What are the key leverage points to improve the innovation capacity of actors in dairy and make the system more robust and resilient?

1.2.2. Specific objectives

- To explain the historical development of the dairy subsector and how policy influences dairy development and innovation.

- To identify the dairy actors in the Addis Ababa milk shed and their roles, responsibilities and interactions for smallholder dairy innovation.
- To determine the extent to which the key dairy resources available in the *milk-shed* enhance or block dairy innovation.
- To determine how policies and institutions (habits and practices of the dairy actors) affect innovation within the existing systems.
- To propose key actions necessary to enhance dairy innovation on smallholder farmers.

1.3. Overview of thesis structure

This thesis comprises seven chapters, with the first introducing the study and includes coverage of the rationale for the study, the ensuing problem statement, aims, objectives and research questions.

The second chapter discusses the context in which the study took place: it describes the major historical, economic, social and political features of the country and provides detail of the key government policies that have influenced the way development is organized in contemporary Ethiopia. An overview of the agricultural extension system, some issues of livestock development and a brief account of the major milk sheds in the country are presented in this chapter.

The third chapter contains a literature review. The review explores a body of theoretical discourses on systems theory, institutional models for research and development and important concepts in the areas of innovation, community resilience, leverage points, and trust building. The fourth chapter covers the research methodology. The data collection methods, the field organization and data analysis tools are described. Chapter Five covers the results of the study. It presents the finding in relation to the key issues mentioned in the objectives of the study. Chapter Six discusses the results presented in Chapter Five while Chapter Seven sets out the major conclusions and recommendations to enhance local innovation processes in smallholder dairy farmer settings.

CHAPTER TWO: CONTEXT

2.1. Introduction

This research is initiated by providing the national context in which it occurs. The intention is to focus on issues, which place farming and that of the Addis Abba milk shed in particular, in the national context. It covers salient points of the country's location, history and highlights major political and economic features. The recently declared Growth and Transformation Plan (GTP) of the Ethiopian Government, which is a five-year national plan and an overarching framework of development in general, is highlighted.

Historical and current practices of extension will also be discussed. This section provides insight into the different pathways of extension in Ethiopia and the founding concepts. The attempts of the government to create social mobilization through organizing rural people as taskforces to perform government planned natural resource management works as well as other extension activities is discussed. The intention is to underline the relationship between state agencies for agricultural extension and the smallholder farmers as well as the dynamism at grassroots. The livestock sector is also considered, and a historical timeline of dairy development is presented. The important milk sheds in the country are described and the important actors in these areas.

2.2. Overview of the historical, political and economic features of Ethiopia

Ethiopia, a land-locked country in the Horn of Africa, is located between latitudes 5°N and 15°N and longitudes 35°E and 45°E. Ethiopia's neighboring countries are Eritrea in the north, Djibouti and Somalia in the east, Kenya and Somalia in the south and Sudan in the west (Figure 2).

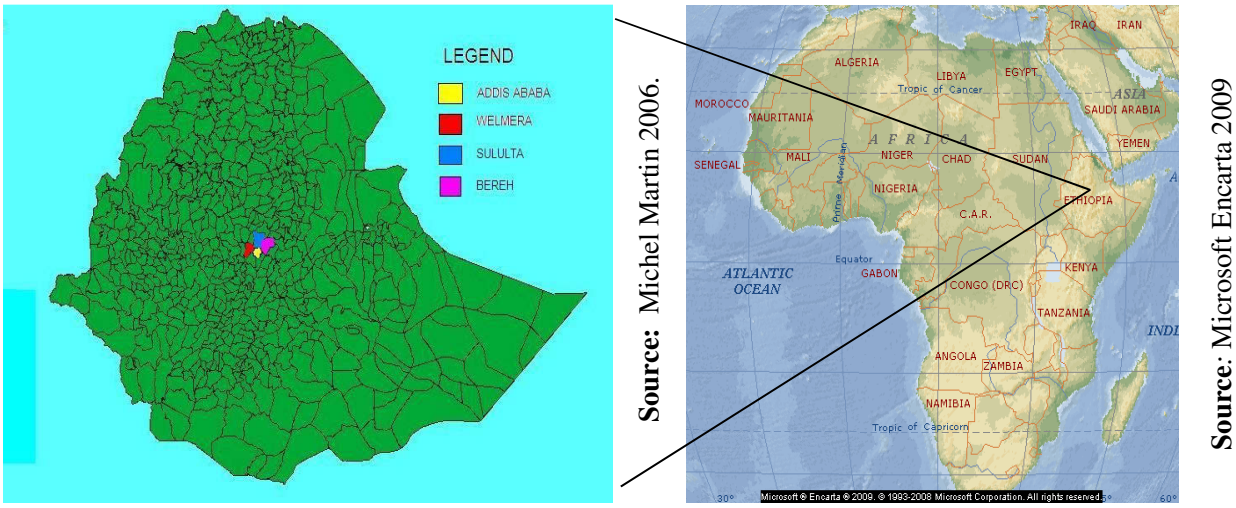


Figure 2*:* Ethiopia and the Study Area in their African contexts

With a total land area of 1.1 million km^2, Ethiopia is the fourth largest country in sub-Saharan Africa in terms of area and the second largest in terms of population (Hailemichael, 2007). Ethiopia's population increased from 22 million in 1961 to 77 million in 2008, with an average annual growth of 2.6 percent with about 80 percent of the people living in rural areas (CSA, 2008a). Ethiopia is home to multiple ethnic groups of people with diverse traditions and cultures speaking more than 83 languages and up to 200 dialects. The country has a federal political system, composed of nine ethnically divided administrative regions and two chartered cities.

Christianity and Islam are the major religions, although, other religious sects and traditional beliefs are also common. A monarchical state, headed by Emperor Haile Selassie, was in power until it was overthrown by a military junta (also called Derg) in 1974. The junta had a communist ideology and confiscated all private possessions including industries, banks, commercial farms, transport companies, urban houses and so on. The government also confiscated agricultural land and redistributed it to the tenants, which then composed about 85 percent of the Ethiopian population. The military regime stayed in power for seventeen years. The Ethiopian Peoples' Revolutionary Democratic Party (EPRDF) came in to power in 1990 and won elections for a fourth term in May 2010. The EPRDF - led government's development

approach can be characterized as rural area-centered and agriculture-led, which pays significant attention to agricultural growth and rural infrastructure development (MoFED, 2006).

Despite the recent encouraging changes, several agencies rate the quality of life of Ethiopians as very low. The recent World Bank Estimate (2013) suggests Ethiopian gross national income per capita is USD 470. This figure represents improvement from the recent past, but still Ethiopia comes at the bottom of the list of countries reported. A report by Oxfam International, which was compiled from the Central Statistical Agency (CSA) of Ethiopia and other sources, stated that 39 percent of the Ethiopian population lives on less than USD 1.25/day and 77.5 percent of the population earns less than USD2/day (Senait & Givey, 2010).

The Government of Ethiopia claims to have achieved two-digit economic growth over the last seven years (MoARD, 2008a). Ethiopia is indeed making significant progress in the area of infrastructural development and investment. Recently, the *Economist* magazine recognized Ethiopia among the five fastest-growing economies of the world and rated Ethiopia the second fastest-growing economy in Africa, after Angola (ENA, 2010). According to the UNDP (2010), Ethiopia is among the 20 countries likely to meet some of the Millennium Development Goals (MDGs) by 2015 (ENA, 2010; ODI, 2010). The huge infrastructural development work going on in the entire country, including roads, hydroelectric power, housing, schools, health centers, universities and telecommunication facilities, and the growing foreign investment flows to the industrial and agricultural sectors, are driving economic change. Agricultural exports have continued to grow, with increased quantity and diversity. The annual average foreign exchange income from agricultural exports in 2002 was 482.7 million USD and in 2008 it showed over 200 percent growth, reaching 1.481 billion USD (MoARD, 2008b). The Ethiopian Government attributes the economic success to the Agriculture Development Led Industrialization (ADLI) policy, which has been implemented for the last decade.

2.3. The policy environment

ADLI is the overarching policy framework of the ruling party (Alemu, 2010; MoFED, 2006). Agriculture here refers mainly to smallholder farming but also to the slowly growing large-scale commercial farming. The policy states that the great agricultural potential of the nation should

play a leading role in stimulating development in all economic sectors. On the other hand, the policy also recognizes that, although agriculture is regarded by the State to be the engine of the Ethiopian economy, it is seriously challenged by low productivity and continued degradation of the natural resources, particularly soil, water, forest and biodiversity (MoFED, 2006).

Unless the resource base, which forms the backbone for agriculture, is protected from unsustainable farming practices and climate change, irreversible damages could take place. This is one reason why the Government is determined to pay greater attention to the natural resource base. Already, the cumulative effects of natural resource degradation and the high population increase have resulted in the country depending substantially on imported food aid to support millions of Ethiopians. The Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), now replaced by the GTP, revealed that about 31 million people in Ethiopia live below the poverty line and 6 –13 million people are at risk of starvation (Amanuel, 2006). In the Ethiopian context, agriculture is not only an important economic sector but also a profound and deeply rooted cultural manifestation of the people, as it is a way of life for the great majority of the citizens. For this reason, it is not easy for national planners to make a quick shift from agriculture to other economic sectors, even if the new choice seems to be feasible from an economic theory point of view. The struggle for development in Ethiopia is therefore challenging, since the developmental landscape is founded on two conflicting scenarios- – investing considerable money to maintain and rehabilitate the natural resource base (especially in the Ethiopian highlands and drought-affected lowlands) and planning the quick transformation of Ethiopian agriculture using the same fragile resource base.

The number of food-aid recipients is highly politicized in Ethiopia and there are conflicting reports from different agencies every year. The issue of famine implies poverty, and poverty is as much a political issue as it is an economic concern (Vadala, 2008). In 2011 some locations of south and eastern Ethiopia and neighboring Somalia and Kenya, were affected by drought, the most serious one in the past 60 years. USAID sources indicate that about 4.8 million people have immediate and critical food assistance needs (USAID, 2011). The Ethiopian Government claims however that famine and death are not to be feared because of the immediate emergency response made by the Government from its own national food reserve.

The five-year GTP, officially announced at the beginning of 2011, is a manifestation of the ADLI policy framework. It is a very ambitious national plan, which seeks to see significant economic transformation in a short period. Among other things, it aims at changing, finally, the famine and food aid history of the nation. Doubling national agricultural production has been chosen as a crucial strategic direction to ensure self-reliance and to stop the need for food aid coming into the country. Increasing the nation's energy sources by fourfold, linking the different regional states of the nation and the neighboring countries using 2,395 km of railway lines as well as networking all rural villages (*Kebeles*) using all-weather roads, are some of the huge infrastructural plans (PANE, 2011).

The policy of the government to develop the agricultural sector is underpinned by the massive up-scaling, improving the access to and capacity for using irrigation schemes by smallholder farmers and the gradual reorientation of smallholder farming to high value products to maximize benefits from the domestic and global market. Along these lines, emphasis is given to the livestock sector. For example, the Government has planned to improve the annual artificial insemination services from 350,000 doses a year in 2010 to two million doses in 2015 and forage seed production from 50,000 tons in 2010 to 145,000 tons in 2015 (PANE, 2011).

As mentioned above, the plan emphasized the agricultural sector, but there is also considerable focus on the industrial sector. It is not, however, very clear whether this is a change introduced to the ADLI policy framework or if it is a realization of the original ADLI policy, which takes into account industrialization as an ultimate goal. This debate emanates from the fact that the current emphasis of the Government is skewed to industries that do not necessarily use agricultural products as raw materials (e.g. cement, steel, chemical industries, and so on). According to the plan, it is hoped that the growth of the industrial sector will depend on the success of small and micro enterprises, which are formed in large numbers in the cities, with the financial support (loans) of the State and international donors. The Government has also made a significant shift in the plans for higher education in the country: 70 percent of the students that go to universities every year will be assigned to study in engineering and science faculties, believing that this will help to improve the supply of trained human resource to the industrial sector. Thirty percent of student entrants will study social sciences.

The first phase of the GTP, designed for the period 2011–15, provides directions for the formulation of sector-specific policies in the country (including agricultural development). The government of Ethiopia is recognized as a "developmental state", characterized as a state involved in critical business activities, where the government believes that the private sector has little or no capacity to undertake that business (for example, in the development of hydro-electric power and the railway network). It also involves itself in market stabilization activities when it considers that short supply of products to the market is raising the cost of living of the citizens. For example, the government has been taking action to import foodstuff from abroad to stabilize the cost of wheat, maize, sugar and cooking oil in the local market. These actions imply that state policies have impact in widening or narrowing the agricultural innovation landscape in many ways. The fact that the state has a tendency of competing with the private sector has the potential to limit private sector innovations. However, the involvement of the state in mega projects such as those of hydroelectric power generation can create opportunities for private sector participation and innovation to take place.

There are several policy frameworks that affects dairy in many different ways. Table 1 provides extracts of the key policy issues, their contents and the possible implications for the dairy innovation system.

One of the policy areas that could have important impacts in livestock innovation is the breeding policy (MOARD, 2009). The draft regulation provides detailed laws on 'dos' and 'do not's' and indicates institutions that should hold responsibility for the different tasks mentioned in the policy (MOARD, 2009). The draft policy also addresses the way breed improvement should happen. Two important functions are identified in the policy:

1) To select and improve indigenous animals with good potential for milk and meat; and
2) To improve milk-production potential through encouraging crossbreeding with exotic animals.

For both items, establishment of functional and robust livestock ranches is a necessary condition. The ranches could be government, semi-government or privately owned businesses. However, some of the issues on establishment of ranches and farms are vague. The Government is selling

ranches and state-owned dairy farms, based on the proclamation for privatization of state-owned enterprises. The Government's direction in animal breeding is to use AI and not to keep breeding centers or ranches under the management of the government. Yet, the draft policy suggests that strengthening the existing ranches and establishing more breeding centers in the country is important.

The other important government policy that will have multi-sectoral implications is the Science Technology and Innovation policy (Ministry of Science and Technology, 2009). This has a direct impact on national and regional research systems, universities, agricultural extension systems and the private sector, in general, and the manufacturing industries, in particular. The policy is rooted in the idea that agriculture is the dominant sector in the country, but is challenged by low-input and low-output structural problems. The Government has envisioned that the country will attain middle-income status in 20 years' time (1000 USD annual per capita income).

Nevertheless, the policy has also recognized that the current capacities of the national research and university systems to generate technologies that could impact rapid growth and economic transformation are very low. A key solution to improve this situation is to adapt technologies from other countries. This is what the Science, Technology and Innovation Policy proposes. The research and university systems are expected to put substantial amount of their resources to import and test technologies quickly and then introduce it to the farming and industrial communities. The policy has also underscored that in the long-term, the national research and university system will be able to lead the science and technology programs of the nation and Ethiopia will slowly move from being a net importer of agricultural and industrial technologies to export some of the technologies manufactured in the country. For this to happen, the policy recommends long term and intensive capacity building work of the research and the university systems in the country.

Table 1: Summary of major policies of the Ethiopian government that affects dairy

Policy institutions	Policy content/objectives	Implications for dairy innovation system
1. **Plan for Accelerated and Sustainable Development to End Poverty** (PASDEP) – in 2011 the PASDEP was officially changed in to **GTP**	- An overarching policy and strategy document of the Federal Democratic Republic of Ethiopia - Provides overall guidance to achieve greater commercialization of agriculture, private sector development and scaling up	- Emergence of high number of investors in the dairy subsector - The policy focus in relation to livestock development is on small ruminants and chicken as well as cattle for export - Dairy cows are not small ruminants and their products are not exportable commodities at the moment; therefore, dairy is not on the priority list of the overall government policy
2. **Agricultural and Rural Development** policies and strategies (2003)	- Based on PASDEP document they clarify policies in relation to agriculture and rural development - Recognizes agriculture as a dominant sector but characterized by low-input and low-output structural problem - Rooted in the national objective of developing a free market economy. - Rapid development, liberating the nation from food-aid dependency and making the poor benefit from economic growth are the key objectives	- While explaining the key pillars of the policy and the most important policy instruments, no mention was made of livestock, despite the huge potential of this for the country - Relatively better attention paid to the pastoral community who depend for their livelihood (about 90 percent) on livestock resources.
3. **Science Technology and Innovation Policy** (MoST, 2012)	- Envisions that Ethiopia begins technology export by 2025 - Aims at coordinating the national technological learning / capability-building effort and ensuring technological independence - Research needs to focus on intensive technology imitation and adoption through development of local technological capability	- Highly likely to contribute to the introduction of dairy technologies and development of local innovation capacity (capability to adapt and use new technologies) - Highly likely for the mushrooming of innovation fora, including some on dairy - Change in practices and habits of research to imitation and adaptation is likely to bring about institutional changes that improve the linkages of research with diverse actors including the private sector

Policy institutions	Policy content/objectives	Implications for dairy innovation system
4. National research direction prepared by the EIAR (subject to revision following the approval of the Science, Technology and Innovation Policy)	- Development of technologies - Popularization of technologies through scaling up.	- Among the major milestones of the organization since 1970 in terms of technology development, several examples are mentioned on crop technology but no single example of excellent achievement is reported in the area of livestock - The concept of technology popularization will be helpful for dairy, if research started to involve in networks and organize learning platforms
5. Agricultural extension system of the MoA	- No specific policy on extension but follows the footprints of PASDEP and Agriculture and Rural Development Policy - System organized to introduce new technologies, provide skill enhancement training, promote farmer organizations, provide support for the production of raw materials, focus on natural resource management and attention to poor rural women - Key strategies: family packages, diversification, unity extension, market orientation, - Establishment of ATVETs and FTCs to train farmers	- Assignment of three DAs/*Kebele* and one vet technician/three *Kebeles* could potentially make significant contribution to improve rural dairy - Market orientation of the system and establishment of ATVETs and FTCs will enhance innovation, if appropriate attention is given to it.
6. Livestock development master plan of MoA (in the making)	- Ensure sustainable and equitable development of livestock and apiculture industries - To formulate at least four national priority projects	- Dairy development could have benefited in either way had the plan been completed and implemented (long overdue)
7. Breeding Policy of the MoA (draft document)	- To guide animal breeding initiatives and actions - To control animal breeds and genotype import-export - To develop national capacity in the area of breeding - To introduce a national breed registration database system	- Long overdue; needs to become a law - Draft policy suggests the establishment of breeding centers (ranches) while the government is selling the existing ranches despite the critical shortage of improved dairy stocks in the market. - Problem associated to breed registration may come to an end and this may contribute to the development of heifer value chain - Opportunities for importing breeds and semen of known breeds will be higher

Policy institutions	Policy content/objectives	Implications for dairy innovation system
8. Oromia Animal Resources, Health Protection and Marketing Agency	- Enhance livestock production and productivity - Provide high-quality health service - Enhance marketing of animal resources and fisheries	- Unique in the country and exemplary work for other regions in terms of creating a responsible agency for livestock (of course the Amhara and Tigray regional states have also adapted recently the same institutional arrangements) - More focused on livestock resources - May come up with innovative ideas to overcome the milk marketing problem in the study area - Unclear structural arrangement - overlap and confusion with the district level office of agriculture
9. Ethiopian Investment Policy	- Exemption of custom import duty - Products and services for export exempted from export tax - Income Tax holiday: exemption from paying income taxes up to five years depending on the conditions	- Attracted significant number of investors in the subsector. - So far no investor is engaged in the export market of dairy products despite the privileges - Highly likely to help industrial growth in the dairy subsector
10. Cooperatives Policy	- Promote mutual interest of members by pooling their resources - To enhance the development of free market economy - To promote saving culture of the people - Exempt coops from profit tax - Provides rights for free access to coops for land - Coops could be organized at local, regional, national or international level	- Significant impact in helping farmers to overcome their challenges in relation to milk market. - Provides huge potential for farmers to become important actors in the forthcoming dairy board - Highly likely to get loans and make investment in processing industries
11. Development Bank of Ethiopia	- Provide medium- and long-term loans for investment projects in commercial agriculture, agro-processing and manufacturing industries. - Made public the list of commercial agricultural activities eligible for loan	- Export commodity focused. - Investment for dairy production not allowed, as it is not on the list - Thus not supporting the expansion of dairy farms in the country

Source: MoST 2012, PANE 2011, FDRE, 1998; FDRE, 2002, MoARD; 2010; MoFED, 2003; MoARD, 2007;

2.4. Population and urbanization

Like many African nations, the population in Ethiopia shows a sharp increase over the past 25 years. CSA (2008a), estimated the current population in Ethiopia at 84.3 million, based on 2.6 percent population increase rate, and using the 2008 census, which reported the total population as 77 million, as a basis. The census of 1984 reported that the total population was close to 42 million (Baker, 1990). The population increase is significantly higher in the urban areas. An increase in population is indeed a huge concern for development planners in the country and is emphasized in the GTP. The flow of many people from the rural areas to the cities and towns has increased the urban population. In the Ethiopian highlands, the number of landless youth is increasing. This is a highly vulnerable group, which could migrate to the cities and towns, if economic opportunities are not created to keep them in the rural areas. The growth of the industrial sector in the big cities, as well as expansion of big commercial farms in some parts of the rural areas, is important factors that drive the youth to leave their places of origin.

Ethiopia is amongst the fastest urbanizing nations in Africa (Land O'Lakes, 2008). Addis City, in particular, has shown considerable growth in the recent past- the population expanding from 2,112,237 in 1994 to 2,739,551 in 2007. In 2012, the population of Addis reaches 3,114, 698. This is calculated based on the 2.6 percent annual population increase rate, as suggested by the Central Statistics Agency (CSA). This shows an increase of 32 percent when compared with the 1994 population of Addis. The population increase of Addis is, on the one hand, an opportunity for the expansion of dairy markets, but the displacement of dairy farms from traditional settlements in the city has had negative effects on viability. The city government gives compensation for residential plots to displaced people, but does not pay out for animals.

2.5. The extension system

Agricultural development received attention in Ethiopia with the establishment of the Ministry of Agriculture (MoA) in 1908 (EEA, 2005), but meaningful interventions were begun by the State, following the opening of some agricultural colleges in different parts of the country in 1947–53. These colleges trained human power for agricultural extension and education. At that time, the Land Grant College Approach (1953), the Community Development Approach (1958), the Maximum Package Intervention (1966) and the Minimum Package Projects (1971) were

Ethiopia's major experiences in agricultural extension (Tesfaye, 2003). These approaches, although they had different names and methods of application, were all based on the same paradigm: transfer of technology (ToT). During the imperial regime, Haromaya University (the then Imperial College of Agriculture and Mechanical Arts) led the coordination of the National Extension System until 1963 (Tesfaye, 2003).

One of the significant institutional and policy changes that took place in the agricultural sector during the Derg Regime in 1974 was the nationalization of agricultural land and its distribution to poor farmers. This had significant impacts in shaping the way extension work was organized in Ethiopia. The MoA had begun to serve smallholder farmers in many parts of the country. Before the reform, these farmers were called tenants of the feudal landlords. Lessons from the Minimum Package Project to introduce some basic agricultural technologies were very important in developing the new extension program. Later, in the early 1980s, the MoA initiated the Smallholder Agriculture Development Project (PADEP) to introduce the Training and Visit extension system to Ethiopia, which was also popular in many Asian and African countries at that time. The basic assumption of the Training and Visit extension system was that the MoA had to access new technologies from research organizations and deliver them to smallholder farmers and periodic field visits. In the crop sector different technologies such as types and rates of fertilizers, improved seeds and pest-control packages were introduced whilst forage production, livestock breed improvement and veterinary services were introduced in the livestock extension program.

The EPRDF-led government that came to power in 1990 continued to work with the PADEP approach for a couple of years. In 1994/95, a new approach known as the Participatory Agricultural Demonstration, Training and Extension System (PADETES) was adopted (Tesfaye, 2003). PADETES was based on the principles of the ToT model and little was changed in terms of strategies. PADETES merged the Training and Visit approach and experiences of Sasakawa 2000, a program that started in Ethiopia in 1993. Sasakawa 2000 demonstrated the possibility of increasing yields by supplying high levels of external inputs through the provision of loans to smallholder farmers. PADETES considered provision of loans for agricultural inputs as necessary to achieve its goals. The main characteristic that distinguished PADETES from its predecessors was its emphasis on selected farmers (also called model farmers) to use all inputs

included in the extension package. Before the start of the global 2000 project, most farmers were not often able to take all inputs recommended by the extension package because some did not have enough resources to buy the inputs and others did not find the approach convincing. The provision of loans to help them implement the package was considered as an incentive by some farmers. Farmers were expected to allocate a half-hectare of land for demonstration and to make a 25–50 percent down payment for the inputs, with the balance due after harvest. The MoA believed that this approach would bring substantial changes in the smallholder economy, but it gave very little emphasis to the livestock sector and the pastoral community.

Since 1994/95 PADETES has continued to dominate the Ethiopian extension system. EEA (2005) in an empirical study conducted in 90 districts (by taking 4587 sample cases) revealed that PADETES did not bring the desired changes. The study indicated that 25 percent of farmers targeted by the PADETES program earned only 23 USD per annum from their crop and livestock activities. In early 2000, PADETES introduced the concept of diversification and specialization, which helped to set out priorities of interventions for the different agro-ecologies and market demands. "Specialization" and "diversification" choices were made, based on the agricultural potentials of the intervention areas. The concept of specialization was introduced to provide market-oriented extension services in places where marketable commodities were growing abundantly. Diversification refers to the possibility of growing diverse foodstuffs to meet the food-security needs of the people. The MoA basically classified the country into 18 major and 42 sub-agro-ecologies, but it was only possible to formulate packages for three major agro-ecologies: areas with reliable moisture, moisture-deficit areas and pastoral areas.

PADETES is still the official extension approach in Ethiopia, but some important strategic changes are being introduced, such as the relatively new initiative of Farmer Training Centers (FTCs). The establishment of 25 vocational colleges to train extension agents, who were responsible for approximately 6000 FTCs across the country, brought an important institutional change to the extension program. In addition, the government began to pay attention to pastoral extension through initiating the World Bank co-financed Pastoral Community Development Programs as well by forming pastoral commissions in the relevant regions. In the FTCs, which is the functional unit of the government extension program, the ToT approach is still in use with no significant changes to the previous approaches.

In the GTP era, a new model of governance appeared regarding the relationship of the Government and the public (farmers and pastoralists, in this case), characterized by a unified, national level and highly organized system responsible for the state-led social mobilization against poverty. This is not basically a new system but following the declaration of the GTP, the government has placed strong emphasis on it, through developing new coordination systems. Every member of the rural community has to join a group of six people, one of which is a leader. The group leaders form a higher hierarchal group, which receives training and directives on leadership roles. The second level of hierarchy makes six groups of 30 people each, known as development groups. The model is regarded as a mechanism for creating a broad avenue for the people to participate in the implementation of the GTP (MoARD, 2011). This huge structure is centralized in terms of flow of information and political leadership, while it is decentralized in terms of managing the day-to-day activities. The key messages and work plans are decided at a higher political level and filter down to the lower hierarchies of the system. Regional, district, and village bodies of the government are responsible for leading and managing the social mobilization. In rural settings, the MoA, which has considerable presence at grassroots level, is the key player in organizing the social mobilization.

On the other hand, others (mainly opposition political parties) criticize this approach claiming it is a political instrument to control the people and deny them diverse sources of information on national political and development affairs. In addition to the public organizations, several NGOs are involved in extension work. Some of these are trying to introduce more innovative and market-oriented extension models, such as the value-chain approach. The value chain approach is often commodity based and focuses on improving the linkages between the different players from production to the point of consumption, aiming at improving markets and ensuring fair distribution of benefits along the chain. The Government seems to be interested in the approach, although it is not taking major actions to adopting it. The increasingly organized and unified approach of the Government in the extension and social mobilization initiatives seems to have little space to adapt new approaches coming from non-public sources. Yet the Government is very keen to make a quick shift from subsistence agriculture into market-oriented business. Therefore, much institutional and strategic change of the extension system is required to realize this goal.

2.6. Livestock resources in Ethiopia

2.6.1. Cattle population and economic benefits

Livestock is one of the biggest agricultural resources in Ethiopia. The subsector is potentially a key source of food, job creation and export commodities. Ethiopia is the leading nation in Africa in terms of livestock numbers. The estimates of cattle population for the rural sedentary areas are 50.8 million head. Of this total cattle population, the female cattle constitute about 55 percent and the remaining 45 percent are male (CSA, 2008b). The CSA report also revealed that 99.2 percent of the total cattle in the country are local breeds. The remaining are hybrid and pure exotic breeds that account for about 0.7 percent and 0.1 percent, respectively. According to the same report, Ethiopia produces 2.94 billion liters of cattle milk and 150 million liters of camel milk. The lactation period for cattle is estimated at six months and the average milk yield per cow is 1.6 liter/day. Some innovative small-scale farmers who are maintaining crossbred cows are, however, capable of producing 4.2 – 6.3 liters/day (Haile, 2009).

In a report issued by the MoA (Hiskias, 1998) a decade before the recent CSA report, Ethiopia produced 926 million liters of cow milk, of which 98 percent was produced by smallholders. Gebrewold *et al.* (1998), quoted in Ahmed *et al.* (2003) have reported that the annual per capita consumption of milk in Ethiopia was not greater than 17 kg per head. A recent CSA report (CSA, 2008b) indicated, however that Ethiopia has made a 217 percent increase in milk production over the last ten years. This would mean the annual milk consumption per capita exceeds 37 liters. In fact this figure tallies with the findings of this study (the study was however made in the high milk producing districts of the Addis Milkshed, and the sample size and locations can not represent the nation). On the other hand, FAO forecast the annual milk production to be far below that from the survey made by CSA. According to FAO, during the period 2001–07,milk production grew at an average rate of 2.6 percent, which is equivalent to the Ethiopia's human population growth rate suggested by the recent census report (Haile, 2009). In other words, the FAO report argues there was literally no growth in milk per capita consumption up to 2007. The considerable difference between the milk production growth rate reports of the two agencies (CSA and FAO) requires critical data examination. The official government CSA report suggests that milk consumption per capita exceeds the sub-Saharan

African average milk per capita consumption but it is still far below the average values of the developing countries and the world, which is 44 and 78 kg/person respectively (see Table 2).

Table 2 : Actual and predicted values of per capita consumption of milk

Region	Milk (kg per year)		
	1964–66	1997–99	2030
World	73.9	78.1	89.5
Developing countries	28.0	44.6	65.8
Near East and North Africa	68.6	72.3	89.9
Sub-Saharan Africa	28.5	29.1	33.8
Latin America and the Caribbean	80.1	110.2	139.8
East Asia	3.6	10.0	17.8
South Asia	37.0	67.5	106.9
Industrialized countries	185.5	212.2	221.0
Transition countries	156.6	159.1	178.7

Source: Staal *et al.* (2008)

The numbers of livestock in Ethiopia are remarkably high. In 1986 about 19 percent of the livestock resources of the entire tropical Africa were found in Ethiopia (see Table 3). The figures in Table 3 are used here to show how dramatic the increase in cattle population has been in Ethiopia over the last 25 years, when these figures are compared with those in Table 4.

Table 3: Distribution of the ruminant livestock population species in regions/countries of tropical Africa (1986)

Region/Country	Thousand head			
	Camels	Cattle	Sheep	Goats
Western Africa	2,045	37,635	40,272	56,488
Sahel	2,027	19,589	20,178	23,259
Nigeria	18	12,169	13,160	26,320
Other	-	5,877	6,934	6,901
Central Africa	-	7,982	3,564	6,888
Zaire	-	1,400	700	2,930
Other	-	6,582	2,794	3,958
Eastern Africa	10,275	85,893	67,939	69,620
Sudan	2,800	22,389	20,600	15,581
Ethiopia	1,000	30,000	23,000	17,000
Other	6,475	33,504	24,339	37,039
Southern Africa	-	29,625	9,613	9,715
Mainland	-	19,140	9,009	8,490
Madagascar	-	10,485	604	1,225
Total	**12,320**	**161,135**	**121,388**	**142,711**

Source: FAO (1987)

When the figures in Tables 3 and 4 are compared, the livestock population in Ethiopia shows tremendous increase. About half a million annual increment is reported despite the increasing incidence of drought and the developing trend of commercial destocking in Ethiopia. It is still debatable whether the change in number is a true reflection of population increase or improvement in data collection effectiveness, which avoids under-reporting. The cattle population in Ethiopia is still in the lead, comprising about 42 percent of the total cattle population of the Inter-Governmental Authority for Development (IGAD) member states, which include Ethiopia, Kenya, Uganda, Djibouti, Somalia, Eritrea and Sudan (Table 4). This is a clear indication of the economic importance of livestock in the country.

Table 4*:* Livestock populations in the IGAD region by country (numbers given in thousands) (2009)

Country	Camels	Cattle	Sheep	Goats
Djibouti	73	289	574	649
Eritrea	295	1,784	1,974	4,335
Ethiopia	2,355	44,744	23,386	23,300
Kenya	861	10,183	8,758	11,985
Somalia	7,359	5,452	15,022	30,004
Sudan	3,224	36,554	45,445	39,071
Uganda	3	6,391	1,854	5,376
IGAD region	14,170	105,337	96,996	114,678

Source*:* Cecchi *et al.* (2010)

2.6.2 Comparison of Eastern African nations on selected dairy parameters

Ethiopia, Kenya Uganda and Sudan are close neighbors and all, except Uganda, share boundaries with Ethiopia. These four nations have similar socio-economic situations except that Uganda, Kenya and Sudan were under the British colonial rule and this had implications for the development of modern dairy. A comparison of the four nations on cow milk production, productivity and exporting is presented using Figures 3 - 5.

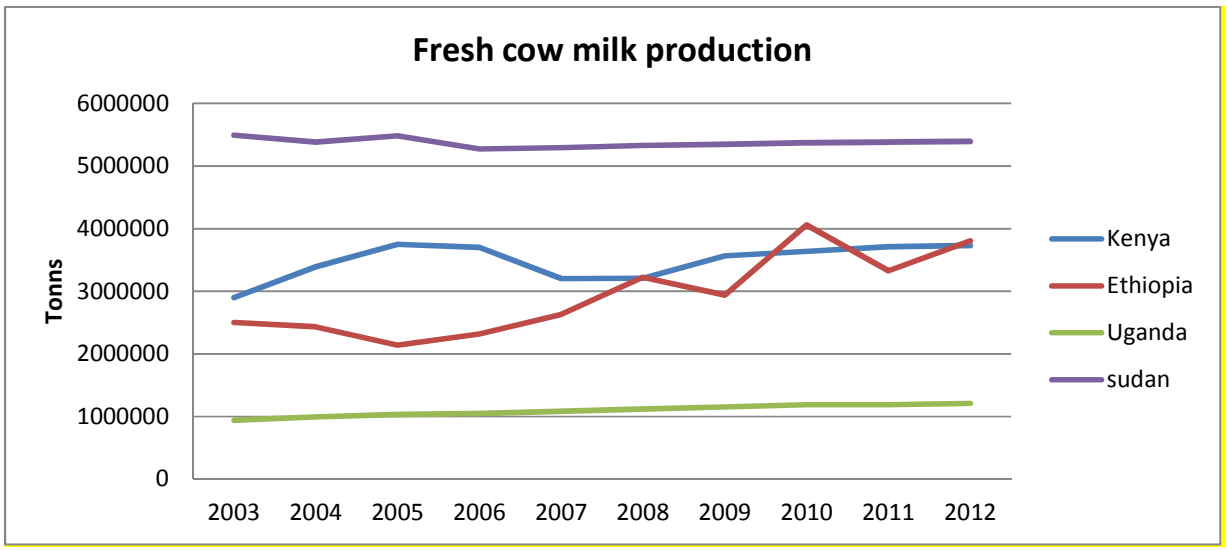


Figure 3: Fresh Cow Milk production since (2003 – 2012)
Source: World Bank 2014

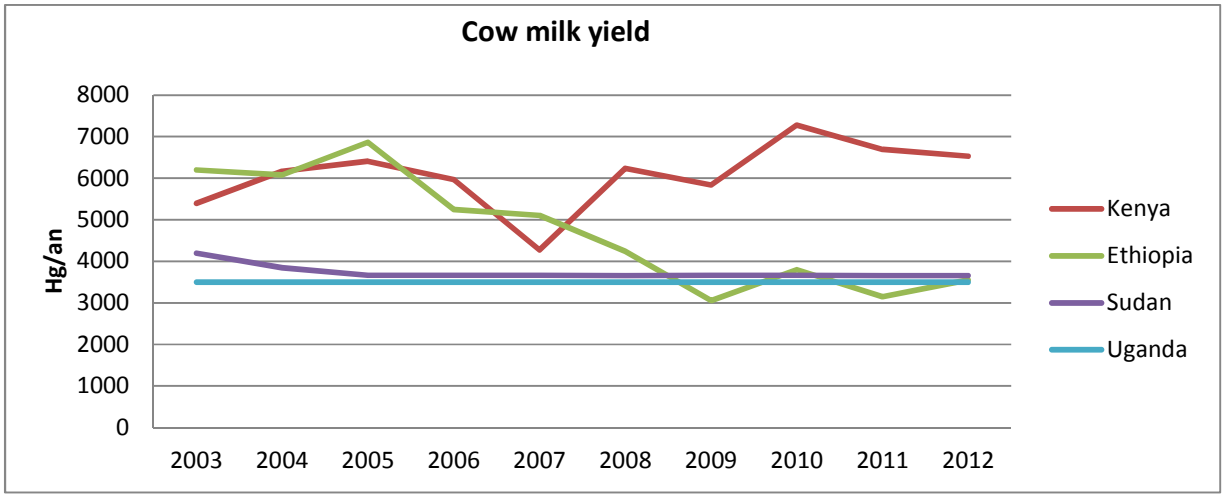


Figure 4: Cow Milk Productivity (2003 – 2012*)*

Source: World Bank 2014

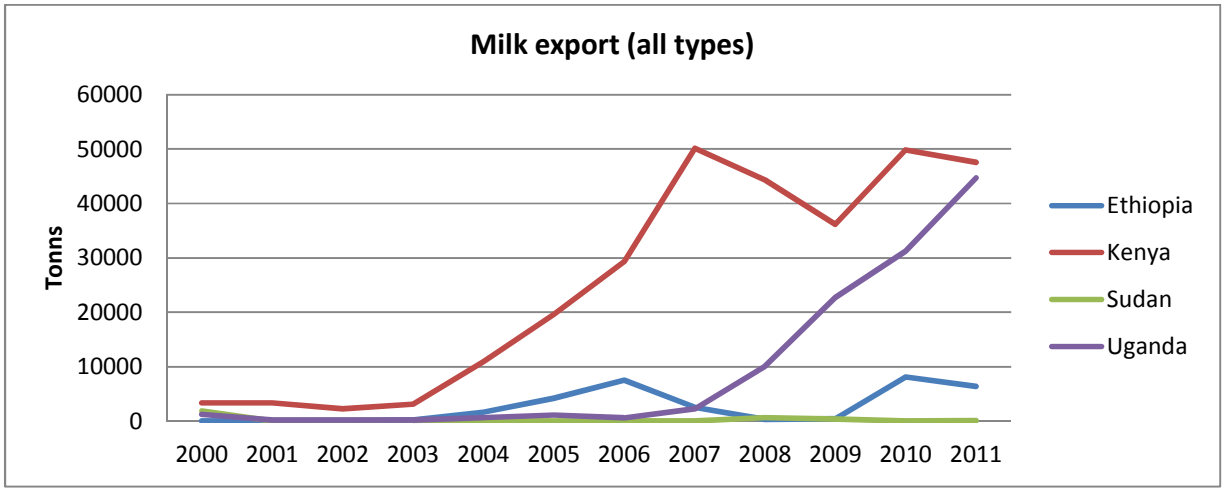


Figure 5*:* Export Market comparison

Source: World Bank 2014

The highest record for fresh cow milk production is reported from Sudan and the milk production graph remains constant over a decade. This is followed by Kenya. From 2010 Ethiopia shows a considerable increase of fresh milk production. Nevertheless the cattle population in Ethiopia is about four times greater than in Kenya (see Table 3) while the productivity of cows in Kenya (Figure 4), is higher than the cows in Ethiopia. The total fresh

milk production of Kenya is also higher. In terms of productivity Kenya shows a steady growth except the sudden fall it experienced in 2007. On the other hand, Ethiopia shows a consistent decline of productivity in the past decade. Productivity in Sudan and Uganda is also low and it remains constant over the past 10 years. Milk export is very low for Ethiopia and almost zero for Sudan while Kenya and Uganda have performed adequately in the last decade. Uganda displays a sharp increase in milk export while the graph for Kenya shows a varied situation, with a recent tendency of continuous decline. In Kenya the fall in total fresh milk in 2011 seem to be related to a fall in productivity in the same year, followed by a fall in its export market.

2.6.2. Historical development of the dairy subsector

An historical account of the dairy sector is presented in Table 5. The table was constructed by consulting various documents as well as gathering reflections of the local communities and key informants in the study area. The year 1947 was chosen as a benchmark because it was then that the United Nations donated dairy cows, which was the first batch of improved dairy stock in Ethiopia (Hiskias, 1998).

2.6.3. The major dairy production systems and milk sheds in Ethiopia

The term *milk-shed* is a defined geographic area where farmers/milk collectors bring/send their dairy products to a known marketplace, which is close to them and offers a relatively attractive price. It is probably not easy to describe all the milk sheds in Ethiopia, as small locations including rural towns are all important places for the milk marketing. Nevertheless, the biggest *milk-shed*s, which attracted the interest of the state and other agencies involved in dairy development, are worth mentioning. The main source of milk production in Ethiopia is cattle, but small quantities of milk are obtained from goats and camels in pastoral areas. Milk production can be considered in terms of production systems and *milk-shed*s. These are discussed below and include pastoral, highland smallholder, intra-urban and peri-urban, and large-scale commercial milk production

Table 5: Historical account of the dairy industry in Ethiopia (1947 -2010)

Emergence of Commercial Dairy
1947 - United Nations Relief and Rehabilitation Administration (UNRRA) donate Frisian and Brown Swiss dairy cows.
1955 – Holetta Dairy farm established using the American donated cattle
1959 – One hundred and nine in-calf Holstein heifers imported from Kenya and added to the Holetta farm.
1960 – A pilot milk processing plant was established in Addis Ababa, in a place called Shola, with the help of UNICEF.
1966 – Establishment of Addis Ababa Dairy Industry (AADI)
1970 – Establishment of Arsi Rural Development Unit (ARDU), with the help of the Swedish government.
1971 – Launching of the first livestock development project, which caused the establishment of Dairy Development Agency (DDA). DDA took over the responsibilities of AADI.
1973 – Launching of the second livestock development project, with a major aim of establishing slaughter facilities in provincial towns and to improve market routes for livestock.
Collapse of Commercial Dairy
1974 - Land Tenure. A proclamation came out to confiscate all the rural agricultural lands and re-distribute it to tenants
1974 – Private enterprises, including big dairy farmers, nationalized by the socialist regime.
1974 – DDA merged with other nationalized dairy farms and form Dairy Development Enterprise (DDE)
1976 – Launching of the third Livestock project that aimed at supporting pastoral community, through developing rangelands, water and roads.
1978 – Proclamation of the cooperative law that puts pressure on small farmers to be organized in socialist oriented cooperatives.
1986 – Launching of Dairy Rehabilitation and Development project by the Ministry of Agriculture.
1987 – Launching of the fourth livestock development project that aims at forage development and increasing livestock health.
1987 – Launching of Selale Smallholder Dairy Development Project
Revitalization of Commercial Dairy
1989/90 – 1993/94 – Dairy milk production drops significantly (government transition).
1990-94: FAO and the WFP assisted village level and small-scale dairy processing units in Selale.
1995-2000 – Finland Government funded the Smallholder Dairy Development Project (SDDP) implemented.
1996 – Investment promotion law proclaimed. It has encouraged several new dairy actors join the industry.
1998 – New law on cooperatives proclaimed. Farmers begin to get organized afresh and enjoy the zero profit tax privilege.
1998 – Establishment of Sebeta agro industry, which is the first private dairy processing plant with significant capacity in terms of production and causes big impacts on producers milk price.
1998 – A law on privatization proclaimed. The government begins to sell state owned enterprises to the private sector.
2006 – DDE, with its milk processing plant and huge dairy farm in Holetta privatized, and re-named as Lame Dairy.
2004 – Launching of IPMS, a Canadian funded project, this in part focuses on dairy development through value chain approaches.
2005 – Launching of the BOAM project of SNV (supported by the Netherlands) and Land O'Lakes Inc. (supported by USAID). Both works on dairy development mainly focusing on commercial dairy.
2001- Formation of the Ethiopian Dairy and Meat Technology Institute in the former holding of ILRI at Debrezeit
2008 – Formation of Ethiopian Milk Producers and Processors Association (EMPPA).
2009 – Formation of Ethiopian Breeders Association, and Ethiopian Animal Feed Industry Association.

Source: Compiled from community workshops, key-informant interviews and various documents (Ahmed *et al*., 2003; Felleke, 2003; Haile, 2009; Hiskias, 1998; and Redda, 2001)

Pastoral milk production

The pastoral areas are populated by about ten percent of the human population in Ethiopia and cover 50–60 percent of the total area, which lies below 1,500 meters above sea level (m.a.s.l.). These areas receive low rainfall and feed is often a scarce resource. The genetic limitations for high production of the indigenous cows, coupled with feed shortages and the low tendency of the pastoral community to commercialize milk, keeps the level of milk production per animal in the pastoral community, or system, very low. Production is also season dependent, as the seasonal rainfall is the most common source of moisture for fodder production. In this system, indigenous stock grazes extensive rangeland throughout the year. Little or no supplementary feeding is provided and there is little animal healthcare. The areas marked in grey in Figure 6 are the domains of pastoral peoples. Reliable data is not available to estimate the contribution of the pastoral system on the national milk production. The government policy towards pastoral development focuses on the gradual movement of pastoralists into settlements, which could be stimulated by availability of reliable water sources for animals and humans, introduction of irrigation facilities and other social services. This policy is, however, proving slow in implementation and no significant results have been reported, except in a few pilot cases.

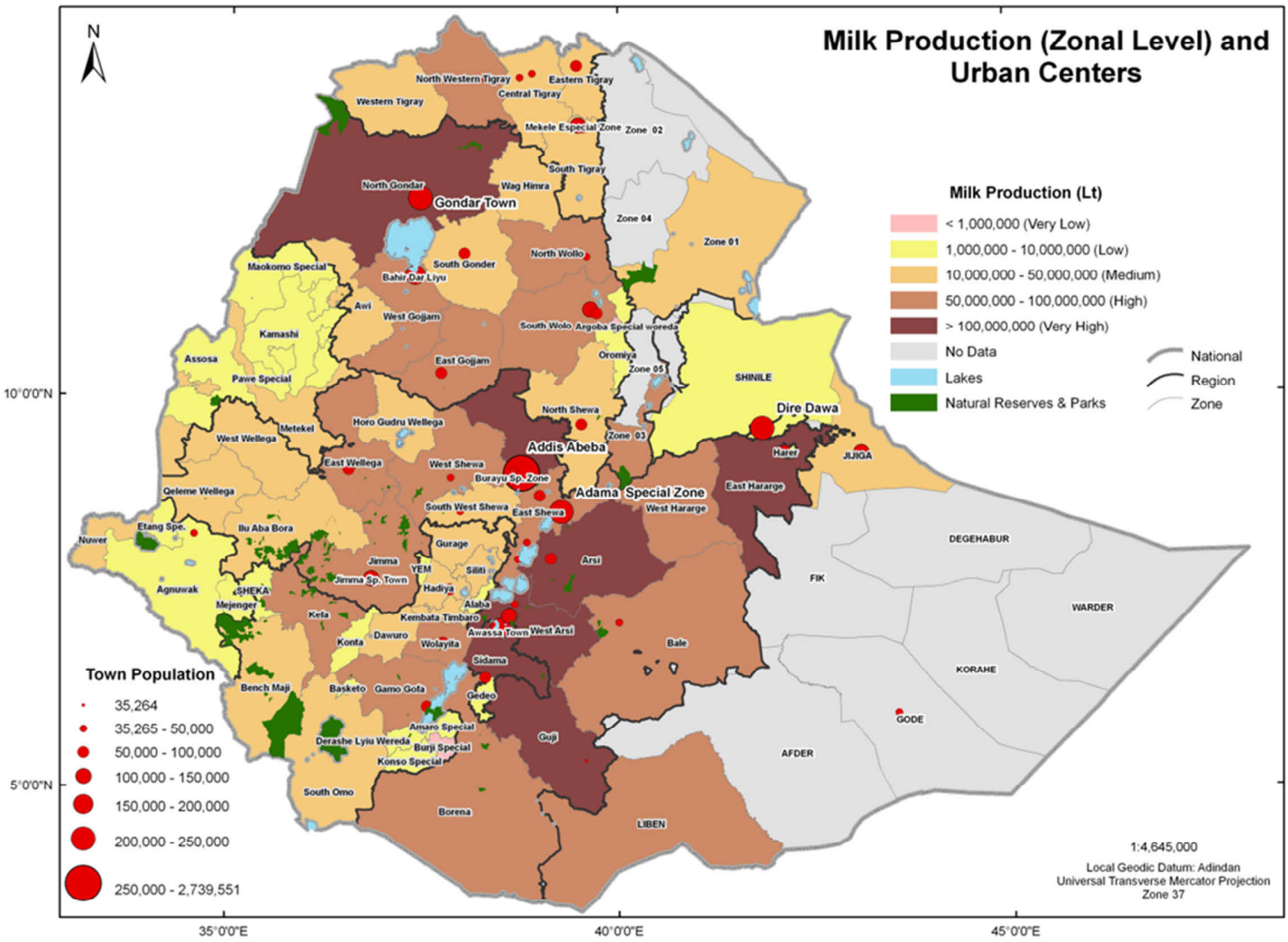


Figure 6: Major Milk-sheds in Ethiopia **Source:** Land O' lakes (2008)

The highland smallholder milk production

The Ethiopian highlands are known as a high potential area for dairy development, not only because of the cool pleasant weather for improved and exotic dairy stocks and the relatively disease-free environment, but also because milk has a relatively higher market demand in the highlands. In terms of area coverage, the central highlands cover about 40 percent of the total landmass in Ethiopia. In most parts of the highlands, the agricultural production system is predominantly subsistence (see Figure 7), often characterized by smallholder mixed farming (crop and livestock husbandry).

Photographed by the author

Figure 7: A typical smallholder farmer in the highlands

Domestic consumption and local milk marketing characterize this system. The major sources of animal feed include forage, crop residues, stubble grazing and hay from native pastures. The growing size of the human population in the Ethiopian highlands increases the demand for additional arable land. This seriously challenges the grazing lands, and most of the better-watered grazing land is turning into crop cultivation. It is common to see livestock grazing on high mountain slopes and other marginal land. The locations marked in deep brown in Figure 6 show the most important dairy domains in the Ethiopian highlands. Addis Ababa, Adam, Hawassa, Shashemene, Assela, Dire Dawa, Jimma, Nekemet, Mekele and Gonder *milk-shed*s are the most important dairy development locations, because these are the biggest cities, where dairy products have better markets and commercial farming is expanding.

Intra-urban and peri-urban milk production

This system is known for its commercial purposes, although the scale of production is not large. Dairy farms have been established in and around the big cities and they mainly dominate the informal milk market in the cities. The main feed sources are agro-industrial by-products (oilseed cakes, bran, etc.) and commercial hay. The dairy farmers keep exotic or hybrid cows, managed under a zero-grazing system (especially the in intra-urban dairies). The intra-urban and peri-urban dairy production systems are threatened by city expansion and new investments.

Large-scale commercial dairy farming

This system exists in the intra-urban, peri-urban and rural locations. It is a highly organized and intensive production system, and is defined as a farm, which keeps more than 30 dairy cattle and

uses modern dairy facilities as well as improved management systems. Those dairy farms that are located in the rural areas use their own transport facilities to supply milk to the processing plants. Some of the farmers even have their own small-scale milk processing equipment. Many of the commercial dairy farmers are concentrated around Addis. The number of this type of farmer is not, however, increasing, because of challenges of feed costs and market problems.

2.6.4. The Addis Ababa *milk-shed*

In terms of the broad categorization of the production systems, the Addis Ababa milk shed falls within the Ethiopian highlands. Peri-urban, intra-urban and commercial dairy farming are very common in this milk shed. The milk shed includes Addis itself as well as 15–20 districts located around the city. This milk shed is divided into two parts. The first is the Addis city, which is the major marketplace for dairy products, a place for intra- and peri-urban dairy, as well as a place where the major dairy actors, including processors, input suppliers, service-delivery agencies, financial agencies and policy institutions, are found.

The second part of the milk shed is the rural part of Addis Ababa, which is essentially the source of most of the milk coming to the formal milk market in Addis, and the area on which this study focuses. The Addis Ababa milk shed differs from the other milk sheds in the country (Figure 6) in that it is the largest market for milk and milk products and the center of policy and knowledge institutions. In this milk shed, the rural-based smallholder dairy producers supply milk to the formal market, while most of the intra- and peri-urban smallholders supply milk to the informal market, mainly through household supply on contractual arrangements and retailing (Hurissa, 1994). The milk processors in the Addis milk shed work below capacity. The Dairy Development Enterprise (DDE), which was the sole state-owned enterprise for the past several years (recently privatized and taken the new name of *Lame Dairy*), has a milk-processing plant of 60,000 liters capacity, but has never reached 45,000 liters of milk throughout its life of operation (Hiskias, 1998).

The recent official census report of the Government of Ethiopia estimated the population of Addis at 2.74 million in 2008, with a possible annual increment of 2.6 percent (CSA, 2008a). The total number of people residing in the milk shed is nevertheless much greater than that, since the Addis *milk-shed* includes several districts that supply milk to the Addis market. The best-

known and closest districts to Addis include Adaa', Addis Alem, Welmera, Sululta and Berek. These districts altogether have a population size of 534,230 (CSA, 2008a). Therefore, the total population of the Addis Ababa milk shed (Addis city and the closest five districts in the milk shed) is estimated in 2010 to be close to 3.33 million. According to a recent CSA report (CSA, 2008b), the per capita milk consumption in Ethiopia is 37 liters. FAO estimates that the per capita milk requirement in biological terms is 100 liters. This suggests that the total milk requirement of the Addis population is 333 million liters per year, and yet the biological requirement of the population is not met by 63 percent.

2.7. Summary

The living standard of the people in Ethiopia is low and, according to the GDP measurements of several international institutions, Ethiopia is always located at the bottom of the list, although promising changes have been taking place in the recent past. Ensuring national food security has been a long-time challenge and Ethiopia still receives considerable amounts of food aid. The political determination of the current government to change the poverty history has created huge expectations among the public. The target is to make the country self-reliant in terms of food production in the first GTP period. To achieve this objective, the government seeks to double crop production in five years and to reach important targets in the production and marketing of livestock products. Despite all these plans and changing contexts, the history and current practices of extension approaches and services in this country do not embrace changes that are commensurate with the policy ideals of the government. The question therefore remains: what kind of institutional changes should be expected so that the national research and extension system can respond to the changing contexts effectively? The contribution of this thesis is therefore to explore the possibilities of making important institutional changes in the area of agricultural research and extension systems for better results. The literature review and theoretical discourse presented in the following chapter guides the development of an appropriate theoretical framework that can inform the design of the methodology need to acquire suitable data to pursue the aim and objectives of the study.

CHAPTER THREE: LITERATURE REVIEW

The broad body of literature on research and development is, narrowed in this chapter in to three important theoretical thoughts that build the methodological framework of this study. These are systems, innovation and resilience. The additional theoretical constructs around of leverage points, institutions and trust building are also raised to reinforce the basic arguments of the other three theoretical ideas.

The broad concept of systems thinking is presented by highlighting some philosophical discussions on hard and soft system theories. This is followed by the three important institutional arrangements for research and development, which are all based on the systems theory and gives raise to the old and present day's practices in research and development. These include the National Agricultural Research System (NARS), the Agricultural Knowledge and Information System (AKIS) and the Agricultural Innovation System (AIS). These institutional frameworks have become popular internationally; one after the other but none is yet obsolete since all are still used in different contexts and in different countries. The theory of innovation is considered in this study not only from the historical accounts of the concept development, but emphasis is also paid to unearth how innovation is understood and used under the different institutional frameworks of agricultural research and development. The theory of resilience has received attention since innovations yield greater impacts when they are systematically combined with actions that promote resilience.

3.1. The systems perspective

The systems perspective is an epistemological choice that looks into the world not from the viewpoint of the exclusive nature of its parts, but with a focus on the whole and the interdependence of the parts of that entirety. The concept of a system in human organization suggests that a set of elements can come together to form a whole that has different properties to those of the individual components. Systems thinking therefore warrants studying the whole, in which the whole has a property that is not only a result of arithmetic summation of the independently performed outputs of the parts, but a synergetic effect of the interactions at higher-level aggregates (Amanuel, 1997). Systems theory has also evolved from an initial view of organizations as functional entities engaged in a linear process of achieving goals, to

one that views organizations as continuously constructed and reconstructed by individuals and groups in an on-going process that reflects the complexity of real world experience (Checkland, 1999).

A system is a mutually agreed definition or delineation of entities performing specific functions. What makes a given situation a system is some degree of "organisedness" that defines its structure (Checkland, 1993; Senge *et al.,* 1994 quoted in Tesfaye, 2009). The structure, in turn, defines its functions and the way the actors in the system behave. Patterns of organization are created in the process of interaction, which are diverse, characterized by a particular way of actors' set up in the system. The overall design of a system includes aspects such as the roles and expectations of different actors, incentive structures to change habits and practices, patterns of interactions in communication within the nodes, and decision-making processes (Tesfaye, 2009).

Scientists and researchers have, in general, two different views of looking into the world from the systems perspective. These include the hard-system and soft-system perspectives. The characterization of the two views by Engel (1997) helps with understanding the complex concepts of systems from the two points of view. Hard-system thinkers (positivists) take their systemic images to be models or simplified representations of the real world. They emphasize the processes of transformation in such a way that the function of the system is determined by the extent to which inputs are processed into outputs in a linear mode. On the other hand, soft-system thinkers – also called social constructivists (Engel, 1997) – do not take the world as systemic nor do they assume their systemic images can be developed into representations. Systemic images such as models and frameworks used by soft-systems thinkers are considered, instead, as instruments to conduct studies. The systemic images could be changed or continuously improved over time, dictated by the realities on the ground.

Agricultural knowledge generation, dissemination and development have experienced some major paradigm shifts in the last few decades. All changing paradigms have taken into account the systems perspective. The characteristics of the different paradigms can be understood from the points of views of the hard and soft systems thinkers. The meanings they attach to the concept of innovation and the way they understand the goals of the systems also provide more

distinguishing features. The gradual evolution of the central source model of innovation of the early days, particularly in the 1970s and 1980s, and then the multiple source model in the 1990s and finally the current Agricultural Innovation System (AIS) approach (Anandajayasekeram, 2005) are the three important paradigms that have had an impact on agricultural research and development (R&D). The following section considers these three.

3.1.1. National Agricultural Research Systems (NARS)

In an institutional framework, NARS is a network of state-owned research organizations and universities, which spearheads and coordinates agricultural research work at a national level. In some countries, extension systems are considered part of the NARS; in this case, reference is made to NARES (National Agricultural Research and Extension System). This form of institution for R&D has long been used in many African countries (it began to be popular in the 1970s) and the use of this model is not yet "history". The legacy of the relative success in the agriculture of India and other Asian countries (Green Revolution), guided by NARS, has influenced many of the policymakers, researchers and extension institutions in sub-Saharan Africa. The NARS is predominantly characterized by the linear model of ToT (see Figure 8). The theory of adoption and diffusion of innovations (Rogers, 1995) forms a solid foundation for the NARS perspective. In the ToT paradigm (Figure 8), scientists make research decisions; technologies are developed in research stations and then handed to extension workers, to pass on to farmers (Pretty and Chambers, 1994). This theory assumes that research institutions are the source of innovations and the innovations are technological artifacts or research findings that have to meet the minimum quality standards set by peer groups in the scientific community in the lead research institutions. The technologies may reach the end users through intermediary agencies and are expected to provide the right answers to the problems of farmers. The absence of a feedback loop also suggests that the strictly hierarchical nature of the model assumes the flow of knowledge and technology from top to down is blameless.

The NARS perspective could be referred to as a *linear innovation system model* (Figure 8). It is a system model because it involves several institutions that are hierarchically arranged and systematically linked in technology processes. It is also an innovation process simply because, no matter who produces the technologies and how, it deals with introducing new

technology/practices to the system. This linear equation is significantly different from the complex innovation systems, which require quite different approaches (see AKIS and AIS below). The differences are attributed to the diversity of actors, norms of communication, power relations of the system actors and the basic philosophy and theory that founded the perspectives. The NARS framework overlooks local complexity; determinist causality also fails to account for the adaptive performance of farmers; technologies successful in one context have been applied irrespective of context, with widespread failure; and professionals and institutions have engaged in self-deception as a defense against having to learn the lessons of failure (Pretty & Chambers, 1994).

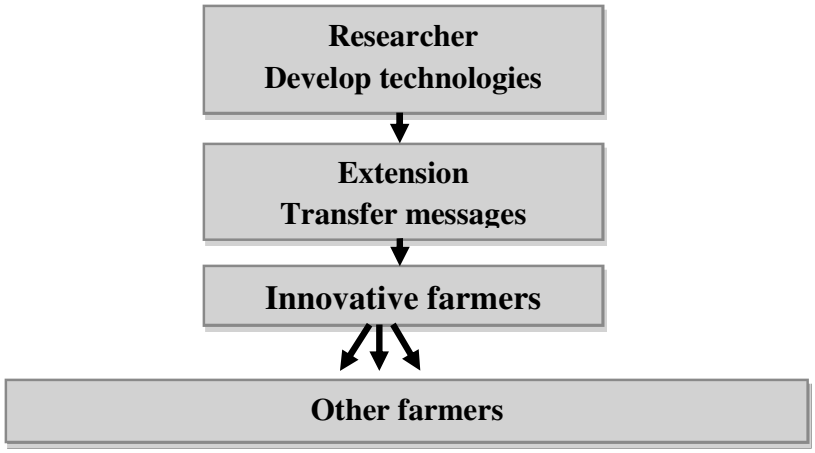


Figure 8 : Transfer of Technology **Source:** Opondo *et al. (2009)*

NARS provides a general guide as to how the state should organize the research system as the sole responsible body for generating agricultural knowledge for development (see Table 6). It recognizes the public goods nature of agricultural research and the absence of market access or purchasing power among many agrarian agents, and thus places necessary emphasis on the role of the state in fostering technological change (Spielman, 2005). This principle has spurred governments and donors to strengthen the supply side (research institutions) in terms of human power, facilities and finance, believing that, the stronger the research institutions created, the greater the knowledge body relevant to solving farmers' problems will be generated.

Table 6: Comparison of the defining features of NARS, AKIS and AIS perspectives

Defining feature	NARS (National Agricultural Research System)	AKIS (Agricultural Knowledge and Information System)	AIS (Agricultural Innovation System)
Purpose	Planning capacity for agricultural research, technology development and technology transfer	Strengthening communication and knowledge delivery services to people in the rural sector	Strengthening the capacity to innovate throughout the agricultural production and marketing system
Actors	National agricultural research organizations, agricultural universities or faculties of agriculture, extension services and farmers	National agricultural research organizations, agricultural universities or faculties of agriculture, extension services, farmers, NGOs and entrepreneurs in rural areas	Potentially all actors in the public and private sectors involved in creating, diffusing, adapting and using all types of knowledge relevant to agricultural production and marketing
Outcome	Technology invention and technology transfer	Technology adoption and innovation in agricultural production	Combinations of technical and institutional innovations throughout the production, marketing, policy research and enterprise domains
Organizing principle	Using science to create inventions	Accessing agricultural knowledge	New uses of knowledge for social and economic change
Mechanism for innovation	Transfer of technology	Interactive learning	Interactive learning
Degree of market integration	Nil	Low	High
Role of policy	Resource allocation, priority setting	Enabling framework	Integrated components and enabling framework
Nature of capacity strengthening	Infrastructure and human resource development	Strengthening communication between actors in rural areas	Strengthening interactions between actors; institutional development and change to support interaction, learning and innovation; creating an enabling environment

Source: As defined by FAO and World Bank (2002), adapted from Hall (2006a).

However, over time, this assumption was challenged, as the gap between the knowledge level created by these institutions and the deteriorating livelihood of farmers in developing nations was visibly growing. The nature of the challenge forced policymakers to make a partial shift to strengthen the knowledge and technology-delivery system. The basic assumption was that weak institutional performance of the delivery agencies (usually extension organizations) caused a low level of technology adoption by farmers. The policy reorientation did not question, however, the quality of the knowledge/technology generated by research organizations in terms of effectiveness, relevancy, appropriateness to the context of diverse farming systems and cost. The blame was mainly on the weakness of the technology-delivery mechanism: the extension system. Because of this bias, more focus was given to the events that take place in the interface of the extension agent/s and the farmer/s (Leeuwis & Ban, 2004) and the motive of the extension workers being to persuade farmers to adopt a new and a better system.

3.1.2. Agricultural Knowledge and Information Systems (AKIS)

The AKIS perspective emerged as a response to the challenges of the theory of adoption and diffusion of innovations, which studied why and how people come to adopt or not to adopt new agricultural innovations and practices (Leeuwis & Ban, 2004). AKIS is a result of a large number of "formative experiences" of applied social scientists who have tried to come to grips with the complex phenomena of facilitating innovation, primarily in agriculture (Röling, 1996). The concept of AKIS was developed by Röling in the early 1990s as a diagnostic framework to helps discern the organizational forms that enable or constrain knowledge processes such as generation, transformation and use of knowledge and information (Engel, 1997). It is broadly defined by Röling and Engel (1991) as "the articulated set of actors, networks and organizations, expected or managed to work synergistically to support knowledge processes which improve the correspondence between knowledge and environment and/or the control provided through technologies use in a given domain of human activity". AKIS demands a radical policy shift from strengthening research or extension institutions, which is so typical for the NARS, to strengthening linkages and communication (Table 6) that should take place among the system actors (Figure 9).

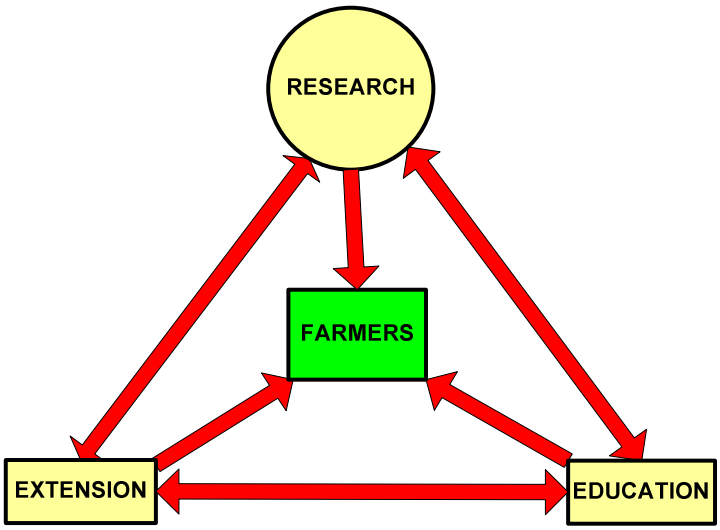


Figure 9 : AKIS framework

Source: Author's Construction

Unlike NARS, in AKIS, farmers are not merely receivers of technology from research organizations via extension. The new actor configuration in AKIS suggests all system actors have a stake in the process of generating, disseminating and using knowledge. Learning about the stock of knowledge in the system actors and creating a platform for the interaction of the actors to facilitate the generation and utilization of new knowledge, are the main principles in AKIS. The emerging and extensive use of many participatory approaches to R&D (e.g. Participatory Technology Development, Farmer Field School, Participatory Innovation Development, Rapid Appraisal of Agricultural Knowledge Systems) are the logical follow-up to the paradigm shift from the linear model to multiple-source models of innovation such as AKIS.

AKIS views innovation differently. In AKIS, innovation is not the desired outcome of a researcher or a group of researchers working in a controlled environment, in isolation from the bigger system, but rather the desired outcome of the knowledge system made up of multiple social actors with complex and interrelated missions and functions (Engel, 1997). Röling (1996) describes innovation as a result of interactions among different actors making complementary contributions. Leeuwis and Ban (2004) share this view and describe an innovation as a package of new social and technical arrangements and practices that implies a new form of coordination within a network of interrelated actors.

Following the theorization of AKIS, important methodological frameworks have been developed and used extensively. Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) is a social research methodology that is useful to describe the status of AKIS and to facilitate agricultural innovation, by focusing on the social organization of innovation (Engel, 1997). The methodology is best used when diverse actors are involved in the action research and a well-trained facilitator is carefully handling the interactive process.

There are some critiques of AKIS. Leeuwis and Ban (2004) claim that it looks at knowledge generation and use without considering the influence of political and other forces in the system and therefore cannot yield a complete and realistic analysis. Hall *et al.* (2006a) comment that the AKIS concept still focuses on research supply but gives more attention to links between research, education and extension and to identifying farmers' demands for new technology. In contrast to Hall's comments, others say that AKIS as a perspective does not see research as the sole supplier of knowledge, but as an important partner of other social actors engaged in generating and using knowledge (Engel, 1997; Röling, 1996).

3.1.3. Agricultural Innovation Systems (AIS)

The Agricultural Innovation System (AIS) perspective is a more advanced form of the AKIS perspective, the main distinction being that AIS addresses a broader spectrum of actors and pays greater attention to the private sector. It also pays important attention to institutional change, not strictly in the sense of organizations but to the commonly set habits and practices that greatly influence the innovation processes. Innovation System (IS) refers to the network of organizations, enterprises and individuals focused on bringing new products, new processes and new forms of organization into economic use, together with the institutions and policies that affect the systems' behavior and performance (Hall *et al.,* 2006a; Rajalahti *et al.,* 2008). The fact that the IS perspective deals with "new" standards makes it different from other development paradigms. The "new" nevertheless contains elements that we do not comprehend and about which we are uncertain (Rosenberg & Kline, 1986). Therefore, one has to innovate to deal with the uncertain circumstances to turn them into scenarios that are better understood.

The IS model (see Figure 10), when applied in agriculture, has added value to the conventional, linear perspective on agricultural R&D (NARS), by providing a framework for analyzing

complex relationships and innovative processes that occur among multiple agents, social and economic institutions, and endogenously determined technological and institutional opportunities (Spielman, 2005). It embraces not only the science supplier but also the totality and interaction of actors involved in the innovation.

It extends beyond the creation of knowledge to encompass the factors affecting demand for and use of knowledge in novel and useful ways (Hall *et al.,* 2006a; Rajalahti *et al.*, 2008). The process is understood as a complex socio-economic phenomenon, which is sometimes not structured and not easily predictable. The involved actors may explore opportunities to make benefits out of the seemingly messy socio-economic set-up, if the right linkages and partnerships for the right purpose are taking place at the right time. What is "right" is nevertheless a subjective phenomenon that can be constructed and negotiated by the constituents in a collective learning mode. In AIS, as in AKIS, the innovation process does not always start with research and the knowledge coming from research does not necessarily create new practice or values. Rather, AIS underscores that it is only within the innovation system that knowledge and information from various sources interact to bring new phenomena desired by the system actors (Table 6).

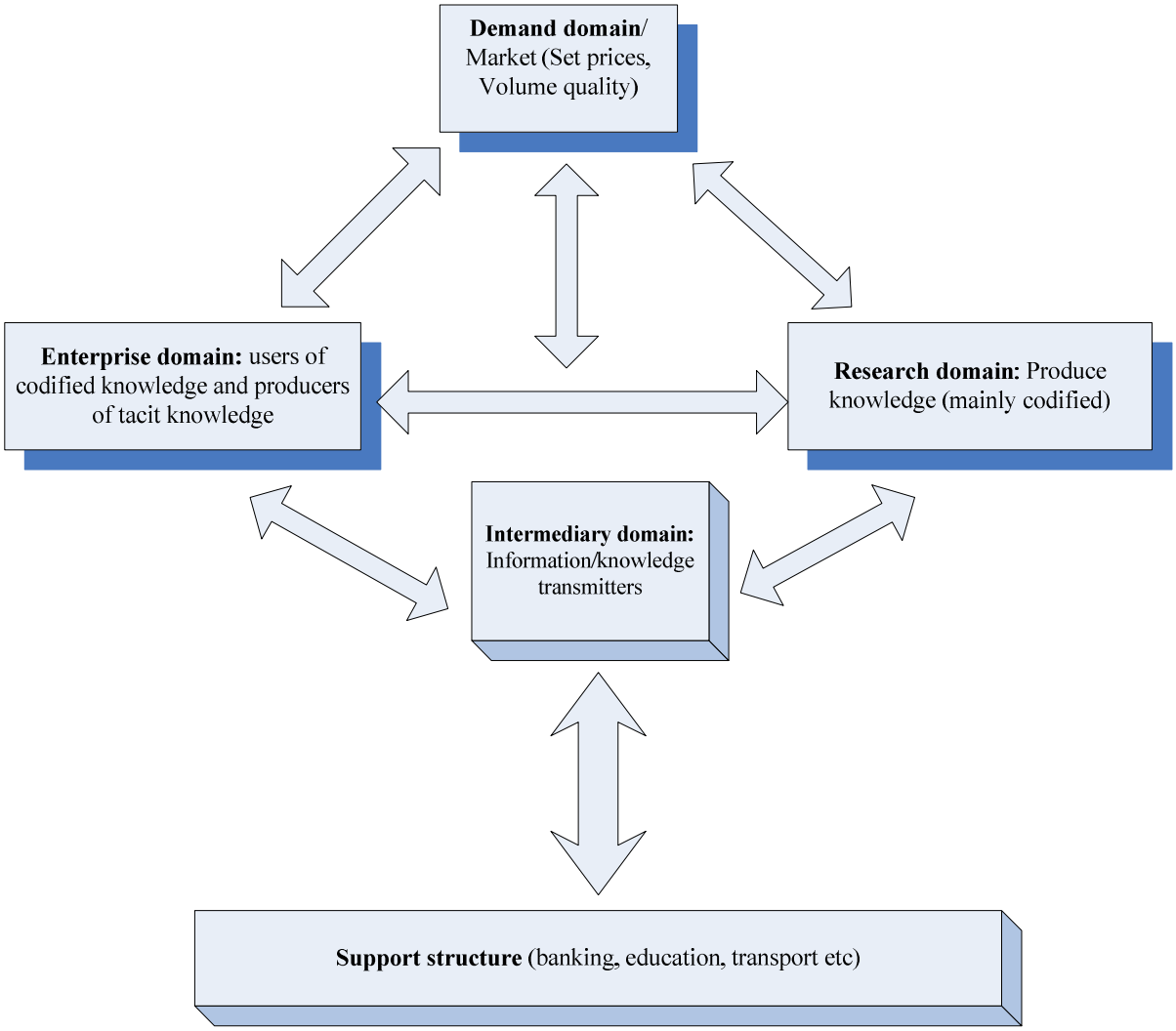


Figure 10: Innovation systems model (adapted from Hall 2006b)

Hall *et al.* (2006a) suggest that *invention* culminates in the supply (creation) of knowledge, but *innovation* encompasses the factors affecting demand for and use of knowledge in novel and useful ways. The notion of novelty is fundamental to invention, but the notion of creating local change, new to the user, is fundamental to innovation. Verkaik (1997, quoted in Leeuwis & Ban 2004) suggests that, in the innovation process, knowledge and ideas need to be translated into skills and technologies and subsequently into real socio-technical innovation. The innovation system figures out the interaction of diverse actors (not limited to research, extension, education and farmers) in a manner necessary to understand impacts of technology, policy and institutions on the economy.

This could be understood at a national level, intermediary level and local level. For example, the local innovation system (Figure 11) shows integration of the diverse actors with the livelihood of the people, which is an important part of the system actors.

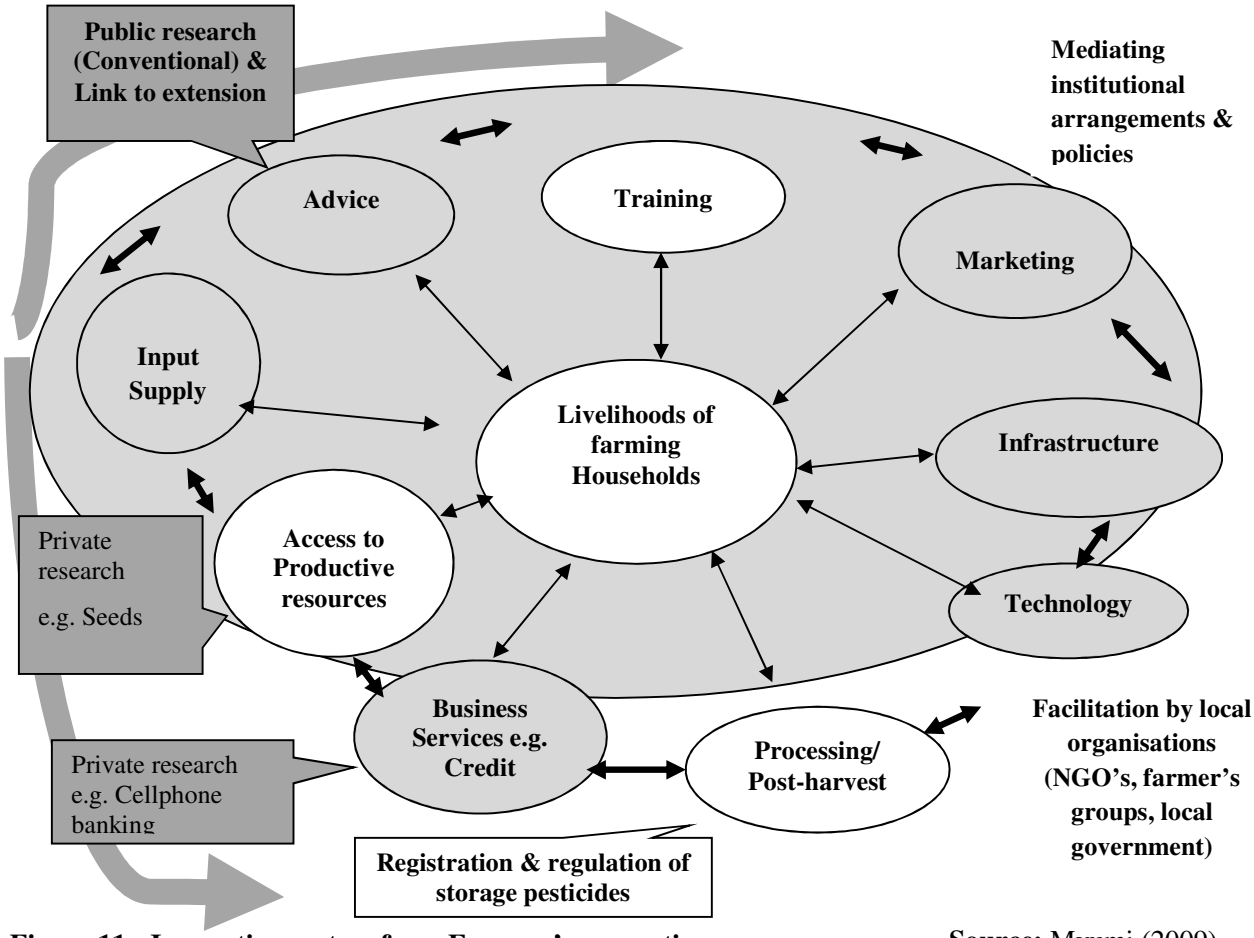


Figure 11 : Innovation system from Farmers' perspective **Source:** Mvumi (2009)

The methodological approaches are new and still need to be tested; some new methods and tools are still required. The AIS perspective may use any social science research methodology such as qualitative studies as well as descriptive methods to analyze and describe the innovation systems at national level. The challenge is how to use the AIS perspective to facilitate innovation performances at the sector level or in a given domain of human activity. One limitation is that no specific and well-thought-through methodologies and tools are available to help design or facilitate innovation from the AIS perspective. More often than not, studies are simply *ex post* descriptions of the dynamics and complexities of some technological or institutional innovations

– and the analysis ends there (Spielman, 2005). However, Tesfaye (2008) has suggested an innovation facilitation framework, which is yet subject to testing and learning. This framework include guidelines for getting started, identification of champion organizations to initiate networking, identification of entry points, socio-economic baseline, in-depth diagnosis of the identified innovation system, planning action research, design and implementation monitoring and learning systems, periodic reflections on learning outcomes, redefining actors and actions and finally consolidating lessons and applying the experiences in another domain**.**

Spielman (2005) has also suggested the possibility of using a variety of methodological approaches in AIS, including analysis of the costs and benefits of knowledge production or dissemination, given the complexity of interactions among diverse agents; methodologies used in studying social learning; benchmark or best-practice methods; game theory models and Agricultural Technology Management System analysis. Hall *et al.* (2006a) has described the basic hypothesis of the methodological framework for the diagnostic study of AIS as follows: the capacity for continuous innovation is a function of linkages, working practices and policies that promote knowledge flow and learning among all actors within the sector. The methodology is not, however, interested only in identifying the links or missing links in the system but seeks to go beyond this and unpack the relationships further to analyze the underlying causes and its impacts on the system. Hall *et al.* (2006a) broadly identified four major focus areas in the methodology: sector timeline and evolution, sector mapping, attitude and practice of organizations, and wider policy and support structure.

The Agricultural Sciences, Technology and Innovation (ASTI) model developed by CTA and associates (CTA/UNU-INTECH/KIT 2005) also studies innovation systems, similar to Hall *et al.* (2006b). However, it contains specific tools that are similar to those described in the RAAKS toolkit but also with further guidance to help analyze policy issues relevant for the sector.

3.2. Innovation

The first theory of innovation considered here comes from the French sociologist Gabriel Tarde in the late nineteenth century (Tarde 1890, 1895, 1898, 1902, quoted in Godin & Est, 2008). Tarde's sociology distinguished statics from dynamics, and was interested in explaining social change (or social evolution) through: grammar, language, religion, law, constitution, economic

regime, industry and arts. Tarde made widespread use of the term innovation (and novation) as novelty, but with no explicit definition. In fact, he used a whole cluster of terms to discuss social changes: invention, ingenuity, novelty, creation, originality, imagination, discovery and initiative. Tarde's theory of innovation was threefold: invention → opposition → imitation (Godin & Est, 2008). Inventions give rise to imitation – imitations of a limited number of inventions happen because of the opposition or competition between the new and the old inventions. The success of an invention (i.e. imitation) depends on other inventions (or opposition between inventions) and social factors (Godin & Est, 2008). For example, the increasing number of coffee consumers portrayed with an S-shaped diffusion curve, shows that a few people adopt a new innovation at first, then the innovation becomes more popular as rich people who are enjoying drinking coffee set an example (Kinnunen, 1996). Tarde first explained the conceptualization of the S-shape model of innovation adoption, using the theory of invention-opposition and imitation.

Rogers (1995) was another scholar who significantly influenced the way people think about innovation. He is regarded as the father of the theory of diffusion of innovation, having built his work on the foundation of Tarde's theorization. He recognized that the S-shaped curve of Tarde is important in his time, too, because "most innovations have an S-shaped rate of adoption" (Rogers, 1995). The diffusion-of-innovation theory predicts that media as well as interpersonal contacts provide information and influence opinion and judgment. Studying how innovation occurs, Rogers argued that it consists of four stages: invention, diffusion (or communication) through the social system, time and consequences.

In his theory of diffusion of innovation, Rogers defined five categories of adopters:

1. Innovators,
2. Early adopters,
3. Early majority,
4. Late majority, and
5. Laggards.

He explains a linear order in which adoption takes place when a given technology is introduced to the users. These five categories of adopters have been and are still used by many agencies to plan their research and extension work and to draft policies. Both Tarde and Rogers emphasized the diffusion and adoption dimensions of the inventions/innovations. The innovations were seen as a function of invention that comes from a single source (central source) and the meaning of innovation was highly anchored in the practice of adoption. In other words, those who successfully adopt the technologies are regarded as innovators, and innovation refers to the technology that is adopted.

Starting in the early 1990s, several authors made distinctions between inventions and innovation and began to see innovation as a phenomenon that takes place beyond technology creation centers. Fagerberg *et al.* (2006) describe invention as the first occurrence of an idea for a new product or process, while innovation is the first attempt to put the invention into practice. This implies that invention is a new product, whereas innovation is a new value that brings benefits to improve human and environmental wellbeing. Drucker (2007) relates innovation with the market, saying that, if an innovation is product-oriented, it may only create a "technology miracle" without creating the expected benefits. In other words, innovation not accepted by the market has little value. In the same direction, Baeon (quoted in Anandajayasekeram, Dijkman, & Workeneh, 2005) describes innovation as the economically successful use of invention, while invention is a solution to a problem. Bringing a “solution to a problem” in its broader sense is also a characteristic and purpose of innovation, whereas inventions provide only “knowledge solution” in a “restricted territory” and the narrowly defined context of the designers. Inventions, if not transformed into innovations by entering into the complex relations and interactions of people, may remain like “miracle” thoughts, practices or methods with limited application in the real-world situation. There is, however, no one consistent meaning and understanding of the term innovation. Even among the innovation systems thinkers, innovation definitions overlap in a semantic sense. It varies from very broad conceptualization to narrow definitions and from sector-specific perspectives to general views.

Röling (2009b), in his article on “pathways of impacts”, categorizes and describes the various models of innovation that used to be popular in the recent past and continue to dominate policy

making and agricultural practices in developing countries. He made extensive review of the theoretical thought and implications to development. A brief summary of the models as presented by Röling (2009b) is given here:

- *Technology pathway*: This model is also called 'the linear model' e.g., Kline & Rosenberg (1986), 'the pipeline model' e.g., Biggs (2007) or the 'technology transfer model' e.g. Chambers & Jiggins (1985, in Röling 2009b). This pathway emphasizes investment in agricultural research and technology development. It looks at innovation as the 'delivery' of science-based technologies to 'ultimate users', and their spontaneous diffusion among these users.
- *Farmer-driven innovation*: At times, scientists tend to forget that farmers are experimenters who have to live by the results. What is more, they keep at it for generations. Although they cannot see microbes, nematodes, Striga seeds or even capsids, their experimental knowledge allows them to develop farming systems, farming procedures and cultivars that work, provide them with essentials and are adapted to their circumstances.
- *Participatory development*: This model emphasizes recognition of the importance of indigenous knowledge by people like Warren *et al.* (1991) and Norman (1974, in Röling 2009b), and emerged partly as a reaction to the arrogance of the technology supply push model mentioned above. The Participatory Technology Development (Veldhuizen, 2003) approach that emerged in agriculture focuses on the active involvement of farmers in technology development to ensure effectiveness*, goodness-of-fit,* desirability and feasibility of the technologies developed. For some observers this does not go far enough (Wettashinha, C and Waters-Bayer A, 2010). It is one thing to give farmers a say, another to give control over research agendas, design trajectories, funds, and the choice of the issues that need research.
- *Market-propelled or induced innovation* (agricultural treadmill): The key assumptions of this model are: farmers are small firms in a free market, producing the same commodity; each one of them is too small to affect the price; introduction of an 'innovation' allows early adopters to capture a windfall profit; soon diffusion leads to overproduction and further price squeeze; in the 'tail' farmers who cannot keep up eventually drop out. It is a neoliberal

economic model and the basis for the World Trade Organization, the European Common Agricultural Policy and, the model on which the strategy of the Gates Foundation is based to lift millions of small farmers out of poverty by increasing the productivity of their resources (Röling, 2009b).

- *Innovation Systems:* The IS model points to additional pathways that have become necessary with the growing interest in enlisting smallholders and their resources for global food security and for mitigating climate change. These pathways are in *statu nascendi*. They all have one thing in common: they regard innovation as the emergent property not of science or of markets, but of interaction among stakeholders in opportunities for development. It is their negotiations, conflicts, agreements and ability to undertake concerted synergistic action that determine whether one will be able to move forward.

A broader characterization of innovation and innovation processes viewed by some innovation systems thinkers was also summarized by Hall *et al.* (2006a) as follows:

- Innovations are new creations of social and economic significance. They may be brand new, but are more often combinations of existing elements.
- Innovation can compromise radical improvements but usually consists of many small improvements in a continuous process of upgrading.
- These improvements may be of a technical, managerial, institutional (the way things are routinely done) or policy nature.
- Often, innovations involve a combination of technical, institutional and other changes.
- Innovation processes can be triggered in many ways, e.g. bottlenecks in production within a firm, changes in available technology, competitive conditions, international trade rules, domestic regulations and environmental health concerns.

3.2.1 Review of global experiences in innovation systems studies and practices

The emergence of the AIS from the industrial system as well as from the conceptualization of AKIS took place over many years. The AIS framework is not yet a fully developed idea but has attracted many scholars and policymakers who are interested to learn more about the model. The following section describes some of the important issues related to innovation systems thinking,

drawn from interactions with various scholars, practitioners and policymakers in relevant conferences and seminars. The key messages of these interactions and meetings were reviewed against the formal literature on the subject.

Farmer innovation has been taking place from time immemorial. The long history of humankind in domesticating plants and animals and developing several systems in agriculture and other fields are examples of farmer innovation, which had significant importance in allowing life to continue before the advent of modern science. The concept of farmer innovation has reappeared now as an old practice and new thinking. It argues that, with the increasing role of modern science in influencing policies and practices of several financial and scientific institutions, the capacity of farmers to innovate has been neglected. Farmers were expected to live by the merits of science-based technologies, while the outcomes witnessed limited achievements in the face of the diverse and complex agricultural systems in Africa and the climate change effects which are apparent all over the globe. This calls for the recognition of farmer innovation by the major R&D agencies for better results.

Two Dutch-funded action research programs, focused on soil and water conservation, were implemented in the 1990s in seven Anglophone and Francophone African countries. The main aim of the programs was not just to contribute to soil and water conservation work in the conventional sense, but to identify and support local innovations in this field (Reij and Waters-Bayer, 2001). The work of the action-research programs was documented in a book entitled *Farmer Innovation in Africa: A source of inspiration for agricultural development* (Reij and Waters-Bayer, 2001*)*. The book introduces the concept of farmer innovation and some of the remarkable innovations that came to the attention of the project partners in the course of the program period.

The book gives substantial emphasis to the processes of promoting farmer innovation through presenting several cases of empirical evidence from the countries involved in the programs. The key message of this literature is, however, that identification or appreciation of farmer innovation is not the ultimate end of the process. Facilitating the building up of partnership between the innovative farmers, research and other development partners is very crucial to achieve quicker and important impacts. The support of policy to help public R&D institutions recognize

promoting farmer innovation as an important development approach to ensure sustainability is another key message of the book.

In November 2005, IFAD (International Fund for Agricultural Development) organized a workshop under the theme: *What are the challenges of innovation for rural development?* The aim of the workshop was to identify the challenges of innovation and explore where innovation is needed most urgently. The central idea of the interaction was that, in the face of the changing contexts of the global economy and political environment, development institutions have to find new and better ways of addressing both old and new challenges so as to eliminate obstacles that prevent the rural people from improving their livelihoods and lives. Foremost are the enormous challenges that globalization brings to smallholder agriculture. The AIS approach could be an appropriate answer to overcome or minimize the impacts of these challenges but the approach was also felt to be slightly complicated and success depends on how conducive the institutional environment is and the presence of a well-articulated demand for and capacity to adapt and adopt and effectively develop new knowledge.

In this workshop, as a mechanism of overcoming challenges of innovation,(Maguire and Cartwright, 2008) introduced the idea of learning from the positive to reduce rural poverty. They elaborated the concepts of "Positive deviance" which is quite similar to the ideas of promoting local innovation, discussed above. The authors strongly argues about taking time to understand the positive phenomena taking place in a community and then build the energy there to address the key and strategic development issues; instead of trying to discover problems and prescribe solutions in a conventional way. Capitalizing on the positive deviance does not mean ignoring problems but addressing the same challenges more effectively using local assets and initiatives rather than externally driven solutions. The key conclusion of the IFAD meeting was that many new ideas on innovation and practices had been raised but more questions remained unanswered. It was suggested that more exploration of the AIS concept is necessary in a collective learning mode.

A group of people who work in research for development in several institutions in Africa also took the initiative to create a platform for the developing concept of innovation systems, with particular interest in learning from the experiences and contexts within Africa. A symposium,

which was the first of its kind in the subject of innovation in relation to Africa, was organized in Kampala, Uganda, in November 2006. Scholars and practitioners who were increasingly worried about the limitations of the conventional ToT model to meet the expectations of complex agricultural systems (from plough to plate) presented their theoretical thoughts and experiences and indicated ways forward. Röling (2009a), who was the keynote speaker in the meeting, stressed that pushing technologies in conditions of limited opportunities is like promoting a free market in a situation where essential market institutions such as banks do not function. In Africa, priority must be given to institutional change. It is not only farmers but also national and international research organizations, local and national governments, and especially international agencies that need to innovate.

A book came out from the symposium under the title *Innovation Africa: Enriching farmers' livelihoods* (Sanginga *et al*., 2009). A key conclusion made in the book is that, despite the range of experiences and acceptance of the AIS model, state-level policy reorientation in line with the model had not yet been reported. Rather, huge initiatives such as the Alliance for Green Revolution in Africa (AGRA), the Millennium Villages, the Bill and Melinda Gates Foundation and the Sasakawa-2000 programs are promoting the return of the conventional diffusion of innovation model to Africa.

The Institute of Development Studies (IDS) in Brighton, United Kingdom, hosted another international workshop on "Farmer First Revisited" in December 2007. The focus of this meeting was to clarify the roles farmers could play in the AIS approach. This workshop recalls on the Farmer First workshop organized by Robert Chambers and his colleagues in 1987 and, the follow-up international meeting in 1992, which was called to gain deeper insights on farmer first approach. The Farmer-First approach puts smallholder farmers' knowledge, opinions, decisions, resources and conditions in general at the center of R&D initiatives. The Farmer-First approach gave birth to the development of important tools and methods such as Rapid Rural Appraisal (RRA), Participatory Rural Appraisal (PRA), Farmer Participatory Research (FPR) and others. The aim of the 2007 workshop was to see to what extent the concepts and practices of the Farmer-First approach, which went through the past 20 years influencing several institutions and

policymakers, are still valid in the face of the changing socio-economic contexts and developing new concepts and theories on research for development, particularly the AIS perspective.

Scoones *et al*. (2009) edited a book, with a forward by Robert Chambers, under the title *Farmer First Revisited: Innovation for agricultural research and development*. A key issue extensively debated in the book is to find where smallholder farmers are placed in the advent of the new AIS model and what apparent methodological changes were needed to reposition farmers and the new configuration of actors. For example, the advancement of the laboratory-based molecular biological research for agriculture has placed farmers too far from research activities with less input into setting priorities for such research. On the other hand, many authors of chapters in the book also noted that innovation, with the development of new domestic and international value chains, has become driven less by science (supply side) and more by markets (demand side). Thus, a more nuanced approach to "farmer first" is required that sees agricultural R&D as part of a context-specific innovation system, where particular economic, social, cultural and political processes influence how research is done and how research influences innovation.

Speakers like Hall (2009) in (Scoones *et al.,* 2009) stressed that farmers are neither first nor last, as the AIS is a collective interaction of diverse actors in the social and economic system. In describing the way forward, the book also suggested that this requires a broad coalition of research and education organizations, private companies, development agents, farmer federations and others – an innovation alliance. Such an alliance could help reinvigorate and expand the Farmer-First movement, bringing much needed clarity, commitment and creativity to the still vital agenda.

In April 2008, the International Food Policy Research Institute (IFPRI) organized an international conference on advancing agriculture in developing countries through knowledge and innovation (Asenso-Okyere *et al*., 2008). IFPRI is one of the 15 international agricultural research centers under the umbrella of the Consultative Group for International Agricultural Research (CGIAR). It is among the CGIAR members that are showing increasing interest in the concepts of innovation systems. The objectives of the conference were to showcase research results and experiences on knowledge and innovation in agriculture and to identify areas of further research and advocacy. Similar to many of the innovation-focused meetings and

workshops organized elsewhere, the concept of innovation was understood as new ideas, practices and products that are successfully introduced into the social and economic processes. When knowledge is successfully transformed, it can yield innovation, which in turn enhances the competence, productivity, competitiveness and livelihoods of agents in the value chain. It considers knowledge, learning and innovation as integrated whole

A summary report of the conference, edited by (Asenso-Okyere *et al.,* 2008) defines knowledge as organized and processed information which is fundamental in the pursuit of innovation. Such knowledge can be tacit or codified and indigenous or scientific, depending on how and where it is acquired. In the same report, four types of learning, including learning by doing, learning by using, learning as a result of formal discovery; and learning through self-education were explained. Significant emphasis was paid to learning, as it is the center of knowledge development and sharing, which eventually yields innovation. It was emphasized that the AIS approach has emerged as a holistic tool for understanding and, to a limited extent, analyzing knowledge and innovation for agricultural growth and poverty reduction. In conclusion, the conference participants pointed to the need to develop capacities to conduct research using a systems approach and to develop the tools with which to empirically assess the way innovation occurs in agriculture.

3.2.2 Review of innovation system studies and practices in Ethiopia

3.2.2.1 Agricultural scaling-up and scaling-out

The Ethiopian Institute of Agricultural Research (EIAR) is a federal agency with a mandate to coordinate the national research programs and policy formulation on agricultural research. In the past, EIAR was restricted to the generation of technologies, followed by conducting verification trials in relatively bigger plots outside the research station. This is still a common practice even today, although some changes seem to be taking place. The recent experience of EIAR on scaling up is an example of the changes going on in the organization. It aims at improving impacts of successful initiatives at local level (Dawit A., 2013) through analyzing success stories and sharing to the wider users. The committed engagement of the EIAR in the scaling-up initiatives suggests it is seeking a better way to demonstrate its work to the public.

Some of the initiatives of the research centers on scaling-up activities were documented in a book entitled *Success in value chains* (Tsedeke, 2007). The book pays high attention to describing the effectiveness of technologies in changing the lives of poor farmers. The case on promotion of improved haricot bean production in East Shewa, Teshale *et al.* (2007), quoted in (Tsedeke, 2007) , which was spearheaded by the Melkassa Research Centre in the Rift Valley, provides a successful example of a partnership among stakeholders in which the principles and theoretical assumptions of the AIS perspective were clearly applied.

Melkassa Research Centre has travelled extra miles to promote the new varieties among thousands of haricot bean farmers, as well as to facilitate marketing of the crop. The research center has literally crossed the traditional boundary of its mandate, which restricts it from being engaged in massive popularization work. It took the lead in the process of popularizing the technology through creating linkages with other key actors and promoting international marketing. Organizing a multi-actor platform for three years was the key strategy for the approach. From the market actors' side, UK businessmen who guaranteed a sustainable market for the commodity (provided that certain quality standards are met) and who also sponsored the innovation processes (meetings, interactions etc.) were in the lead. Several agencies, including researchers, cooperatives, unions, the Commercial Bank of Ethiopia, NGOs, the Ethiopian Seed Agency, the Ethiopian Standard Authority Agency, the Ministry of Agriculture and Rural Development, zonal and district administrators, traders and exporters were meaningfully involved in the process. Every single actor had a specific role to play and vested interest to achieve. During the three years, several meetings were held in which a number of effective partnerships were developed, knowledge and information was effectively shared, access to financial resources was secured and exports market opportunities realized. The process also encountered several conflicts and misunderstandings among the actors, most of which were addressed over time. EIAR not only took the role of facilitation but also drove the process with a strong role of coordination. The process resulted in about 400% price increase for thousands of smallholder haricot bean farmers in the Rift Valley and contributed to the foreign currency gain of the country, Teshale *et al.* (2007), quoted in (Tsedeke, 2007).

3.2.2.2 Improving Productivity and Market Success

The main partners of the project known as Improving Productivity and Market Success (IPMS) include ILRI and the Ministry of Agriculture and Rural Development. The Canadian government, through its international cooperation body (CIDA), provides most of the financial support. The IPMS project proposes to 'contribute to improved agricultural productivity and production through market-oriented agricultural development, as a means for achieving improved and sustainable livelihoods for the rural population' in Ethiopia. To accomplish this goal, the project supports development and (action) research on innovative technologies, processes and institutional arrangements in three focus areas i.e.: i) knowledge management; ii) innovation capacity building of public and private sector partners, farmers and pastoralists; and iii) market-oriented production technologies and input/output marketing and financing; contributing to evidence-based policymaking to support innovation processes and capacity development (Puskur *et al.,* 2006).

Improving the dairy innovation system in the learning sites of the project is among the important initiatives of IPMS. It made an empirical analysis based on the experiences of the learning sites and concluded that the Ethiopian smallholder dairy subsector has not been able to take off despite decades of development interventions. Using the innovation systems perspective (Tefera *et al*., 2008) look into the paradox of long years of development intervention and the sluggish progress of the dairy subsector in the country. They identified and discussed the implications of emerging opportunities and challenges for subsector development and explored strategic options for subsector takeoff.

3.2.2.3 Maize-livestock innovation system study

This study was initiated in the main maize-growing areas of the country to look into the technical and institutional interactions that took place in the interfaces of the maize and livestock subsystems and to find out the determinate factors that affect productivity and growth. This is an ILRI-supported PhD research project done by Ashenafi Mengistu, a staff member of Addis Ababa University, School of veterinary medicine (Ashenafi, 2010). This study employed the innovation systems approach as a key theoretical framework and according to the results of the

study the overall picture of the maize-livestock innovation systems is tied up with the conventional top-down approach, which is not participatory, and learning based. The system suffers from shortage and high price of inputs added to lack of timely supply. The study also recommended that a continued capacity building efforts for all of the actors and promotion of trust worthy interactive learning processes for better technological uptakes and responsiveness to the demands of end users is necessary

3.2.2.4 Smallholder innovation in Ethiopia: Concepts, tools and empirical findings

An IFPRI study on smallholder innovation (Davis *et al.,* 2009) is among the pioneer studies in the country, which considered the concepts and perspectives of innovation systems to look into local innovation processes. The purpose of this study was to analyze the determinants of smallholders' capacity to innovate, the processes and systems that contribute to enhancing their capacity, and the organizational, institutional and policy options that can strengthen smallholders' innovative capacity and enhance pro-poor innovation processes in Ethiopia. This study went beyond the traditional unit of analysis, the household, to look at the innovation system, the set of interrelated agents, their actions and interactions and the institutions that condition their behavior (Davis *et al.,* 2006). This study recognized that one of the problems in trying to understand the innovation system in its broader essence is a lack of robust tools and methods. Therefore, the paper tried to introduce tools and methods from a variety of disciplines to isolate and analyze components and linkages within the local innovation system.

3.2.2.5 Agricultural Knowledge Systems (AKS): the case of Tigray

Mekelle University, which hosted the multi-stakeholder Dutch-funded project in 1997–2001 known as Indigenous Soil and Water Conservation (ISWC), a forerunner project to the national network of PROLINNOVA–Ethiopia, played an important role in promoting local innovation in Tigray Region. This is one of the nine federated states of Ethiopia, located in the north, where Mekelle University is also found. The university staff members conduct much research on rural development issues, but a recent thesis by Mamusha Lemma, then a staff member of the university, on the Agricultural Knowledge System of Tigray Regional State in Ethiopia is worth mentioning. (Lemma, 2007) argues that the studies so far conducted on Agricultural Knowledge

Systems in Ethiopia follow the traditional approach of looking into a single institution. Such an approach fails to understand the interplay of knowledge and information in the complex system of actors. He further argues that the theory of Agricultural Knowledge Systems (see AKIS), which is a methodological choice for his study, was not used adequately in the conditions of Ethiopia to generate empirical evidence for the theoretical assumptions.

His study finds out that there is a huge gap between the formal knowledge system and the informal local agricultural system. The agencies from the formal system, particularly the extension bureau (entry point of the study) and research, have the perceptions and practices that the sole responsibility of bringing change in people's livelihoods rests upon them. As a result, there is too much control and push from the formal system to make the farmers go in certain direction, while farmers – particularly those who are successful in escaping from the trap – have diverse opportunities to make their own choices of livelihood. He suggested that the state seems to realize this problem and has come up with a new extension strategy, which is more liberal and market-oriented. Nevertheless, he expressed his doubts whether the new strategy would be able to bring significant change, as the long history of failure in the extension system suggests an overall change in attitudes and institutional behavior would be necessary but will probably not happen in the short run.

3.3. Community resilience

The theory of resilience is another important concept that helps to understand how social changes take place with the advent of shock or stressful conditions. Understanding the relationship of resilience with innovation processes is very important for finding out the leverage points where the right mix of these processes could be used to maximize benefits. Social resilience is a form of behavior that could manifest at different levels, including individual, group and family, community, societal and national levels. The ideas of community resilience are relevant for this study, as its focus is on grassroots communities and a specific sector of development in which the community engages. This section tries to shed some light on the concept of resilience in general and briefly investigates the community-level phenomena.

The theory of resilience has been applied in social sciences in recent years. Social resilience, which combines the merits of social theory and resilience theory (Marshall, 2010), is now

becoming an area of interest for those who want to look into the strengths and pitfalls of a community to resist external pressures that could disturb their existence and functions as a system. Those who are interested in the changes that take place in ecology and environmental phenomena are also applying the theory of ecological resilience, which helps to see how ecological systems respond to external shocks. Holling (1973) brought the theory of resilience into the discipline of ecology for the first time and developed a non-linear systems framework to understand ecological processes. The critical interaction of human behavior and ecological phenomena is also a subject of interest for those who work on social-ecological resilience, i.e. an account of the interplay of human activity system and the ecological systems, in which mismatches may lead to disaster. It provides a bridging opportunity to share lessons concerning the governance of both (Smith & Stirling, 2008). The more the occurrence of collective challenges such as climate-change effects, communicable diseases, conflicts and so on become evident, the more the concept of resilience gains importance among policymakers, researchers and practitioners.

Different authors departing from their disciplinary affiliations have defined resilience. For example, Holling (1973) defines resilience as the ability of the system to absorb disturbances and reorganize while undergoing changes so as to still retain the same function, structure, identity and feedbacks. It relates to the ability of the system to tolerate disturbances without collapsing into different states, controlled by different sets of processes. Leach (2008) explains resilience as an approach that emphasis flexibility, diversity and adaptive learning as key responses to real-world dynamics. This offers prospects for more integrated and effective policymaking towards sustainability. Adger (2000) defines social resilience as the capacity of a community to cope with disturbance or change and to maintain adaptive behavior. Adger explains that social resilience has economic, political, spatial, institutional and social dimensions. A resilient community is able to respond to changes or stress in a positive way and can maintain its core functions as a community despite these stresses. The conceptualization of Garmezy (1994, quoted in VanBreda 2001) provides a different insight, with slightly different thoughts. He defines resilience as the skills, abilities, knowledge and insight that accumulate over time as people struggle to surmount adversity and meet challenges. An on-going and developing fund of

energy and skills can be used in current struggles. Garmezy stresses knowledge and skills as the central force of resilience.

The work of many authors demonstrates similarities rather than differences and complementarities rather than sharply conflicting ideas. Garmezy's definition, however, provides a window to analyze the concept of resilience and see its relevance with the other theories used in this thesis (innovation and system). Garmezy not only refers to the acts of response to tackle challenges that destabilize the community functioning and structure but also emphasizes the source of that energy of response. He recognized that the fund of energy is accumulated knowledge, wisdom, skills, ability and insights over time, which form a major constituent of societal culture, also referred to as "social capital". Community/societal resilience refers to the application of the collective energy of the people that is embedded in their culture and often mobilized to mitigate challenging situations that put at risk the existence of the people to perform their normal life functions. This energy spontaneously responds to the shocks to ensure stability and durability. The shocks could be natural, economic, political or social.

Maguire and Cartwright (2008) have identified three aspects of resilience as *stability*, *recovery* and *transformation*. Stability and recovery take the ecological perspective and deal more with the phenomena of the system to return (bounce back) to the pre-existing state. Resilience is measured by the ability of the community to return (to stability) and the time it takes to come back to normal (for recovery). Resilience as transformation is, however, a recent view that considers social resilience as the capacity of the community for adaptive change. Rather than simply returning to a pre-existing state, it involves changing to a new state that is more sustainable in the current environment. For example, an agriculturally based rural community may develop different economic activities (e.g. tourism) or may develop new farming practices that suit the current environment. Folk (2006, quoted in Maguire & Cartwright 2008) argues that, in a resilient social-ecological system, disturbance has the potential to create opportunity for doing new things and for development. It is here that the difference between social resilience and ecological resilience becomes clear. Social resilience recognizes the powerful capacity of people to learn from experience and to incorporate this learning into their interactions with the

social and physical environment. This explanation is quite similar to in the one in the concept of innovation.

High-level challenges (at community level), shocks, disturbances, for example, are enough reasons to mobilize the embedded energy in the community for response. However, the embedded energy (the potential) can also be mobilized to transform the people (economic or social transformation); even when stressful conditions do not take place. Mobilizing the positive energy of the community for change should not wait for stressful conditions. The resilient actions take place spontaneously with stressful conditions coming from within the community. This implies that the embedded energy and the social capital of the community is a great force that needs to be mobilized in normal times to cause economic and social transformation by creating new space for innovation. This new space could be understood as an orchestrated innovation process (planned and organized by outsiders) but also as an opportunity-driven innovation, which springs out from inside because new chances are created to do business differently.

For an outsider, mobilization of the positive energy for change requires mapping socio-economic phenomena and deeper understanding of the resilience structure. For example, the Asset Based Community Development (ABCD) (Cameron *et al.,* 2008; Mathie & Cunningham, 2008) approach emphasizes the positive energy of the community through applying the techniques of appreciative enquiry, to help people appreciate the capacity they have to change their own world, without being highly dependent on external actors including the government. In other words, this approach is used to strengthen the resilience of the community, not necessarily to respond to shocks but also to innovate and change their economic, social and environmental worlds, making them more useful. PROmoting Local Innovation (PROLINNOVA) in ecologically oriented agriculture and natural resource management (Waters-Bayer *et al.,* 2008), which is an international network committed to support local multi-stakeholder innovation processes, shares the same school of thought. Individuals, groups or communities that strive to improve their own performance by trying out new ideas or using existing knowledge for new applications in their own pace and leadership are examples that show the links between innovation and resilience.

In short, innovation and resilience could be two aspects of the same phenomenon. The tendency of individuals, groups or communities to respond to shocks shows resilient behavior, while their tendency to apply knowledge and create new value is the behavior of innovation. All resilience actions are not necessarily innovations, nor are innovative practices necessarily actions of resilience. However, there are times when both behaviors of a community, a group or an individual manifest together. The highest leverage point for transformation is when resilient actions are innovative. *Innovative resilient actions* could take place as a result of internal social phenomena but also as a result of the support of outsiders.

3.4. Other theoretical constructs

3.4.1. Leverage points

The innovation systems perspective deals with a broad spectrum of actors characterized by inherent connections, seeking to introduce new ways of doing things at a system level. Pushing the right button to cause desirable changes in the possible shortest time is therefore a critical factor of success for innovation system facilitators. The challenge is, however, to discover the right buttons to push by the right actors at the right time. For system thinkers, this could not be a result of analysis of a single firm in the system. A thorough system analysis that covers both actors' interactions at different levels and understanding of the institutional and policy factors is critical. The right buttons to be pushed for desirable changes at a system level are referred to here as 'leverage points.' From the innovation systems point of view (collective actions and interactions), innovation consists of a variety of new and independent practices that may be implemented by a variety of people at different levels and in a complex set-up. Even for a single actor, innovations have composite natures that include a variety of technical and social practices at different levels (Leeuwis and Ban, 2004). Understanding the leverage points of highest value at the system level is the key area of interest in this study.

Meadows (1999) explain leverage points as places in a complex system where a small shift in one thing can produce big changes in everything. Along the same lines, Hodges *et al.* (2006) have defined leverage points in the healthcare system - as places of influence where system planners and implementers intervene strategically in their existing system context in order to affect the development of their system of care.

Meadows has identified twelve leverage points as entry routes of impact and change at the system level. It is not perhaps essential to apply all the entry points suggested by Meadows to all system contexts but one can adapt the most suitable entry points for analysis. For example, Hodges *et al.* (2006) develop their own leverage points for a system of healthcare development, by drawing lessons from the work of Meadows. Their leverage points were grouped into four important categories that describe the types of interventions that can be used to accomplish system changes. *Structure* leverage points refer to specified roles, responsibilities and authorities that define organizational boundaries and enable an organization to perform its function; *information* leverage points address the availability of feedback to system stakeholders; *goals* leverage points relate to the expectations and intended outcomes of system changes. *Values/beliefs* leverage points address the intrinsic philosophy that is fundamental to the system. These leverage points are broad enough and appropriate to adapt for the innovation systems of this study. Likewise, taking the important concepts of innovation systems in to account, historical legacies, dairy resources, Actors interaction, Polices and Institutions are identified as important leverage points.

3.4.2. Institutions (habits and practices)

Institutions in the context of this study are not referring to organizations *per se* but to the formal and informal social rules that structure social relations (Hodgson 2006; Ostrom 2005: 3). It is often not easy to understand the concept of an institution, which is about the software aspect of development. Institutions are not visible or touchable unlike many of the hardware artifacts such as roads, schools, health centers, irrigation schemes, medicines, new crop varieties and new animal breeds etc. Institutions rather refer to the hidden but also critical driving forces of the hardware, which are necessary for them to function properly. When America failed to deal effectively with Hurricane Katrina, it was not because of a lack of machinery, military transport, or communications equipment; it was the 'software' – or the institutional arrangements – that were the problem. There was poor communication between different agencies and weak leadership and even racist attitudes towards those affected (Herring, 2006). Communication, linkages, leadership and attitude make up the important aspects of institution in this particular example.

Herring (2006) gives us other examples to demonstrate to what extent institutions are important. When poor farmers in Africa want to improve their farming, it is not simply better varieties of crops they require. Often, issues of land tenure, lack of knowledge about markets or an inability to access financial services are the real barriers. For a good education system, it is not only school buildings, books and computers are important. What really make the difference are the incentives teachers have to help them be good teachers and the attitudes parents have about supporting their children's development. Here, Herring is referring to another set of institutions such as knowledge, law, market and incentives. More institutional issues may include important aspects of a social capital such as social organization and value systems, which may include trust, respect, cooperation, confidence, pride and others.

Technological advancement in today's world tends to overshadow the importance of institutions, yet it cannot ever replace the role of institutions. Development organizations in agriculture are, for example, often more concerned about the generation and dissemination of technologies. Research protocols are frequently signed to develop agricultural technologies, and extension systems are designed to promote new technologies. The critical institutional issues are often undermined, while many of the problems associated with effectiveness, sustainability, equity, and scale are related to institutional challenges, such as poor communication, weak linkages, undeveloped markets, inadequate incentives, mistrust and inappropriate laws/policies. The argument here is that our modern societies have become much better at technological innovation than at institutional innovation, and environmental sustainability, social justice and coping with the massive demographic change the world is experiencing hinge on rapid institutional transformation. Hence, institutional innovation becomes critical to a wider understanding of capacity development and its link with government (Held, 2004; Milbraith, 1989). Improving the 'software' side of how societies function is what is meant by institutional innovation. Many capacity-development interventions have been driven by the needs of technological innovation rather than the needs of institutional innovation. However, the global challenges of the 21st century call for institutional innovation that entails a very different dynamic of the relations within society. Changing institutions – whether related to societal norms and values, government policies, market incentives, political systems or organizational processes – requires

the ‘soft’ capacities of communication, trust building, diplomacy, networking, making sense of messy social situations, political advocacy and leadership (Woodhill, 2010).

3.4.3. Trust building

Conventionally, trust is defined as willingness to rely on an exchange partner in whom one has confidence (Moorman, 1992) but trust is also treated in one of two distinct ways in the literature. Trust has been conceptualized as a feature or an aspect of relationship quality. Dawyer & Oh (1987) and Crosby & Evans Cowels (1990, quoted in Moormon, 1992), for example, described trust as a feature of relationship quality along with satisfaction and opportunity. The second way of conceptualizing trust is as a determinant of relationship quality.

Trust is a phenomenon that takes place between organizations, within an organization or between individuals. In the innovation systems networks, several organizations may come together to achieve shared objectives, which are partially overlapping. According to Wehmeyer & Riener (2007), the following objectives are the driving forces behind why organizations may network:

- to reduce research and development,
- to achieve economies of scale and/or scope,
- to exchange technology,
- to co-opt or block competition,
- to overcome government-mandated trade or investment barriers,
- to facilitate international expansion and opening new (global) markets,
- to link complementary contributions of the partners in a value system (vertical quasi-integration); and
- to achieve synergy effects.

All these objectives are not, however, easy to achieve unless trust building among the network members receives attention.

Trust building is not simply an activity. It requires a change in institution (habits and practices) that may come into effect as a result of staying together for long time with proven and

progressively changing behaviors – to create a value of confidence in and respect for each other. Inter-organizational trust primarily builds on relational trust, which is based on experience and interaction with a specific partner in a dyad (Dodgson, 1993;, Ring & van de Ven, 1992; Zaheer *et al.,* 1998; all quoted in Wehmeyer & Riener, 2007). However, if the relational dimension of trust is lacking or underdeveloped, different bases of trust need to fill the gap. Trust may develop as a result of strong organizational rules and regulations, which could not be violated and if they are, which could be easily reversed as a result of using legal facilities and actions. For example, one might not need to establish long-term relations to develop trust in the banks, insurance and similar companies, which are founded on a legal basis. The legal and organizational system in the bank, as well as the proven history of many of the financial institutions, gives a customer confidence to be part of the system straight away. However, the type of activities the customer may carry out with the banks is limited to and bound by several legal restrictions. In networks, which are created on a voluntary basis, for collective actions to take place in a relatively open system, trust induced by good relations over time, is more important than legal instruments. It provides space for creativity and innovation through taking risks and exploring new opportunities.

However, the pool of companies in a network of innovation might be large and is subject to change in size and focus over time. It is likely that not every company in this pool has a history of bilateral cooperation with every other company in the pool. Some possible dyads of companies might even include almost no knowledge at all about the other company on both sides. Such a lack of relational trust (Ring and van de Ven, 1992, quoted in Wehmeyer & Riener 2007), which would be grounded in mutual cooperation experiences, emphasizes the need for other bases of trust when it comes to a delicate task like, for example, the formation of specific value chains (project networks).

3.5. The conceptual framework

The AIS perspective, as defined and explained above, is the main theoretical framework for this study. The analytical framework of AIS used by CTA for the Agricultural Science, Technology and Innovation (ASTI) model (CTA/UNU-INTECH/KIT, 2005) and by Hall *et al.* (2006b) in assessing capacity in agricultural innovation systems are the main sources of knowledge used to

develop the framework for this study. The framework was further developed by including important concepts to make it more useful and relevant to analyze the innovation system in the Addis Ababa *milk-shed*.

According to Hall (2006), the framework he used needed to be tested in real-world situations and be developed further. The theoretical framework (see Figure 12) therefore aims to analyze innovation systems in the changing context of developing countries. The important addition of this work to the Agricultural Innovation System framework is summarized in the concluding chapter. The key components of the theoretical framework for the Agricultural Innovation System as applied to this study include: historical evolution of the sub sector; sector mapping**;** resource base analysis; unfolding actors' interactions; scanning the policy environment; understanding habits and practices of the system actors; and identifying the resilience features and leverage points for change. Successful analysis of a system using these components has the potential to lead to better understanding of the innovation system.

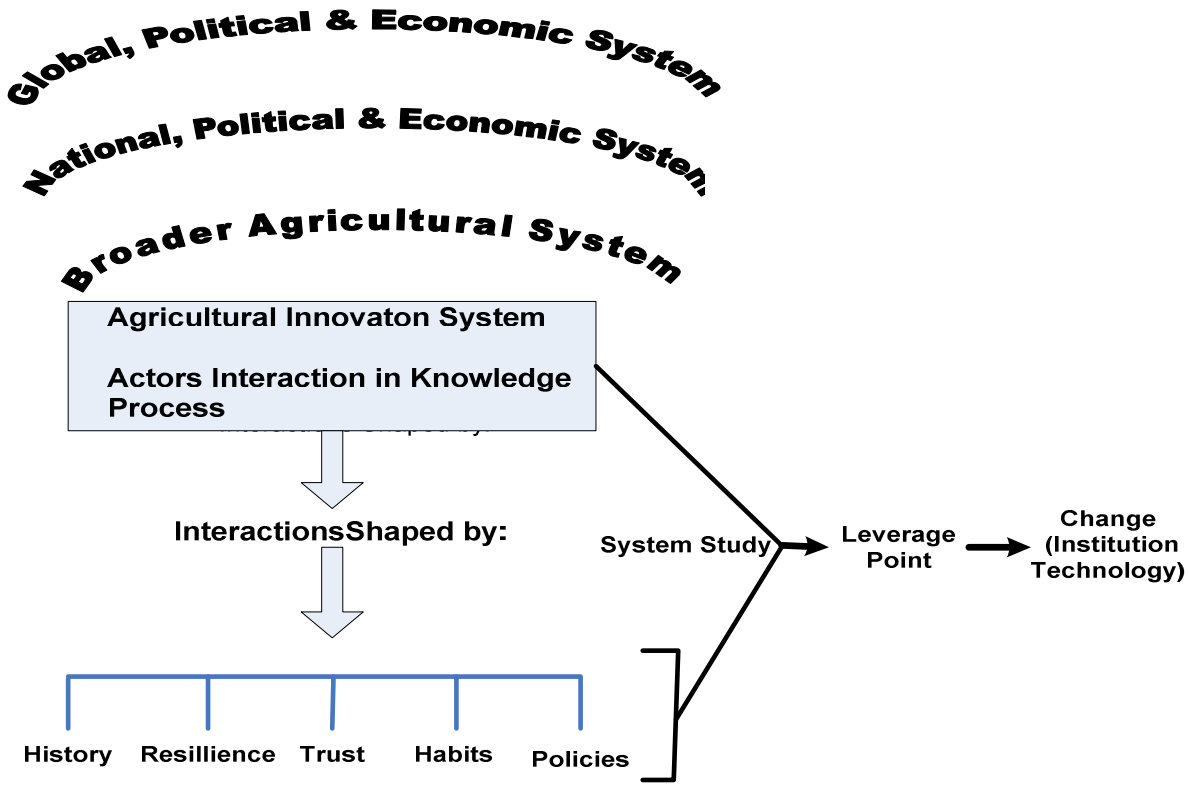


Figure 12: Theoretical framework

Source: Author's Construction

3.6. Summary

Systems thinking occupies an important space in the literature review and theoretical framework of this study. It underpins the basic thought that the properties of the whole are greater than the sum of the different parts. Understanding the nature and properties of the whole (system) is therefore the main area that needs the attention of system thinkers and researchers. In addition to the broad and generic ideas of systems theory, two key aspects of systems – the concepts of *innovation* and *resilience* – were considered in this study as important areas of focus.

The intertwined applications of the innovation and systems theory in agricultural R&D were explained by taking into account the NARS, AKIS and AIS frameworks, which are also known as the three most important institutional arrangements for R&D in our time. The three frameworks represent two important paradigms, the ToT and complex systems paradigm, which came into existence one after the other. The AIS framework, which is appropriate to study complex systems in agriculture, was taken as a principal framework for this study. The issue of resilience was discussed by focusing on community resilience. The main reason to consider the theory of resilience in this study was to show the links between innovation and resilience. The meeting points of these two important social processes are considered in this study as important as they allow for the identification of leverage points – points for intervention in the system. The concept of leverage points was addressed to indicate critical places of intervention that could bring about substantial changes in a system set-up.

Other aspects of social capital such as trust building and institutions have also received attention. Institution is understood to include the habits and practices of the actors in the innovation systems. All innovation systems are significantly shaped by the particular nature of institutions, which are typical to the system. Institutional innovation is therefore critical as it may stimulate technological and other forms of innovation. Trust is an integral part of institutions, and important changes that may lead towards building trust are essential for the success of the innovation processes. The logical combination of systems theory with the concepts of innovation, resilience, leverage points, and institutions therefore provided the basis for the formulation of the theoretical framework for this thesis. In Chapter four which follows, I outline

the research methodology, outlining both quantitative and qualitative methods used in the process of data collection.

CHAPTER FOUR: METHODOLOGY

4.1. Introduction

This study aims at understanding dairy actors' interaction and innovation in the Addis Ababa milk shed and to identify key leverage points that could trigger favorable changes in smallholder dairy innovation. Specifically, the study pays emphasis to historical phenomena that affect dairy innovation, the extent actors interact and how these interactions affects smallholder innovation, Implications of the existing resources to dairy innovation and the extent policies and institutions affect the dairy innovation system in general. The methodology used in this thesis is therefore systematically integrating the technical, social and historic perspectives of development. It is an interdisciplinary study which involves quantitative and qualitative methods to arrive at the results. Key-informant interviews, questionnaires, community consultations in workshops (see Figure 13), document reviews and a literature review were the principal methods used to establish the integrated methodology. The field work was conducted in 2009 and 2010 and the study was an integral part of long term development efforts of Agri-Service Ethiopia, a key NGO in the country. The work of the thesis was, however, designed with its own aim and objectives within the broader development work of the NGO.

Photographed by the author

Figure 13: Community Consultation at Wolmera district, Holleta

The process of data collection including the methods, organization of the fieldwork, and sampling procedures, are discussed in this chapter. Table 7 summarizes the research objectives, data collection methods, data collection tools and data analysis tools. This table provides an overview of the linkages between the methodology and research objectives.

4.2. Integration of objectives and methods

For the sake of clarity and ease of comprehension, it is important to show how the specific objectives of this study are linked with the data collection and analysis methods. Table 7 below depicts the linkages.

Table 7: Matrix of objectives, data collection methods and data analysis tools

Objectives	Data collection methods	Data collection tools	Data analysis
To understand the historical development of the dairy subsector and how policy impacts dairy development and innovation	- Community consultative workshop - Review of documents - Key informant interviews - Questionnaire	- Minutes of three community workshops - Study the reports of the MoA and other projects - Study of key policy and regulatory documents - Checklist - Survey questionnaire	- Qualitative analysis (text analysis) - Timeline series
To identify the dairy actors in the Addis Ababa milk-shed and their roles and responsibilities	- Key-informant interviews - Document review - Workshops	- Checklist for key-informant interviews - Review of minutes of value-chain workshops (2005–10) - Meetings of S NV-led value-chain networks (March 2009–July 2010)	- Qualitative analysis (text analysis)
To understand the resources the actors are working with and potential contributions to dairy innovation	- Questionnaire interviews	- Survey questionnaire	- Descriptive statistics
To explain how the important habits and practices of the dairy actors affect innovation processes within the existing systems	- Questionnaire	- Self-administered questionnaire	- Descriptive statistics
To explain the implications of actor interactions for innovation processes involving smallholder dairy farmers	- Key-informant interviews - Questionnaire interviews - Document review	- Checklist - Questionnaire survey - Minutes of value-chain workshops (2005–10)	- System drawings - Matrix linkage - Typology of linkages - Vertical system analysis - Sub-system typology analysis - Horizontal assessment
To propose key actions that will enhance dairy innovation with emphasis on smallholder			

4.3. Organization of the field study

4.3.1 Selection of the study districts

The Addis Ababa milk shed is too large to cover in this study. Sululta, Welmera, Addis Alem, Adaa' and Berek are the most important districts in the milk shed because:

- They are close to Addis and have better access to markets;
- They have relatively high levels of dairy-related and other development activities (magnitude of interaction); and
- Historically, these districts have benefited from state and non-state interventions to develop dairy in the last 60 years.

For cost and time reasons, this study covered three of the five districts, which are summarized in Table 8. The three districts were selected by conducting a preliminary field study and generating important information based on some criteria like contribution of dairy to the rural economy, presence of commercial dairy, presence of farmer organizations on dairy, extent of investments on dairy by the state and the private actors and extent of NGOs intervention on dairy .

Administratively, all the districts in the Addis Ababa milk shed (except Addis City) belong to the Oromia National Regional State (referred to here as Oromia Region), which is one of the nine federated regional states of the country. Addis Ababa itself is geographically located within Oromia Region but, as the national capital city, is a chartered city, with a mayor who reports directly to the Prime Minister of the Federal Democratic Republic of Ethiopia. Oromia Region is subdivided into 16 zones. All the districts around Addis, including those considered in this study, come under one administrative zone (Finfine-Zuria Lieu Zone).

Adaa' District was excluded as it is generally characterized as an urban dairy system, like Addis itself. However, any important linkages that extend from the selected districts to Adaa' and Addis dairy actors have been mentioned in this study.

From the four remaining districts, Sululta and Berek represent places with high and low dairy economy, respectively. The concentration of commercial farmers, farmer organizations and

dairy-related investment is high in Sululta and low in Berek. The third choice was between Welmera and Sebeta Districts. Both represent a typical mixed-farming system, in which crop and livestock (dairy) are equally important in the rural economy. Considering Holetta Research Centre (in Welmera) could help to see the extent of knowledge sharing between research, extension and farmers. This was therefore considered as an advantage for Welmera.

Table 8: Dairy-relevant features of five districts in the Addis Ababa milk shed

Parameters	Districts in the Addis Ababa milk shed				
	Sululta (Chancho)	**Addis Alem (Sebeta)**	**Welmera (Holetta)**	**Berek (Sendafa)**	**Adaa' (Debre Zeit)**
Contribution of dairy to the rural economy	Very high (about 80 percent of the people make greater part of their livelihood from dairy and fodder sales)	Medium (mixed-farming system)	Medium (mixed-farming system)	Medium (but livestock and crop production is underdeveloped when compared to others)	Low (teff and other cereals being primary commodities in the rural economy)
Commercial dairy	Very high	High	Medium	Low	High
Farmer organizations	The first dairy union, formed by 18 cooperatives	Three cooperatives under formation	Four dairy cooperatives and a dairy union formed recently	Three dairy cooperatives registered but not in full action	Well-established Adaa' urban and peri-urban dairy cooperative
Dairy-related private investment	- Several milk collection centers and cooling facilities that belong to various agencies - Elemtu milk-processing plant in the making	- Sebeta agro-industry (the biggest milk-processing plant in Ethiopia)	- Dairy farm that belongs to Lame dairy (the previously state-owned facilities)	- No	- Adaa' farmers' cooperative milk-processing plant - Genesis farm (with milk-processing plant) - Lema dairy (with milk-processing plant) - Bora milk-processing plant - Holland Dairy milk-processing plant
Presence of NGOs working on dairy-related activities	- Land O'Lakes (outreach), SNV, Hundee, VOCA (outreach)	- None	- Self-help Africa, Hundee, Land O'Lakes (outreach), VOCA (outreach	- Agri Service Ethiopia, Land O'Lakes (outreach)	- None

Source: Survey results and Key Informants Interviews

Therefore, the three districts chosen for this study were ***Sululta*** representing a dairy-dominated economy, ***Welmera*** for the mixed-farming system and ***Berek*** for underdeveloped dairy, despite the potential it has. Most of the districts of the Addis Ababa milk-shed (15–20) fall into one of these three categories and the selected districts belongs to the highland ecology, with dominant small holder agriculture and mountainous terrain (see Figure 14).

Photographed by the author

Figure 14 *:* **Scenery of the study area in Berek and Sululta: A typical landscape of the rural Addis Ababa milk shed**

4.3.2 Selection of sub-districts

Kebele (sub-district) is the local name given to the lowest level of the government structure for public administration. A group of *Kebeles* makes a *Woreda* (district) and a group of *Woredas* form a zonal administration in some areas. The next level is the regional state and, above that, the federal government system. For this study, the lowest unit of data collection were the *Kebeles* (sub districts) in the selected districts. *Kebeles* were chosen based on purposive sampling. District-level public extension workers and NGO staff were involved at different stages of the selection process (Appendix 4). The basic idea that justified purposive sampling was that a study on dairy innovation needs to focus on those places where there are more interactions among the dairy actors. However, in order to have a feel for the *Kebeles* furthest from the dairy hot spots, about 20% of the 26 *Kebeles* selected from the entire study area were also intentionally chosen from places where dairy-related activities are limited.

4.3.3 Selection of farmer interviewees

The original plan was to select ten *Kebeles* from each of the three districts and conduct an interview with eight people from each *Kebele* and five additional farmers from each district to compensate for inappropriately completed questionnaires. This would make the total number of interviewees for each district of 80 or more. The actual count of interviewees for Berek, Sululta and Welmera was 84, 79 and 81, respectively. The variation was due to some questionnaires being discarded, as they contained inadequate and imprecise information.

Identification of the interviewees was based on the gender of the respondents and the *breed of animals* they keep. Taking gender into account as a criterion for selecting interviewees was very important because about 20–30% of the rural population in the study area are in women-headed families that are also involved in dairy farming. So the sampling ratio for men and women farmers was basically 70% and 30% respectively.

The second criterion for the selection of the interviewee was the breed of animals kept by the smallholders. The dairy system in the rural part of the Addis milk-shed is simply defined as a system of smallholder farmers (with some big commercial farmers) who run a mix of crossbred/exotic dairy animals and local animals. Many of the crossbred/ exotic dairy cattle owners are located closer to the main road. Therefore, it was necessary to understand the views of the farmers who keep local animals and those who keep exotic ones. Exotic refers here both to the crossbred and pure exotic animals. September is the beginning of a new year in Ethiopia and August is the last one. It is much easier for farmers to speak using this time frame during data collection. The data generated on livestock resources including, cattle, feed and others therefore refers to 2008- 2009 September.

Out of the 70% men farmers in the study population, 60% and 40% were planned to be drawn from the local and exotic cattle owners, respectively. Similarly, half of the 30% women farmers were supposed to be chosen from each category (local/exotic cattle). The selection exercise did not, however, go as planned. Of the total number of 245 interviewees, the selection exercise finally resulted in 22% women interviewees with 53% and 47% of the total study population being exotic and local cattle owners, respectively. This happened because the number of exotic herd owners in all districts, particularly in Sululta District, was higher than originally predicted,

although the selection procedure was in accordance with the design. The variation was recognized while processing the data on herd composition. Data from some of the interviewees from the local herd category ultimately fell into the exotic herd category. This is because the sum of the exotic animals kept in the entire dairy herd (cows, heifers, calves, bulls, oxen) of those individuals shifted in to the exotic herd category, was found higher than the local animals they own. The number of women was lower than planned because in some *Kebeles* not enough women involved in dairy could be found.

4.4. Methods of data collection

4.4.1 Quantitative methods

Quantitative information was analyzed using the Statistical Packages for Social Sciences (SPSS). A questionnaire interview was administered to 245 (191 male and 54 female) farmers in the three districts (Appendix 2). Of these, 17 men and 19 women were illiterate, while the rest had educational backgrounds that ranged from primary school to college level. For both genders, the major educational category was Grade 1–4 (71 men and 24 women). The physical resources, such as the cattle population in general, the population of exotic dairy cattle, and the land and feed resources, are the key inputs in the dairy subsector; the questionnaire interviews focused on these to generate quantitative information. Services like veterinary care, artificial insemination, bull service provision and heifer supply were also considered as part of the resources.

In the questionnaire-based interviews, farmers were also asked to describe their demands for dairy-related knowledge/information (technical and market-related), its sources, the mechanisms of accessing this, and how they rate the knowledge in terms of influencing their performance (Appendix 2). The demand for knowledge was captured by tracing the frequently discussed knowledge issues between the farmers and other system actors. They were asked to indicate the extent to which they are linked with different actors and the issues they are most interested to deal with (Appendix 2). This was very helpful to understand the diverse knowledge and information networks at both the local level and beyond.

A self-administered questionnaire was used to generate another set of quantitative data to assess the important habits and practices that affect innovation processes in the dairy subsector. 116 people completed the questionnaire. These are in addition to the 245 randomly selected

interviewees mentioned above. The core principles of the innovation system perspective were the points of departure to study the supportive and restrictive habits and practices of the dairy actors. These include issues like willingness for interaction and collective learning, knowledge sharing, taking risks to try new ideas, linking knowledge/practices with market, creating/getting easy access to information, recognizing, appreciating and utilizing various sources of knowledge (Appendix 3). Critical questions, based on those concepts, helped in understanding the key institutional reforms that need to take place in order to improve the innovation system performance of dairy in the Addis Ababa milk-shed.

4.4.2 Qualitative methods

The qualitative information was analyzed mainly with the tools described in Hall's model. The most important tools used included systems drawing, linkage matrix, typology of linkages, habits and practice analysis and content analysis such as hierarchical system analysis and subsystem typology analysis.

Key-informant interviews, using a "snowball" (University of Surrey, 2001) sampling technique, were instrumental in generating qualitative information. To kick off the process, some actors were first identified from relevant documents as well as through exploratory study in the field. The innovation system actors who were first interviewed were asked to list the key players in the dairy subsector (system). After some time, a preliminary list of the actors was created and was continuously presented for enrichment by the chain of actors who were interviewed subsequently. The cumulative result was then used to make an exhaustive list of actors in the system. Accordingly, 25 agencies were visited and 59 people who work at different levels were interviewed. In addition, key-informant interviews were carried out with 30 extension agents and supervisors who work closely with the farmers at village level. This instrument was helpful to identify the dairy actors and how the growing interactions of dairy actors at higher system levels are influencing the local innovation processes. The interviewees were asked to show who they are strongly and loosely linked with and why, about the existing networks and platforms in relation to dairy, innovation practices they are most familiar with and policy and institutional issues (Appendix 1). The agencies visited for key-informant interviews included the MoA, research and universities, NGOs, farmer organizations, market actors (private sector) and other

government offices such as the Addis Ababa Municipality, bureau of trade and industry and the Ministry of science and technology.

Important ideas in relation to the historical evolution of the dairy subsector were obtained from the community consultative workshops. These meetings were conducted in each of the three districts, after the major part of the field study. Smallholder farmers, extension agents, NGOs and farmer organizations were present. Preliminary analysis of responses to the questionnaire interviews was presented for discussion. The local people were able to provide considerable insight into the history of the subsector. It was nevertheless important to generate additional date through key informant interview to figure out a complete picture of the subsector, which was built over many decades. This information was further substantiated through consulting other documents; including government reports, project mission reports, evaluation and consultancy reports, dairy-related project proposals, research reports, extension programs, work plans of field extension agents, statistical reports and minutes of networks.

Towards the end of the data collection and in the middle of undertaking some important analyses, it became necessary to deepen understanding of some of the issues, particularly those regarding market and knowledge processes. More actors (in some cases, for the second time) were consulted. Sixty enterprises, which included commercial farmers, milk processors, milk shops and supermarkets, were interviewed to elaborate some controversial issues in relation to marketing, in which case smallholder farmers complain for facing milk market challenges while the milk processing plants operate under capacity.

4.4.3 Training of enumerators and pre-testing

Before the data collection started, enumerators were given three days' training. The enumerators were all qualified with diploma or degree in agriculture/agricultural extension, and all worked for a local NGO in Berek. The content of the training was focused on the concept of innovation system and how it differs from the conventional extension approach with which they are familiar. Extensive discussions were held on important sections of the questionnaire, which was designed to collect data based on specific research objectives. After the training, the enumerators went into the field for pre-testing. This was very helpful in changing some questions that were a bit vague and to reach a common understanding on some of the

measurements that helped to assess the local resources, particularly the feeds.

4.4.4 Role of the researcher in data collection

The trained enumerators were mainly responsible for the questionnaire-based interview with 245 farmers, because the researcher did not understand the local language

The researcher mainly played the role of a supervisor throughout the process in order to make sure the enumerators understood the questionnaire and technical and facility-related support was provided to them at the right time. The researcher also conducted some of the interviews (see Figure 15) with people who could speak the national language (Amharic). After every interview session, there were meetings conducted with the enumerators based on the important observations of the researcher and challenges reported by the enumerators. These kinds of meetings were only necessary for the first couple of days and the enumerators developed the interview skills and abilities quickly. All the key-informant interviews, community workshops (with the assistance of translators), distributing and collection of self-administered questionnaires and the deepening of data from interviewees were handled by the researcher

Photographed by Manyazewal Ejigu

Figure 15. Key informant interview with a farmer at Berek

4.5. Sampling procedure

In most of the *Kebeles* of the three districts, the MoA has a complete list of the residents in the *Kebele*. This list is used to manage and monitor the food-security status of the community. The list includes not only names of household heads but also the agricultural resources they own, including number of livestock, mostly based on breed composition. Therefore, in most *Kebeles*, this list helped to make the random-sampling procedure simple and effective. From the master list, a separate list was prepared for the men's group to identify men keeping exotic and local breeds. Random sampling was then done. The same procedure was applied to the women's group but, in places where the number of women was too small to do random sampling, purposive sampling was used to select the interviewees, by taking into account the level of engagement of the women in dairying.

4.6. Data analysis

The data were analyzed using qualitative and quantitative methods. Qualitative methods were used to analyses the information obtained from the key-informant interviews to define the key features of the innovation system, the dairy market status, policy, linkages, capacity, challenges and some aspects of the data on habits and practices. Some of the data's/findings are annexed to provide more information on the critical issues considered in the discussion chapter. The data on self-administered questionnaire on habits and practices was collected and structured using a Likert measurement for further qualitative analysis. Quantitative methods, using SPSS, were used to analyses parts of the self-administered questionnaire on habits and practices and parts of the questionnaire-based interview: smallholders' resource holdings; market-related data; relationships of interviewees profile with some important parameters, such as resources; some aspects of linkages and knowledge and information flow. The data analysis was guided by the key questions of this study presented in Chapter one. As explained above, the main analytical framework in this study is adapted from the ASTI model and the work of Hall on innovation capacity assessment. The methods and tools used for analysis are presented briefly in Table 7.

4.7. Summary

This study takes an interdisciplinary approach, which uses both qualitative and quantitative methods. Together they cover the technical, historical and social dimensions of development, as integral aspects of a system. Semi-structured key-informant interviews and questionnaire interviews were used to generate the primary data to understand the dairy innovation systems in the Addis Ababa milk shed. Two hundred and forty five farmers, 52 state and non-state actors, 67 private-sector actors (a total of 364 people) were interviewed. In addition, 116 people from all categories of actors completed a self-administered questionnaire on habits and practices.

Different sets of questions, which aimed at achieving the various objectives of the study, were prepared and used (Appendices 1, 2 and 3). Broader community consultation was carried out to validate findings as well as to develop in-depth understanding of the historical development of the dairy subsector. Consultation of relevant documents was found to be very helpful to generate important information that supports the analysis of the entire system in general but also the historical development in particular. Policy and organizational information was mainly drawn from relevant public and non-public documents.

This study has also contributed to the methodological and analytical framework developed by Hall. Particularly the tools used to analyses the nature of institutions in the system, including the hierarchical system analysis and subsystem typology analysis, are worth mentioning. Some of the data such as that on policy issues was analyzed using conventional text analysis, guided by key questions. The results of this study, which are presented next, are therefore the direct outputs of the methods and tools described in this chapter.

CHAPTER FIVE: RESULTS

5.1. Introduction

This chapter aims at understanding the *key dairy actors, resources, interactions, institutions and policies* that affect the dairy innovation system in the Addis Ababa *milk-shed.* Based on this aim the result chapter is organized into three categories. The first part deals with the diversity of dairy actors in the system. Descriptions of the key dairy actors in the Addis Ababa *milk-shed* in relation to their competences and roles are presented. Findings on dairy resources in the *milk-shed*, including cattle feed, land and services is also part of this section. The actor diversity and the resource base together provide information on the scale and complexity of the dairy innovation system. The second section deals with actors' interactions and linkages. The linkages are presented in three different ways. The first is a linkage drawing that portrays the setup of dairy actors at the highest strata of the system. The second is the linkage matrix that shows the key issues that link two dairy actors.

This matrix provides information concerning the linkage agendas of the most important actors in the dairy system, using pair-wise analysis. The third presentation on linkages provides more information on system dynamics. It shows the important typologies of linkages based on the nature and goal of the relationships of the actors involved. This qualitative presentation demonstrates a number of innovative practices as shown by the linkages.

The third part of the chapter deals with findings on policy and institutions that affect dairy innovation in the milk shed. The policy information was generated by analyzing key government policies. The views of various actors on restrictive policies, challenging policies and policies that may require more enforcement are presented. The results on institutional issues include important habits and practices that affect dairy actor's linkages, interactions and therefore innovation. The information generated from the self-administered questionnaire that aimed at understanding the responses of interviewees to statements framed based on an innovation system concepts, were used for capturing the key habits and practices. The responses were reorganized into the issues of actor diversity and the changing context, source of knowledge and innovation and market challenges.

5.2. Actors and their resource bases

Key actors, their missions, roles and competencies

The key dairy actors fall in to five clusters based on their missions, roles and competences in the innovation system. These include:

1. **Farmers**: including smallholder farmers, small-scale commercial farmers, medium-scale commercial farmers and large-scale commercial farmers.
2. **Farmer organizations**: including cooperatives and unions.
3. **Market actors**: such as milk processors, supermarkets, feed manufacturers and milk shops.
4. **State actors**: including extension agencies, research organizations, State agencies to support private sector development and universities.
5. **NGO actors**: which include both national and international agencies.

5.2.1. Typology of farmers

Farmers were placed in one of four categories as shown in the Table 9 based on their farming modes (mixed farming vs. specialization) and the number of cattle they kept. The data on Table 9 is mainly a result of the survey work from the rural area but some information for the medium scale farmers and the big commercial farmers was obtained from government sources because these people are not residents of the *Kebeles* in which the survey was carried out.

Farmers of all categories are important actors in the production and processing of milk and milk products, mostly at household level. Professional processors, who work at an industrial scale, are recognized separately.

Table 9: Typologies and key features of farmers

Aspect	Smallholder farmers	Small-scale commercial farmers	Medium-scale commercial farmers	Large-scale commercial farmers
Livestock numbers	- Mixed farming with a few local cattle (most commonly 2-3)	- Keep 1-5 improved dairy cows (crossbred and pure exotic)	- Keep 6-30 improved dairy cows	- Keep 31 or more improved dairy cows
Access to land and road infrastructure	- Work on own land - Isolated from major road networks	- Works on own land - Better access to the main road than smallholder	- Work mainly on own land, some leased land - Good access to main road	- Mainly rented on lease arrangement from state - Good access to main road
Goals of the dairy farms	- Mainly to improve household food security (domestic consumption), with some possibility of selling milk and butter	- Commercial production mainly milk	- Commercial production mainly milk	- Commercial production mainly milk, cheese and butter
Access to markets	- Little access to milk market, dairy farmers discouraged by this phenomenon - Less use of improved dairy technologies - No conscious investment in business	- Relatively good access to market - Better access to technology - Some investment in business	- Good access to market - Uses improve technology - Bigger investment in business	- Good access to improved dairy technology - Significant investment in business - Good access to market
Taxation	- Taxation on land	- Taxation on land	- Taxation on the business, in addition to payment of lease for the land	- Taxation on the business, in addition to payment of lease for the land

Source: Survey Data 2009

Table 9 presents results of randomly selected farmers but the sub-districts (*Kebeles*) were selected purposively because the innovation study focuses on places with high interaction of dairy actors, including market actors. It is therefore possible to conclude that 43.5 percent of the farmers in those rural areas known for higher interactions of dairy actors own exotic and crossbred cows (Table 10). From the total dairy farmers that falls in the four categories mentioned in Table 9, about 85 percent owns only 1–5 crossbred or exotic cows (small scale commercial farmers).

Table 10: Number of exotic cows owned by small and medium scale commercial farmers, by gender in the three districts in September 2008- 2009

Number of cows (cross and exotic)	Gender	Berek	Sululta	Welmera	Total	Percentage from interviewed Households
1 – 5	Male	20	33	23	76	
	Female	4	6	5	15	
	Total	24	39	28	91	36.99
6 – 10	Male	1	9	2	12	
	Female	0	1	0	1	
	Total	1	10	2	13	5.28
11 – 30	Male	0	1	1	2	
	Female	0	1	0	1	
	Total	0	2	1	3	1.22
Grand Total		25	51	31	107	43.5

Source: Sample Survey 2009

Note: No large-scale commercial farmers were amongst the local people. Large scale farmers often come from other places as investors, and yet not included in this survey result.

An account of the large-scale (and occasionally medium-scale) commercial farmers, also referred to here as "investors", was taken directly from the local authorities of each district (Table 11). It was not possible to get a complete set of data on the number of cattle they keep, however, proxy indicators such as the capital investments on the dairy business, number of people employed on the farms and land size accessed are used to estimate the scale of the farms (medium or large).

Table 11: Large - and medium - scale investors in the dairy in the study area

Name of district	No. of dairy farms	Land size accessed on lease (ha)	Capital in Birr '000	No. of people employed
Sululta	7	30.55	24.14	116
Berek	7 (only those registered)	121	29.00	NA
Welmera	5	34	3.1	18
Total	19	185.55	56.24	134

Source: Investment Offices of Berek, Sululta and Welmera districts, 2009.

Note: Information on dairy investment from Sululta town, (another preferred site for investors on dairy) is not under Sululta district administration, thus not included. The investment office in Sululta town could not provide data.

Some "investors" have accessed land from the local administration and agreed to start dairy business in the study area, but did not do so or took too long to finalize the construction work

and set up the business. For example, according to the information obtained from Sululta District Investment Office, in addition to the information provided on commercial dairy farmers in Table 11, twenty dairy farms with a total capital of USD 2,901,875 have accessed a total 40.6 ha of land. However, all, landowners did not start business for about one to three years.

5.2.2. Farmer organizations

There are 18 cooperatives in the study area (Table 12). The cooperatives have different capacities in terms of financial resources and membership. Many of them seem to be in the beginner phase as indicated by their resources and the year of establishment. Structurally, unions are the next layer of the cooperatives. Cooperatives form unions to perform some functions that they cannot do effectively. The Selale Dairy Union is the biggest as well as the first union in the country and it was emerged mainly as a result of the milk market challenges the members were facing for many years. The union has passed through several market challenges until it finally gets enough access to sell fresh milk to diverse buyers. At the moment the Union is in the process of establishing its own milk processing industry, with a motive of securing a reliable end market to the smallholder producers.

Table 12 : Cooperatives in the three districts, membership (segregated by gender), collection centers and capital

	Unions	Coops
Total number	2	18
Number of Staff/members		
• Male	7	829
• Female	2	133
Total	9	952
Total number of collection centers	20	
Total Capital (USD)		21,167

Source: Oromia Region Animal Resource Development, Health Protection and Marketing Agency

5.2.3. State actors

Several state actors, including those involved in tax collection, public administration and investment offices etc., are important in the dairy subsector. This study, however, has emphasized the actors described in Table 13, as they are the most relevant in learning and innovation processes.

Table 13 : Some features of state actors in the innovation system

Aspects	Public extension organization	Research organizations	Universities and ATVETS[1]	Ethiopian Meat and Milk Technology Institute
Role and function	Coordinate the regional bureau of agriculture, and supervises the three district extension offices in the study area.	Technology generation and sharing, through organizing different forums, most importantly the national farmer-research-extension council meetings and through extension workers	Teaching and training of agricultural professionals	To develop capacity of milk and meat producers and processors as well as to support investors who are ready to take part in milk and meat related business
Relevancy to the study area	District level public extension offices coordinate the work at grassroots. Manages 85 Farmer Training Centers (FTCs) which deliver agricultural training to farmers in the study area. 24 percent, 31 percent and 19 percent of the respondents in Sululta, Wolmera and Berek respectively attended training on different modules	Farmers linkage with research is only reported from Wolmera (78 percent), where Holleta research Centre is located (The linkage issues are dairy, feeds and livestock health, 29 percent, 21 percent and 11 percent respectively)	Farmers had no contacts with the universities. All the extension agents are graduates of the ATVET	Located in Ada, but has a federal mandate. Sometimes trainings are organized to commercial farmers, although there is no report available in this regard, Has little or no formal contacts with smallholder farmers.
Emphasis on livestock development	Animal Resources Development, Health Protection and Marketing Agency is present and this is only unique to this region, although there are some indications of adapting same model by other regions.	Holleta, Debreberhan and Ada Research centers work on livestock research and located not too far (50-100 KM) from the study area	One ATVTE is present at Holleta and a faculty of veterinary sciences of the Addis Ababa university is present in Ada, which is less than 100km from the study areas	Its mandate area is on Dairy and Meat technology promotion. Industrial level operations on animal feed and Apicultural business have also come under its mandate recently.
Human resource	Three experts with diploma qualifications are assigned to the FTC (sub district) to deliver training and extension services	Senior researches with PhD qualification are only present on fodder. No senior researcher in dairy sciences is available	Professors, senior instructors, and researchers are available at university level but have very little or no contact with farmers	Very little human power when compared with the objectives it has. the organization has restructured itself recently and it is now working to have more staffs
Major development approach	Transfer of technology to model farmers using the farmer training centers as a mechanism	Research is usually on technical issues and, mainly done on station. FRG and farmer-research and extension council meetings are used for technology sharing and learning,	Conventional teaching approach, sometimes supported by apprenticeship	Training of commercial farmers (small to large scale farmers) on cost recovery basis

Source: Compiled from survey results and key informant interviews

[1] Agricultural Technical and Vocational Education and Training System

Except for the public extension organizations, which are found at regional and district level, all agencies have a federal mandate. Although they all have some common interests on dairy development, there is no any platform that brings all together to undertake collective learning and action. The animal science experts working for those agencies participate in a national professional association, which is an important avenue to exchange views but it is often more academic and has very little impact on work with farmers.

5.2.4. Non-Governmental Organizations (NGOs)

This refers to NGOs that are engaged on dairy-related work in the study area. The involvement of NGOs in such kind of business is relatively new. In the past, many of the NGOs were involved in relief assistance and a few in development work, mainly in southern Ethiopia. Currently, five NGOs are interested in the dairy subsector in the Addis Ababa *milk-shed*. The profile of these NGOs is briefly described in Table 14.

Table 14*:* Non-Governmental Organizations and Projects Involved in Dairy in the Study Area and Key Features

Key features	SNV/Business Organizations Access to Market (BOAM)	Land O Lakes	Self Help Africa	ACDI VOCA	Agri Service Ethiopia
Country of Origin	The Netherlands	USA	USA	USA	Ethiopia
Coverage	National, including the study area	National, including the study area	National, including the study area	National, including the study area	Some parts of the study area
Year of project Launch	2005	2005	2008	2004	2003
Areas of Support	Specialized in capacity development mainly through value chain approach	Technical support to improve productivity, management and marketing	Organizational capacity building, including dairy equipment support and training	Organizational development, private sector development, and improvement of feeds in the value chain	Breed improvement, through establishment of Bulling stations
Primary Targets	Business organizations including coops/unions	Commercial dairy farmers (all farmers with more than one X-breed cows)	Farmer organizations, including coops and unions	Farmer organizations, including coops and unions	Smallholder farmers

Source: Compiled from survey results and key informant interviews

Most of the projects do not target the smallholder farmers directly. The focus is mainly on market development and organizational support to farmer organizations. The SNV supported project focuses on value chain development in the area. This platform was also the base for the formation of the Ethiopian milk producers and processors association. A similar association known as Ethiopian breeders association as well Ethiopian Feed Manufacturing association were also created with the support of the Land O' Lakes project.

5.2.5. Market actors

Market actors in the dairy subsector are diverse. Only the key ones are presented in Table 15. Milk collectors, transport providers, equipment suppliers, private artificial insemination (AI) providers, private veterinary service providers and veterinary drug shops are all part of the complex system of the dairy subsector although they are not considered in the following table. The criteria used to choose the key futures and analyze the role of the actors in Table 15, include the effect of the actors on the dairy economy (scale), the impacts of the actors on market problems and key issues that could affect the formal milk market system in Addis (issue of quality and dominancy of the informal market).

Table 15: Important market actors in the Addis Ababa Milk shed

Key features	Milk processors	Super markets	Milk shops	Feed manufacturers
Scale	Currently, there are about 11 major milk processors of different capacities. Several new and small ones are also joining	The number of supermarkets in Addis is increasing. Most sell imported milk products in addition to the local products.	They are important Market outlet for pasteurized milk and provided easy access to the majority of the consumers (middle to low income).	- Previously there was only one state owned feed manufacturing industry in the country (recently privatized). - Currently there are six major private feed industries in and around Addis
Response to market problems	- Almost all milk processors operate below capacity mainly because of the limited end markets. - Oversupply of milk from farmers during fasting periods	Six supermarkets, among the biggest in Addis, were interviewed about milk market. Except for one, all indicated there is no shortage of milk supply.	Twelve of the seventeen shops interviewed had no shortage of milk supply and the current supply seems to be optimal to them.	- Feed cost is increasing and some dairy farms are almost closed because of this. - In addition to the feed processing plants, the presence of food and brewery by-products significantly contributes to the animal feed market
Quality issues	Processors complain for lower milk quality coming from rural area- based smallholder farmers	Sell pasteurized and bottled milk, with less risk of contamination	Sell pasteurized and bottled milk, with less risk of contamination	Consumers complain of feed quality issue because there is no regulation in placed on quality control. No one is sure if the information on feed composition, written on the packages is correct
Informal market	Processing plants are affected by the presence of extensive informal milk market in Addis. Most of the middle - low income consumers enjoy the informal mark	The informal market negatively affects sales of supermarkets. Price of a litter of milk is relatively higher here when compared with the informal market	The informal market negatively affects sales of the small shops, Price of a litter of milk is relatively higher here when compared with the informal market	Formulated feed suppliers (distributes) are emerging in the rural markets informally; however smallholder farmers are less interested because of the higher prices.

Source: Compiled from survey results and key informant interviews

Results of 17 randomly selected shops shows they carry mostly two brands i.e., MAMA milk followed by SHOLA. These are the two most popular brands although new brands are also quickly coming to the market. The average quantity of milk the shops sells per day is 19 liters. -Lame Dairy, Sebeta Agro Industry and MB PLC (family) are the three big milk-processing plants in the country, which are also important end markets for the rural area based dairy farmers. The estimated annual production of these companies in 2008 was about 14 million liters of pasteurized milk, 120,000 kg of butter, 20,000 kg of cheese and 90,000 kg of soft cheese (Genet, 2009). "Working under capacity" is a common feature observed in all processing plants portrayed in Table 16

Table 16: Some features of milk processing plants in Addis Ababa milk shed

Name of the processing plant	Year of establishment	Production capacity in liters/day	Actual average performance per day in liters	Reason for under performance	Remark
Lame dairy	(1974) 2008	60,000	20,000	Limited market, limited supply of milk	1974 is first establishment under the state
Sebeta Agro Industry	1998	40,000	29,000	Limited market, limited supply of milk	
MB PLC (Family)	2003	10,000	5000	Limited Market	
Adaa' dairy cooperative	____	15,000	7000	Poor linkage between producers and market	
Genesis	2001	-------	------	---------	Information not available
Lema Dairy	2004	10,000	3000	---------	
Bora Dairy	2008	2500	1000	---------	
Holland dairy	2007	12,000	3000	Limited market	Focused on yogurt making
Berta Dairy	___	350	150		No distribution of milk, focus on cheese making
Tsegana Betesebu	2009	3000	2000	Limited market	
Life agro industry	2008	3500	1500	Limited supply	

Source: Compiled by the author

For example, the daily total installed processing capacity of the 11 milk-processing plants in the *milk-shed* is 145,000 liters while the actual average production performance per day is under half of that at 67,150 liters (Table 16), which 43 percent is a share of Sebeta Agro

industry (Mama). The limited performance of the processing plants, the saturated market of milk market as suggested by the supermarkets and milk shops, the shortage of market experienced by small holder farmers in the rural part of the Addis Milk shed- *more pronounced during the fasting seasons* (see Table 9), the long fasting seasons of the Orthodox church believers- which is the majority of the population in Addis and the dominancy of the informal milk market were pointed out by various dairy actors as key factors that slows down dairy innovation and market in the milk shed.

The increasing price of milk was also found as important impediment to the low end market. For example, according to the public civil service salary scale in July 2010, an average family in the, the middle-income family category has an annual income of 1100 USD (BCS, 2010). If this family (average family size in Ethiopia is 5) used a liter of a milk per day, the annual expenditure for milk would be 288 USD, or about 26 percent of its total annual income. A liter of milk a day for a family of 5 would mean the per capita milk consumption would be 73 litters, which is very close to the world average (78 litters). But, it is highly unlikely that the middle-income group of civil servants could afford to buy a liter of milk a day for the family. Families at lower salary scale levels (1–6) would have to spend 75 percent to 50 percent of their annual income for milk, if they were to use the same quantity of milk per day (see Figure 16). The survey made on milk consumption in the rural areas (excluding Addis) shows that (see Table 17) the average milk per capita consumption is 37.8 liters, Wolmera being the highest with 48 liters per capita consumption. The CSA report (CSA, 2008b) estimates the national milk per capita consumption at 37 liters. Dividing the total annual milk production by the total human population for the year made estimation of the per capita consumption. It was very difficult to account milk wasted for different reasons and consumed by calves and other animals after farmers finish the milking exercise. This figure therefore provides not precise information on per capita consumption.

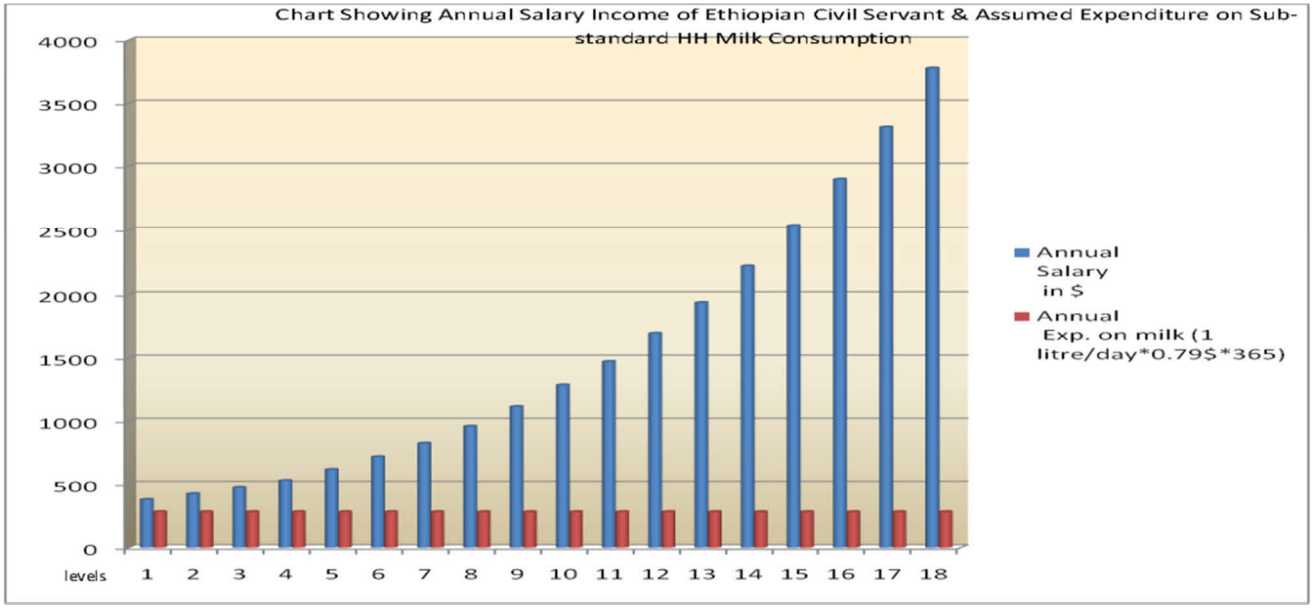


Figure 16: Salary Scale of Government Employees vs. Milk Buying Capacity in 2010

Source: Ethiopian civil service agency 2010

Table 17: **Average Milk Market Share of a Household in Liters in the Study Area vs. Household* Consumption of Milk for the Period Sept 2008–09**

Production and Market Share	Berek		Sululta		Welmera		Total	
	Mean	n	Mean	n	Mean	n	Mean	n
Total Milk production per HH per annum in Liters	986	85	4491	81	1854	79		
Cooperatives	0	85	1511	81	0	79	499	245
Processing plants (collectors)	334	85	2120	81	1300	79	1236	245
Snack bars	0	85	474	81	177	79	214	245
Traders	501	85	207	79	137	78	288	242
HH level used milk	151	84	179	80	240	78	189	242
HH level milk used in %	15.3		4.1		14.8		8.3	
Milk consumption per capita	30.2		35.8		48.0		37.8	

Source: Survey data 2009

5.2.6. Dairy resource base in the rural Addis Ababa *milk-shed*

Dairy herd sizes

Dairy herd refers to cows, heifers, calves and bulls in a farm. In the study area, both local and exotic dairy herds are available although it is not easy to tell the exact genetic composition of the crossbred and local animals, mainly because of poor records on pedigree history. Information gathered from farmers show that the mean dairy herd size of a household in the sample population in the study area is 11.3 (Table 18). This refers both to the local and exotic animals in the dairy herd. A comparison between means of the three study districts reveals that the dairy herd size per household was statistically different between Berek and Sululta, and Sululta and Welmera districts for cows, heifers and calves.

On the other hand, the average herd size between Berek and Welmera Districts was not statistically different (Appendix 6). Similarly, the comparison between means for bulls indicates that there was no statistical difference between districts (Appendix 6).

Table 18 : Livestock population and land resources in the study area

	Average no. of cattle per household	Average no. of cows per household (exotic + local)	Average exotic cows per household (improved + pure exotic)	Average no of local cows per household	Average landholding in ha		
					Private	Leased	Total
Welmera	10.3	2.6	1.32	2.3	2.3	1.2	3.5
Berek	9.2	2.2	0.94	2	2.3	0.9	3.3
Sululta	14.4	3.6	2.81	3.2	2.9	1.9	4.8
Mean n=245	11.3	2.8	1.69	2.5	2.6	1.3	3.9

Source: Compiled from survey data 2009

Data on dairy herds, differentiated into local and exotic breeds, was not available because many of the respondents keep mixed herds. Mixed herds are common. The size of exotic dairy cows per household is statistically different for Sululta (2.81), when compared to Berek (0.94), and Welmera (2.3), while the comparison between Welmera and Berek Districts did not show any difference statistically. The emphasis of the state and NGOs intervention on dairy for many years in Sululta and the suitability of the water-logged ecology for fodder production contribute for the difference.

Land Resource

Land resource here refers to the land size the respondents are using for crop production, livestock rearing, settlement and other uses. The Constitution of the Government of the Federal Democratic Republic of Ethiopia recognizes land as a property of the state and not as a marketable commodity. There are, however, several ways of gaining access to land, depending on the purpose of the land as classified by the state. For example, smallholder farmers in the study area have a user right entitlement, while investors in dairy and other land users are governed by a lease policy, and the price and lease period varies from place to place, depending on the market value, location and type of business. In addition to the land user right entitlement, the respondents also access land by entering into short-term contracts (hiring) with individuals, mostly informal, or buying land with some structures on it (e.g. house, cattle barn). The results show that the dairy farmers in the rural Addis Ababa *milk-*

shed use on average about 3.9 ha (Table 18), which is much bigger than the national average landholding for smallholders, which is becoming less than 0.5 ha/household over time. The water logging areas in many places of the study area, which is not usable for other agricultural activities than fodder, attributes partly to the higher average land holding in the area. Of the total land used by dairy farmers in the study area, 2.6 ha of land on average is privately held by respondents, with the balance (1.3 ha) accessed by renting, sharecropping or other arrangements for temporary use.

There is no visible difference between the private land holdings of the respondents in the three districts (Table 18). The variation is mainly attributed to the land accessed by the farmers through rental or any form of temporary arrangement. The average land size, which is used by a household in Sululta through rental or any form of special arrangement is almost twice greater (1.9 ha) than Berek (0.95 ha/household) and Wolmera (1.02ha/household). There is also a relationship between total land holding of the respondents and the available herd size. The higher the total exotic herd size the greater is the tendency of the farmers to have more access to land resources. The same relationship is also true to the total herd size (both local and exotic) and the total land holding. But the relationship makes more sense between the herd size and land accessed as a result of special arrangement. The higher the herd size the bigger will be the interest of the respondents to access more land through rental or any other special arrangement. On the other hand there is no relationship between herd size (in this case both exotic and total) and the privately owned land. In other words, the interest of farmers to look for additional land is motivated when they begin to have more dairy animals.

Feed resources

The available feed resources in 2009 were used as a benchmark to assess the diversity and adequacy of feed for the dairy animals in the study area. The feedstuff most commonly used by the smallholder dairy farmers in the rural Addis Ababa *milk-shed* is hay, with a mean annual consumption of 3,731 kg/hh, followed by grazing land (where animals stay for feeding), 3,182 kg/annum/hh and crop residue, 2,834 kg/annum/hh (Table 19). Farmers were asked to estimate the yield from the grazing land using local measurements, later converted into kilograms. On the other hand, urea-treated molasses, followed by fodder trees and concentrate are the least used feedstuff in the study area. Most of the industrial source feed

stuff including oilseed cake, wheat bran, concentrate, molasses, and brewery by-products, which are also sources of high energy and protein are used in very small quantities

Table 19: Most common Feed resources and annual utilization at household level in the study area

	Berek		Sululta		Wolmera		Total	
Feed diversity	**n**	**Mean**	**n**	**Mean**	**n**	**Mean**	**n**	**Mean**
Hay in kg	86	3472	81	5154	74	2476	241	3732
Green pasture in kg	86	643	81	958	79	680	246	759
Forage from grazing land in kg	86	1524	81	2244	78	5987	245	3183
Oil seed cake in kg	86	235	81	1206	79	404	246	607
Concentrate feeds in kg	86	17	81	118	79	629	246	247
Urea treated molasses in liters	86	27	81	24	79	11	246	21
Crop aftermath in Kg	86	245	80	429	79	1601	245	742
Brewery by products in liters	86	315	81	890	79	491	246	561
Wheat bran in kg	86	233	79	568	79	39	244	279
Fodder trees in kg	86	2	80	52	78	76	244	42
Crop residue in kg	86	1483	80	2926	79	4214	245	2835

Source: Survey result

The district-level t-test, based on the critical (tabulated) values for five percent significance level (1.745), shows some differences between districts (Appendix 5). Any test statistic value that is greater than the critical value (1.745) indicates that there were differences between districts. These values are presented in bold in Appendix 5. For example, the comparison of means for annual oilseed cake used, annual concentrate feeds used and annual estimated use of brewery by-products indicates that the means between districts are different. However, in most cases, the comparison between means of districts indicates that there was no statistically significant difference between districts.

Dairy services

The dairy services, which are considered as part of the important resources in the dairy innovation system, include AI services, bull services, heifer supply and veterinary services. The following is a brief summary of the assessment exercise.

1. Five sources of veterinary services were identified in the study area: state-owned veterinary clinics, NGO-supported clinics, traditional healers, illegal drug dealers and private veterinary service providers. More than 75 percent of the respondents obtain services from state clinics, followed by private service providers, which account for 17 percent.

2. There are four major sources of heifers in the study area: the local market, state supply through extension services, own sources and NGO support. However, of the total respondents (242), 93 percent reported they had no experience with buying or selling improved heifers from the local market.
3. Ways of accessing improved bulls are: NGO support, private service providers and own source. There is no state-sponsored bull service in the study area. The number of respondents who have no access to bull services in any way is 37 percent (total 242 count respondents) and the biggest number comes from Welmera, followed by Berek.

5.3. Interactions of dairy actors

5.3.1. Actors' linkages

The innovation system framework, as suggested by Hall (2006b), includes five major clusters of actors. These include: the demand domain (groups of actors that demand the products and for policy knowledge), the enterprise domain (the producers who utilize knowledge for action), the intermediary domain (those agencies that transfer knowledge and technologies), the research domain (actors who engage in knowledge production) and the support domain (actors who provide infrastructural support, administrative support and inputs and services). The key element of classification is the actors' role in the knowledge processes. The above classification does not contradict the thinking of the innovation system approach which emphasizes that every actor could be a source of diverse knowledge which is often developed in to working knowledge and innovation; through interactions of the actors in many ways. Based on the above framework of categorization, the mid-level actors' linkages in the Addis Ababa *milk-shed* are summarized in Figure 17 and the details of the linkages in the rural settings are presented in Table 20, for which some descriptions is given in the next section.

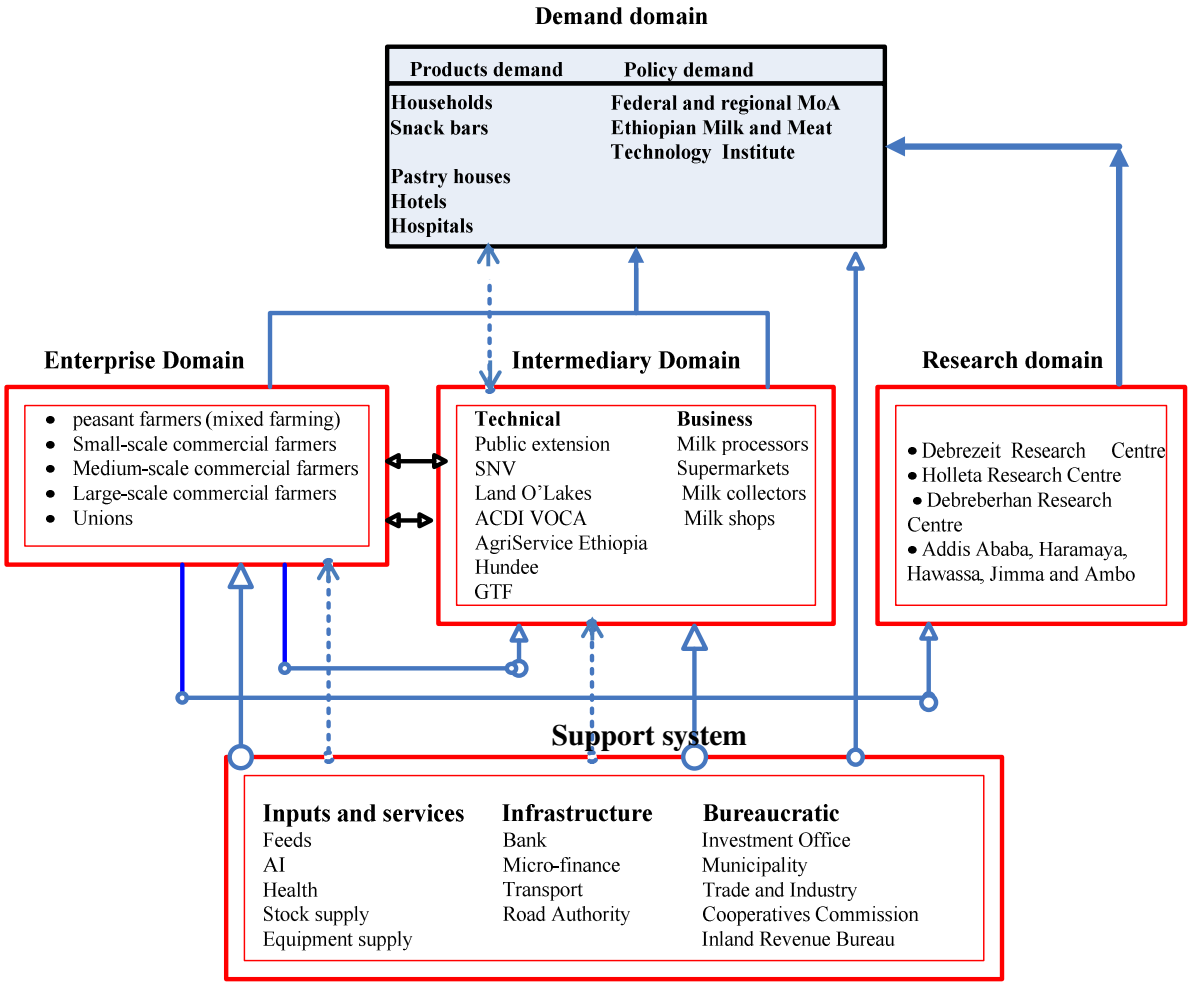


Figure 17: Linkage of dairy actors at mid-level

Source: *Author's Construction*

Note: Broken lines symbolize weak linkage. Solid lines represent strong linkages

Figure 17 presents the relationship of clusters of actors in the system in general. Two-way interaction exists between the enterprise and intermediary domains. These involve actors engaged in extension, production, processing and marketing. A one-way interaction is observed between the research and the demand domain, and the important actors in the demand domain include the policy actors. Some actors from the enterprise domain, particularly the medium and big commercial dairy farmers proactively access information from the research domain, often at times of business establishment or feasibility studies.

5.3.2. Linkage matrix of dairy actors in the Addis Ababa *milk-shed*

The rural innovation system (presented in Table 20) refers to the typical grassroots system, where more production activities and less marketing take place while Figure 17 represents the

mid-level hierarchy of the dairy innovation system. This refers to the group of organizations and firms, which are having linkages with the grassroots actors, and the national level players in dairy. The highest hierarchy refers to the national dairy innovation system, which includes the interaction of actors in the entire country. The national dairy innovation system is however beyond the scope of this study although some of the important actors and factors in the national dairy innovation system are also considered in this study. There is, however, no solid boundary between the different system hierarchies, although a theoretical classification is made to ease understanding.

The linkages portrayed in Table 20 explain the lower level rural innovation system, particularly the interaction of different actors to access and use information, share knowledge, technology and other materials in the study area. The relationship between the most important actors is given in more detail. It shows the extent to which each actor networks with the rest of the actors in the system. Each cell in Table 20 represents the relationship between two actors, which is the intersection point of the actors positioned on the vertical and horizontal locations. For example, smallholder farmers (see first raw in Table 20) sell hay, and rented land to the commercial farmers and, the commercial farmers listed in the second row supply heifers and provide bull services to smallholder farmers mentioned in the second column. In the linkage table, the exchange of knowledge, information and technology, which is at the innovation systems perspective, is expressed by key words like conferences, trainings, networks, exchange of information, partnership, advisory services, action research, joint advocacy agendas, experience exchange, institution building and others.

Table 20: Linkage matrix of some dairy actors

RECIPIENTS

SUPLIERS	Smallholder farmers	Commercial farmers	Unions	NAIC[2]	EMPPA[3]	Processing plants	Public extension	Research Centers	Feed manufacturing industries	EMDTI[4]	NGO
Smallholder farmers	Exchange of information, resource sharing	Hay sales, Land renting/ sales	Membership, milk sales	Demands AI services	2	Milk sale	Expression of training and input needs when asked	Sources of reachable problems he relationship of the most important actors	Buy feed staff	1	Expression of development needs
Commercial farmers	Heifer sales, bull service	Networks, fora and associations	Membership and milk sales (small-scale commercial)	Demands AI services Enter partnership for bull raising	Membership	Milk sale	3	3	Buy feed stuff	Training	Information
Unions	Input supply, training, price negotiation	Input supply, training, price negotiation	----------	Demands AI services	Member of the executive committee	Milk sale	1	1	Buy feed stuff	No direct linkage	Information
NAIC	Provide AI services	-Provide AI services -Enter partnership for bull raising -Train private AI technicians oA	Provide AI services	.....	2	1	Receive policy guidance and management support including budget	2	1	2	Provide training on request
EMPPA	1	Policy lobby, Information	Policy lobby, Information	3	_____	Policy lobby, Information	1	1	Joint advocacy and learning	2	Information
Processing plants	Milk buying, input delivery (feeds)	Milk buying	Milk buying	1	Membership	3	1	1	1	3	Expression of capacity needs, information
Public extension	Training, advisory services, input	3	3	Coordinate the NAIC services	3	1	Annual conference on farmer research and extension	3	1	2	Present capacity support

[2] National Artificial Insemination Centre
[3] Ethiopian Milk Producers and Processors Association
[4] Ethiopia Meat and Dairy Technology Institute

	Smallholder farmers	Commercial farmers	Unions	NAIC[2]	EMPPA[3]	Processing plants	Public extension	Research Centers	Feed manufacturing industries	EMDTI[4]	NGO
	provision						linkage				needs, information, Joint planning
Research Centers	Training, action research, supply of culled cows and forage seeds	Training and input support for small-scale commercial farmer	1	2	3	1	Information on new technologies, training, Farmers Research and extension forum	Annual research review	Feed Sales	3	3
Feed manufacturing industries	Feed supply, information provision	Feed supply and information	Feed supply and information	1	Joint advocacy	1	1	Feed sales	Joint advocacy agendas	1	Joint advocacy, feed sales
EMMTI	2	Training on dairy, information on investment	2	1	2	2	3	3	1	_____	2
NGOs	Training, institution development, input provision, market linkages	Market linkage, training, business plan development, experience sharing, research	Institution development, equipment supply, sponsoring training, experience exchange	Demand for training of AI technicians	Institution development, financial support, sponsoring training and learning fora	Market linkage, training, business plan development, experience sharing, research	Training, provision of revolving funds	Joint training, sponsoring farmer research interactions	Joint advocacy agenda and learning	2	3

Source: Survey results and key informants interview

Keys: The important agendas of linkages are presented in the cells. For" No linkages" the following codes are used.

1. No linkage at all
2. No direct linkage - linkage are their but indirectly
3. No meaningful linkage - there is some linkage but the social and economic benefits are not significant

5.3.3. Typology of linkages

This section elaborates and provides empirical evidence to explain some of the key linkages in the matrix (Table 20) to show the relationship from the point of view of interactions for learning and innovation. A complete picture of all partnerships described in the next section is not, in the matrix, mainly because of limitations of space. It is also difficult to include all typologies in the system, including the extensive interactions of actors in the marketing front, because they are many. The most relevant and exemplary types that could show the scale and diversity of interactions taking place in the dairy system, including those not recognized by the formal research and extension system, are selected and presented here.

From the analytical tools provided by Hall (2006b), the key typologies of linkages chosen to demonstrate some of the diverse forms of interactions of dairy actors in the Addis Ababa milk-shed are partnerships, paternalistic linkages, networks, and linkages to supply inputs and outputs. Based on these parameters some of the key linkages found in this study are presented in this section. The key-informant interviews and questionnaires were the sources of this information. The next section provides qualitative information on the typologies of linkages. The selected cases are also examples of innovation processes, which could be considered as changes taking place at institutional and technological levels. Each case elaborates the nature of the linkages but also shows the mechanism how learning is taking place among the partners.

Partnership: refers to joint problem solving, learning and innovation, which may involve a formal contract or memorandum of understanding. It might be less formal such as participatory research but also highly interactive. It may involve two organizations or more with a focused objective and defined project (Hall 2006b). Examples of some of the partnerships found in the dairy system are given in Table 21.

Table 21 : Dairy actors' linkages on partnership mode

Partnership agenda	Key partners	Partnership arrangements	Learning mode
Family dairy enterprises	Smallholder farmers and their relatives staying in Addis	Smallholder farmers are sources of land and labor while their partners provide initial capital for establishment	Weekend meetings. Farmers learn about running a modern business while other partners improve their knowledge on livestock management
Raising dairy bulls for semen production in partnership	National Artificial Insemination Centre (NAIC) and big commercial farmers	NAIC provides AI services to selected farms (currently two) and farms provide male calves from highly bred cows to NAIC for semen production	A new project, still in progress. The practice was learned from Kenya and partners are waiting to see results and learn from them
Effective Micro-organism Technology (EMT)	Ethiopian Feed Industry Association, Waleji Agricultural and Industrial Private Limited Company, Japanese biological engineers as well as interested commercial farmers	The company provides EMT to the feed industry association and the association is testing the technology in collaboration with commercial dairy farmers	Learning takes place by means of demonstration sites and more learning events are planned to be organized in the presence of users, experts, the company and members of the association
Supply of heifers to poor women as a corporate social responsibility	CCD (real-estate agency) and Gudina Tumsa Foundation, an NGO. 33 women farmers in Berek received the support from CCD	The real-estate agency took land from the state for construction and wanted to initiate dairy development among farmers residing in the area, through the NGO	This partnership meets the interest of the real-estate agency and the NGO, although the objectives are quite different. There is no common agenda of learning for both agencies.

Source: Survey results and key informants interview

Paternalistic linkage: is characterized by delivery of goods, services and knowledge to consumers with little regard for their preferences and agendas (Hall, 2006b). Two typical examples of a paternalistic linkage are demonstrated in Table 22 in the relationship of the state agencies and smallholder farmers in the study area.

Table 22: Dairy actors' linkages in paternalistic mode

Partnership agenda	Key partners	Partnership arrangement	Process and implications
Farmers' training	Farmers and extension agents working in the FTC. 18%, 24% and 33% of the interviewees in Berek, Sululta and Wolmera respectively did participate in modular and non-modular trainings	Modular base training delivered for six months and non-modular training as short courses	Farmers are less consulted on learning agendas, modules are prepared by regional experts, no successful modular training reported in the study area so far although that was top priority of the state extension agency, extension agents are frustrated and the state is trying to revise selection criteria
Supply of Boran heifers to farmers at cost	Oromia Region extension bureau, Hurtu Boran private ranch, smallholder farmers	The public extension bureau and the private ranch agreed on the supply of the Boran heifers to farmers in the study area at cost.	An example of state private sector and farmers' linkage for development. Farmers and extension agents were, however, consulted less with regard to the supply. Supply was made by Hurtu Boran and farmers were asked to raise money to buy the heifers. However, farmers and extension agents were not happy with the physical appearance and performance of the heifers.

Source: Survey results and key informants interview

Network: refers both to informal or formal relationships of actors with common interests with the main objective of facilitating information flow, providing expertise and early warning information on marketing, technology and policy change. Networks also build social capital, confidence and trust and create preparedness for change, lowering barriers to forming new linkages (Hall, 2006b). Examples of social networks at the smallholder farmers' level, formal network driven by NGOs and market innovation of small dairy enterprises in the rural area are considered to demonstrate how a network mode of partnership affects dairy innovation.

Dairy knowledge network at smallholder farmers' level

Table 23 depicts the linkages of smallholder dairy farmers with local-level actors to show how information and knowledge are shared. For all three study districts, the chances for peer learning are higher when the smallholders are linked with their neighbors who are engaged in similar business (Table 23). Sharing labor and other resources is most common for those who have linkages with their neighbors. Table 23 also indicates high values for no linkages particularly for research and input suppliers with farmers. The only important linkage of researchers with farmers is reported from Wolmera and this is because the Holleta research Centre is located in

Wolmera and the researchers sometimes work closely with the farmers. This indicates the extent dairy innovation depends on local knowledge of the farmers.

Table 23: Smallholder farmers and rural dairy actors' linkages

Name of actors and most common linkage agendas with farmers		Berek	Sululta	Welmera	Total count	Table %
Neighbors engaged in similar business .	No linkages	33	10	35	78	32
	Fodder (local and industrial sources)	11	9	15	35	14
	Breed improvement	10	22	23	55	22
	General dairy cattle management	3	12	6	21	9
	Milk/ butter price and other market issues	8	9	0	17	7
	Livestock health	6	0	0	6	2
	Sharing labor and other resources	15	18	0	33	13
Total		86	80	79	245	100
Relatives engaged in similar business	No linkages	30	8	58	96	39
	Fodder (local and industrial sources)	14	12	11	37	15
	Breed improvement	10	26	8	44	18
	General dairy cattle management	7	9	2	18	7
	Milk/ butter prices and other market issues	4	7	0	11	4
	Livestock health	8	0	0	8	3
	Sharing labor and other resources	13	19	0	32	13
Total		86	81	79	246	100
Input suppliers	No linkages	73	46	58	177	72
	Wheat bran and oilseed cake market	5	16	12	33	13
	General feed price information	6	19	5	30	12
	Heifer market	2	0	4	6	2
Total		86	81	79	246	0
Researchers	No linkages	86	81	18	185	75
	Improving milk production (dairy)	0	0	29	29	12
	Feeds and grazing land management	0	0	21	21	9
	Livestock health	0	0	11	11	4
Total		86	81	79	246	100
NGOs	No linkages	42	73	67	182	74
	Breed improvement	33	5	8	46	19
	Feeds	4	3	1	8	3
	Livestock health	7	0	3	10	4
Total		86	81	79	246	100

Source: Survey data 2009

Table 23 is a result of the questionnaire used in the study. The linkage agendas were not stated as leading questions in the questionnaire, but it was formulated from the frequently appearing

results of the respondents. Therefore, this refers to the most common agendas of linkage and some other important but not common linkages are not included here.

The issue of "feeds" (Table 24) is considered here to show the information and knowledge flow among smallholder farmers in the study area as well as the extent to which innovation takes place at local level as a result of diverse sources of information, and not necessarily from the formal research and extension. The questions that generated the information in Table 24 were open-ended. The type of information stated in the second column is therefore the direct opinions of the farmers interviewed. The information needs of farmers on industrial by-product feeds, improvement of local feedstuff and introduction of exotic forage species, appear in Table 24 with higher values. From the total number of interviewees (246), 39 percent of the farmers indicated extension and research as the main source of information, while 40 percent indicated other local sources than research and extension.

Table 24: Farmers' information needs, sources and mechanisms of accessing in relation to feeds

Information needs, source and means of accessing		Berek count	Sululta count	Welmera count	Total count	Table %
Most common information needs on feeds	No specific information need	19	1	13	33	13
	Improvement and utilization of local feed stuff (hay, grazing land)	32	15	12	59	24
	Industrial by-product feeds	11	35	16	62	25
	Concentrate feeds	3	9	1	13	05
	Improved fodder trees and exotic forage species	8	19	21	48	20
	Using quality feeds	13	2	16	31	13
	Total	86 (35%)	81 (33%)	79 (32%)	246 (100%)	1.00
Most common source of information on feeds	No specified source	21	2	13	36	15
	State extension	21	40	25	86	35
	NGOs	5	0	11	16	07
	Neighbors and other local people	12	15	3	30	12
	Private farmers (commercial) and business men	15	17	8	40	16
	Parents and relatives	4	1	2	7	03
	Own observation and experimentation	8	6	8	22	09
	Holetta Research Centre	0	0	9	9	04
	Total	86 (35%)	81 (33%)	79 (32%)	246 (100%)	1.00
Most common means of accessing information on feeds	No defined information-accessing mechanism	23	10	20	53	22
	Training	21	38	43	102	41
	Social interactions	10	6	1	17	07
	Own observation and experimentation	8	9	0	17	07
	Experience-sharing events	10	9	9	28	11
	Market interaction	14	9	6	29	12
	Total	86 (35%)	81 (33%)	79 (32%)	246	1.00

Source: Survey data 2009

Dairy farmers in Berek, followed by those in Welmera, depend mainly on locally available feeds. Previously mentioned findings on the milk system and the butter system indicate that Sululta is most inclined to the milk system, followed by Welmera. Similar results in relation to concentrate and industrial by-product feeds (which are in greater demand by commercial dairy farmers under normal condition) are reported in Table 19. This shows Sululta has great potential to be developed to an important dairy development corridor in the central region. Already good

growth indications are observed in Sululta when compared to the other study districts. However, Table 23 shows that there is no information and knowledge sharing between research centers and dairy farmers in Berek and Sululta. The private sector interaction happens to be a very important driver of dairy innovation in Sululta than research and universities do.

National Dairy Value Chain Network

The National Dairy Value Chain Network is an initiative of the Netherlands Development Organization (SNV), which is supported by the "Business Organizations and their Access to Market" (BOAM) project of the Netherlands Government. This project aims at building the capacity of business associations through implementing activities in the fields of networking, policy dialogue and value-chain development in four food sub-sectors including milk and milk products, edible oil and oilseeds, honey and bees' wax, and pineapples.

A launch workshop for the milk and milk products value chain was conducted in October 2005. The BOAM project provides expert support (long-term, short-term national/international) to the dairy actors and funding opportunities such as leverage funds (funds made available to support dairy project initiatives of the members), research and study funds and financial intermediation funds (funds spend to prepare a bankable proposal or to meet requirements demanded by financial institutions for loan). Creating a space for policy dialogue among private and public actors involved in the dairy-value chains was another key area of engagement. A Coordination Group (CG) was formed from the members and it has been involved in the management of the network over the past five years. The three major activities of the network include accessing the different types of funds (mentioned above) by the network members through developing projects, knowledge sharing on dairy-related matters and knowledge generation by contracting researchers.

In general , 23 dairy related topics (value chain studies, technological topics, strategic issues and research reports) were presented and discussed by the network members and invited researchers, by organizing 17 workshops over five years' time. Big commercial farmers and processing plants dominate this network. Only two dairy union representatives and four urban dairy cooperatives were taking part. The rural smallholder farmers were not part of the network and it was

presumed that they will be represented by the farmers unions, which had in fact little chances to access resources from the initiative. Another limitations of this network was that its inability to attract the participation of researchers from formal institutions. Knowledge generation in relation to dairy is taking place in the formal research system but pragmatic networks like this one had no relationship to access the knowledge. On the other hand, the network was spending resources to generate knowledge through research by hiring private researchers. Some of the knowledge is however available in the shelves of the formal research institutes.

Value-chain financing is another important support of the project to the network. The leverage funds, financial intermediation fund (FIF), and research and study fund are the financial cost centers of the project. During the study period about six projects (four on leverage funds and two on FIF) were approved by SNV and implemented by the grantee. None of these funds was however accessed by the smallholder farmers, except some for training to improve milk quality.

Self-initiated market network in the Nano Guto Daluta Kebele of Sululta district

This is a case that demonstrates how local-level dairy innovation processes are taking place with little or no support from outsiders such as extension agents, NGOs, researchers and others. The common practice is for farmers to produce fresh milk, and milk-processing plants from Addis to collect the milk every morning. Some village-level entrepreneurs have followed a different direction from this practice. They have transformed themselves into small-scale milk-processing service providers and this happened without the intervention of outside forces. Two farmer entrepreneurs staying in Nano Guto Daluta *Kebele*, who are neighbors, bought a cream separator and began to provide services to other traders who want to produce and deliver cream, butter and skimmed milk for the Addis market.

One processor, for example, has about 20 customers who are all youth and were unemployed before joining this business. The business network was established spontaneously following the introduction of the household-level processing equipment. The young traders buy the milk from farmers for Birr 4/liter if the farm is not too far from the roadside, and they pay Birr 3.50/liter if they have to travel some distance from the roadside. These traders have their own permanent customers from whom they buy the fresh milk. Donkeys are utilized to transport the milk for

long distances and they then take the milk to the processors in the village. The processor charges only 10 cents/liter to separate the cream and they can adjust the percentage of cream they want separated. Normally, they separate about 50 percent of the cream and make butter from this. According to the processors, they need 20 liters of milk to produce a kilogram of butter, which can be sold in Addis market for US$5 (in 2010). They also sell the milk remaining after separation for Birr 4/liter to small tearooms and restaurants in Addis, which can transform the milk to yogurt for sell (the cost of full cream milk in the informal markets of Addis was Birr 10/liter during the study period). This location is only 17 kilometres from Addis, and they can make several trips a day using the taxis operating in the area. Every young trader can make about five US$ a day. This study has also identified one self-organized marketing group in Berek and two in Holleta. This gives some indication to what extent people are innovating better ways of marketing to overcome the market challenges.

Linkages to supply inputs and outputs

This linkage is mainly informal but can also be formal. The arrangements are characterized by connecting organizations to raw materials, input and output markets. This includes access to credit and grants from national and international bodies for development or market expansion (Hall, 2006b). Table 25 provides some information in this regard based on the relationships of some NGOs and smallholder farmers. This kind of partnership is not so common between the state actors and smallholder farmers, although it is very crucial to enhance local innovation processes in dairy.

Table 25 : Linkages to supply inputs and outputs

Linkage agenda	Key partners	Linkage arrangement	Process and implications
Establishment of bull stations	Agri Service Ethiopia (NGO) and Abdi Boru (farmer organization with 3400 members but those who had access to the bulls were only 1800 farmers)	ASE provides highly bred bulls as a grant to Abdi Boru farmers organization to help them establish bull stations in places where the AI services of the public extension are not adequate	It is a self-organized farmer organization for community development. They established their own modality to administer the bull stations. More than 600 calves were born from the bulls and milk production increased. However, farmers faced market problems.
Improving dairy feed supply	ACDI VOCA and Farmer cooperative unions	ACDI VOCA provides feed processing machines to the unions and unions are supposed to supply the product to members for reasonable prices	Availability of non-roughage feeds improved although did not show substantial fall in price, as the cost of raw materials is still high.
Forage seed production	Land O'Lakes and smallholder farmers	Land O'Lakes provides training and forage seeds to selected farmers who are also referred to as "models" by the organization	Farmers produce forage seeds and make it available for sale among fellow farmers. Forage seed is one of the most scarce inputs and this intervention is expected to improve the situation, although it has to go much further to see reasonable impacts

Source: Survey results and key informants interview

5.4. Institutions that affect dairy innovation

This section presents the results dealing with institutions. Findings of the self-administered questionnaire on key habits and practices as well as reflections of the important dairy actors in value-chain networks and in community consultation workshops are captured and presented. Rules (social and legal) are also important aspects of institutions but they are embedded in the practices of the actors, since the routine practices of people are mainly attributed to rules and norms. Respondents were asked to give their opinions on selected statements that helped to understand some of the important habits and practices of the major dairy actors in relation to linkages, knowledge/information and markets. These were used to gain insight on implication of those institutions for innovation. The detail finding is presented in Appendix 7.

5.4.1. Responses of research and extension actors to changing contexts

Conventionally, studies on linkages in agriculture focus on the relationship of smallholder farmers and extension workers may be also with researchers. With the growth of a market economy in Ethiopia, this scenario has changed – particularly in the rural areas around Addis Ababa. This change demands change in policies, habits and practices of the major public actors to help them deal with the new sets of actors and contexts. One of the statements included in the self-administered questionnaire was formed around this notion.

More than 83 percent of the interviewees agree that the diversity of actors in the rural areas is more complex than before. The issue now is whether key government institutions, which are in a position to provide agricultural services to the people, are taking this change into account or not. To this end, interviewees were asked if research and extension organizations are responding to the changing diversity of actors in the rural areas in the sense that they are trying to work with the private-sector actors, which are the major new actors emerging in the rural economy.

Some 54 percent of the respondents agreed with the proposition that research and extension are making no effort to address the diverse actors in the new context. A large number of the respondents (20 percent) could not comment, as they did not have enough evidence to support the "yes" or "no" responses. However, some of those respondents who supported the idea that research and extension is making changes in accordance to the changing context gave remarks in relation to the efforts of the government extension programs to link farmers with processing industries elsewhere. This was only in the case of some crop commodities, and was totally absent in the dairy subsector, although there is a need for the research and extension services to bridge the gap between the milk processors and the smallholders.

5.4.2. Perception on knowledge sources and innovation

One issue of diverging views among several dairy actors is the way smallholder farmers are seen in terms of knowledge and competence. Some think that smallholder farmers operate at a micro level and may not be considered a source of knowledge that could generate much impact at system level. Others think that farmers are creative and knowledgeable and know what can and

cannot work in their context more than anyone else. It is on the premise of these arguments that the dairy actors were asked what they think about farmers as sources of knowledge.

The result in Table 26 shows that 20 percent of the respondents do not believe that farmers' knowledge could bring about meaningful impact in development. Most of the respondents (74.2 percent) believe otherwise. Further analysis of the persons who responded that farmers' knowledge could not have greater impacts in the local economy reveal that it comprised of 23 percent of the interviewed farmers (total 44) and 17 percent of the Office of Agriculture staff interviewed (total 42). However, the majority are still of the opinion that farmers' knowledge could influence development positively.

The follow-up statement in the questionnaire was put to understand about the role of research as a source of knowledge in agriculture (see Table 26). This was meant to reveal the role played by the EIAR. Most people (60 percent) agreed that research is the main source of knowledge; 25 percent disagreed and the rest of the respondents do not want to make comments. The linkage results in the previous sections revealed that some farmers from Holetta (Welmera district) have strong linkages with research. Because of this reason some farmers, extension agents and NGOs who were asked to fill the self-administered questionnaire from Holetta, considers research as a main source of knowledge."

Table 26: Farmers and researchers as sources of knowledge

Statement 5 Smallholder farmers cannot be a source of meaningful knowledge that impact development	No of respondents	Percentage	Statement 6 Research organizations are the main source of knowledge for agricultural development	Count	Percentage
1	32	27.6	1	12	10.3
2	54	46.6	2	17	14.7
3	7	6.0	3	16	13.8
4	15	12.9	4	48	41.4
5	8	6.9	5	23	19.8
Total	116	100.0	Total	116	100.0

(1= disagree, 2 = strongly disagree, 3= neutral, 4= agree, 5= strongly agree)

Source: *Survey data 2009*

Some 78 percent of the respondents also indicated that there is no any known learning platform for farmers and other actors on dairy related issues and only eight percent indicated the existence of some platforms. Those extension agents and private sector actors who had chances to participate in the SNV led dairy value chain networks as well as in the Land O'Lakes organized commercial farmers meeting indicate the relative presence of such forums in the study area. In the key informant interviews several actors (particularly those from the public extension services) indicated that the annual meeting organized by the national council for farmers, research and extension linkage is the only formally known avenue to share technologies and hold learning processes with farmers. The respondents have also mentioned the limitations of such platform that it is elite dominated and farmers get only very little from the interactions.

The competence of the research stations in terms of having the ability to work with other stakeholders, such as the private sector, was also addressed. With the growing participation of the private sector in the dairy industry, the private sector could use the expertise of research to generate knowledge that could respond to the challenges of the dairy value-chain actors in general. So far, there is no citation to refer to the research partnership of the private sector and public research organizations. This was further substantiated by the answer of the interviewees on their assessment of the responses of the public research and extension to the changing scenario. However, it was important to find out if the private sector has enough confidence in the research organizations to subcontract public-sector researchers for any research projects. 52 percent of the 116 respondents said they have no confidence that the private sector actors will be willing to enter in to such partnership while 21 percent of the respondents were unable to comment because of limited information in this regard. About 27 percent of the respondents (most of them from research) indicated that they have the confidence for the possible research partnership of the private sector and research actors.

5.4.3. The milk market dilemma

The traditional habits and practices of research and extension is to focus more on production and productivity. It was therefore important to find out if there are changes in the habits and practices of the MoA from the point of view of making their programs market-oriented in the dairy subsector. About 60 percent of the respondents (see Table 27 for list of respondents) said

that, although they understand the timeliness of the issue, they had no clarity on how to link their work with the market. The milk market issue was also another issue on which opinions were gathered. Over 40 percent of the respondents felt that the low capacity of the milk processors in Addis is the reason why milk supply to the end market is low. On the other hand, 45 percent of the respondents believe that the farmers' milk production capacity is low and regard this as the main reason for the low supply of milk in the market, and not necessarily the milk processors. This result was a bit of a paradox and it was necessary to probe more into the milk market challenges in the study area. Further exploration of this case through conducting key informant interview indicated that the factors contributing to the unclear market challenges include the long fasting seasons of the Orthodox Church believers - which constitute a significant proportion of the consumers in Addis, low milk drinking habits of adults in Addis, the high milk price and low income of the citizens and the dominancy of the informal market in Addis, which lowers the intake capacity of the processing plants from the rural producers.

Table 27: List of respondents on habits and practices

Type of organization	n	Percentage
Not stated	3	2.6
Farmers	44	37.9
Farmers' union/organization	3	2.6
NGO	10	8.6
MoA (extension agents and supervisors)	42	36.2
University	2	1.7
Research	6	5.2
Private sector	6	5.2
Total	**116**	**100.0**

Source: Survey data 2009

In addition to the self-administered questionnaire, the respondents of the key informant interview and participants of the community consultation workshop as well as members of the value chain networks; reflected several habitual issues that affects dairy innovation. Those responses are categorized and presented as restrictive and supportive to dairy innovation (Table 28).

Table 28*:* Summary of key habits and practices that affect the dairy innovation system in the Addis Ababa milk shed

Innovation processes and relationships	Restrictive habits and practices	Supportive habits and practices
Interacting, knowledge flows, learning	- Technology transfer oriented research and extension approach with little or no attention to the diversity of dairy actors with limited efforts on multiplication of dairy technologies - Limited or no preparedness and practices of the extension service to be involved in promoting dairy markets - Centralized planning habit with less opportunity for the field staff to interact according to the context - Unnecessary involvement of the public administration in grassroots community fora such as unity extension - Mistrust between milk processors and milk producers - Limited/no participation of public research & universities in organized dairy value chain networks - Low tradition of internet use as a source of knowledge and information as well as a mechanism of communication among the dairy actors - Lack of confidence of the private sector in the capacity of the public research - Lack of a national body that represents the private sector in the milk industry (including smallholders) to interact with policy and for collective learning and advocacy - Absence of a national custodian (public or private initiative) for dairy-related information in the *milk-shed* and in the country (until the period this research was conducted) - Limited roles of ILRI to interact with the dairy actors in the Addis Ababa *milk-shed* despite its presence in the area.	- Deployment of high number of extension agents at grassroots level - Establishment of a new agency that focuses on livestock resources in Oromia Region - Privatization of state-owned dairy enterprises - Establishment of Ethiopian Milk and Meat Technology Institute
Inclusiveness of poor stakeholders and the demand side	- Limited interaction of SNV and Land O'Lakes with smallholder farmers (more attention to commercial farmers and milk processors) - Limited attention of the SNV-led dairy value chain to the grassroots extension workers - -Citizens Low pre-capita income which significantly affects milk demand in Addis market	- The experiences of the learning alliances project facilitated by EIAR (including smallholder farmers) - Establishment of grassroots structure by the state ("unity extension")
Risk taking and investing	- Little access to financial resources for those who wanted to be involved in dairy production - Land-grabbing tendency of commercial dairy farmers	- Increasing actors involvement in the dairy industry - Investment and technical support of NGOs - High interest of farmer organizations to invest in milk-processing plants
Traditions and culture	- Long fasting periods of majority of Addis citizens, affecting milk sales - Little interest of adult citizens in Addis to make milk part of their daily diet	- High consumption of milk during the fasting periods of Muslim communities is witnessed by supermarket owners and milk shopkeepers

Source: Compiled by the Author from key informant interviews

5.5. Key policy issues that affect dairy innovation

5.5.1. Results of current policy review vis-à-vis dairy development

Policy in this study refers to all laws, proclamations, regulations and directives that guided the course of action of the Ethiopian Government for investment and development. A summary of the key policy issues relevant for this study are presented in Chapter two. Here the most critical policy issues that have implications to dairy are only considered.

PASDEP/GTP: In the last ten years, these two national policy frameworks for economic development came in to existence, one after the other. The GTP happens to come up with huge and ambitious physical plans based on the important lessons the government drew from the PASDEP. The critical issue in relation to dairy is that either the PASDEP or the GTP has a clear plan of "dairy development", except putting some indicators on forage seed production and AI. Contrary to the huge livestock resource the country has in Africa, the overarching policies of the country has no any vision of making Ethiopia a leading milk exporter nor a thoughtful strategy is set out for import substitution. At the moment Ethiopia is importing more than 114 million dollar worth dairy products in 2010 (Land O lakes 2010). In these policy frameworks meat, live animal export and hides and skins receives better attention than dairy (PANE, 2011).

Implication of the GTP to other policies: All other major policies, such as the Agriculture and Rural Development Policy, the investment policy and the state-owned development bank policy, are crafted taking in to account the basic principles and goals stated in the PASDEP/GTP. Apparently, dairy never comes at the Centre of the policies of agriculture and rural development, investment, state owned development banks and others. This is because the emphasis in the GTP is exclusively on export commodities and dairy is not an important commodity on the export market yet. For example a review of the loan information of the development bank of Ethiopia, which is playing a pivotal role in enhancing investment in the country, no loan is approved in the last three years for dairy farming. The bank's annual report also clearly indicate the types of businesses eligible for loan, in which case, dairy farming and other non- exportable commodities are absent (Development Bank, 2009). The Agriculture and rural development policy follows the same trend. For example, dairy development never appears as an important topic in the

policy document, while very high emphasis is placed to crop and livestock commodities, which have export market demand. In addition no dairy development programs of any scale are considered by the ministry, while these were common in the past when the livestock unit was organized at vice-ministerial level.

5.5.2. Opinions of dairy actors on key policy issues

The analysis of results in Table 29 present the opinions of the dairy actors on policy issues obtained through key-informant interviews. The opinions of the dairy actors were categorized into supportive policies, challenging policies, policies that require better enforcement mechanisms and new areas for policy.

Table 29: Summary of reflections of dairy actors on key policy issues

Supportive policies	Challenging policies	Policies that require better enforcement mechanism	New areas for policy
- Formation of Livestock Production, Health and Marketing Agency in Oromia. - Incentives of the investment policy - Assignment of 3 DAs at *Kebele* level, all over the country - ADLI framework of the State - Free market economy policy - Infrastructure development policy - Proclamation on cooperatives - Science Technology and Innovation Policy.	- High expansion of investment that displaces dairy farmers in the study area - Crop-biased intervention of State, even in high livestock potential areas. - Land grabbing in name of investment in dairy - Lack of access to financial resources for dairy production - Delay to materialize the removal of value-added tax from feeds, although decision made by higher policy people - Withdrawal of State from managing government-owned ranches (heifer production)	- Land-use policy to manage communal grazing land - Land policy of City Administration does not clearly consider allocation of land for dairy, although it pays attention to urban agriculture. - Lack of well-developed system and enforcement mechanism to translate the Government's policy on changing subsistence agriculture to market oriented business in the livestock sector. - Lack of enforcement structure of the Ethiopian Quality and Standards Authority in relation to milk market, feed market, drugs and AI services.	- Breeding policy not yet a law - Inadequate AI system in the entire country (quality, availability, timeliness); aggravated by closing of government-owned ranches - Quality-based milk pricing - Unrestricted cattle mobility on their way to Addis market (high risk for disease transmission) - Special incentive for investors involved on multiplication of technology (such as heifers) - Formal and informal market debate requires a policy that could respond to the needs of the majority. - Public education to encourage milk consumption through powerful media programs - No regulatory system on private AI practitioners - No milk market policy, resulting in critical challenges for dairy actors. - Rethinking FTC and roles of DAs, making them more responsive to market and farmers' needs.

Source: Compiled by Author from key informant interviews

5.6. Summary

One of the important findings from the historical accounts of dairy development (see Chapter two, Context) is the emphasis on the livestock sector, particularly on smallholder development, during the communist regime and the establishment of the Addis Ababa Dairy Enterprise to promote private dairy development during the imperial regime; are worth mentioning. These actions contributed to the development of smallholder dairy during the past regimes. Referring to the current situation, an individual farmer's household in the study area may own an average of 11.33 dairy cattle (including local and exotic breeds), and may have access to 3.91 ha of land resources. The daily milk production per cow from exotic cows was estimated to be 5.59 liters. Farmers depend less on commercial feeds and have good access to local feedstuffs, hay being the most commonly used. The key findings in relation to actors' interaction also include:

- There are several social networks through which knowledge and information is shared
- Local people including farmer organizations have the capacity to innovate.
- There are several NGO initiatives that foster knowledge and information exchange.
- Smallholder farmers benefit less from the various networks and initiatives on dairy.
- The ATVETs and FTCs are the closest partners of farmers in the knowledge processes
- Research has better linkages with farmers in Welmera District than the others.
- Research is not part of the on-going value-chain network on dairy.

The free market economy policy of the current regime showed significant impact in improving dairy innovation in the processing and marketing wing of the dairy industry. On the other hand, the key policy issue that seriously affects the dairy system is the tendency of the government to focus on export commodities, which dairy is not one of the subsectors that are enjoying the benefits. Finally, among the various institutional factors the most relevant ones are found to be:

- Less response of research and extension organizations to the changing context in the dairy system.
- Factors that affect the formal milk market – including long fasting seasons, low milk-drinking habits of Addis citizens, low income of consumers and dominancy of the informal milk market are never addressed systematically.
- Mistrust among the dairy actors, affects dairy innovation.

CHAPTER SIX: DISCUSSION

6.1. Introduction

This chapter focuses on the discussion of the results presented in Chapter five. The results, in relation to the descriptions of the key dairy actors in the Addis Ababa milk shed, their competences, roles and the basic resources they are using are important in terms of providing insight into the level and complexity of the dairy innovation system. Therefore, aspects of the discussion are in connection with these issues. However, my main emphasis will be to look in to the dairy innovation system in the Addis Ababa milk shed *as a function of technologies, actor linkages, policies and institutions.* These factors play key roles in triggering or blocking innovation. The discussions in this chapter therefore draws critical lessons by unearthing the often hidden phenomena in the complex system, with due emphasis to historical and current situations.

The first section of this chapter addresses the historical legacies in dairy development. The historical timeline, which is presented in the context chapter, is used as a basis for discussion. This discussion leads to lessons which have implications for the current system and planning for the future. Section two discusses the important dairy resources in the Addis Ababa milk shed, including cattle, land, feed and services. The main issues covered in this section include the extent to which dairy innovation has been affected by these resources and explore the possibilities of triggering innovation. The third section, which is indeed the focus of this chapter, refers to the actor linkages. Two important tools are used to discuss the linkage findings presented in Chapter five. This section provides understanding of the system actors and their role in decision making and information exchange. As part of actor interactions and linkages, the relationship between community resilience and innovation in the study area is also discussed based on the cases of the Selale Dairy union to improve milk market opportunities for the smallholder farmers and the case of HUNDEE (a local NGO) on the traditional support system to resist shocks that causes cattle loss.

The last section deals with policy and institutions. This section discusses only key policy issues that affect the dairy innovation system most directly. These include implications of the overarching government policy (PASDEP/GTP) for the dairy subsector; the Science, Technology

and Innovation policy, the National Animal Breeding policy and the controversial phenomena of city expansion, industrial villages and challenges for dairy. Key institutional issues that may shape the interactions of dairy actors also received particular attention. Habits and practices of market actors are selected to provide an example of how institutional factors affect innovation in the dairy system.

6.2. Reflection on the research problem and objectives

The problem this study addresses can be summarized as: *Despite the efforts of government and other agencies in the past, the growth of the dairy subsector in the Addis Ababa milk shed is not commensurate with the great potential there exists for dairy. Recent developments show that new dairy actors are emerging and the interaction of actors in the subsector is becoming increasingly complex. Nevertheless, little is known about how the interaction of actors is occurring in this complex system so that it can lead to innovation. Most importantly, the implications for benefiting smallholder dairy farmers are only vaguely known*. The aim of the study is therefore to understand the framework in which the interaction of the dairy actors takes place and to identify and clarify the leverage points that may help to improve the dairy innovation system performance and thereby the benefits to smallholder dairy farmers.

6.3. Historical legacies and implications for innovation

The policy and ideology of the three regimes that came to power during the past 60 years in Ethiopia had a significant influence on the roles of the commercial and smallholder dairy farmers. They have determined the fate of commercial and smallholder dairy in Ethiopia: the emergence of commercial dairy during the imperial regime, the collapse of private commercial dairy during the Derg Regime, and the resurrection of the commercial dairy industry during the current EPRDF-led government. The imperial regime is credited for pioneering the development of commercial dairy in Ethiopia. The importation of highly bred dairy stock and the subsequent introduction of more improved cows from Kenya (Hiskias, 1998), as well as the policy decisions made to establish the Addis Ababa Dairy Industry, were key events in the history of commercial dairy business development in the country. The start-up of commercial dairy farms led to the gradual growth of formal milk marketing in Addis. This was further strengthened as a result of

the expansion of restaurants and cafes, as well as the beginning of the UNICEF-supported pilot milk processing plant in Shola (Ahmed *et al.,* 2003).

The subsequent Derg Regime took policy actions that reversed the growth of private commercial dairy: it nationalized land and industries, including large dairy farms. The State had a greater policy emphasis on and support for big state and cooperative farms. The management of a communist coop is easily accessible to the state and they were regarded as part of the state apparatus rather than a free association of farmers. During the "Derg" regime the state farms consumed about 95 percent of agricultural inputs (introduced seeds, fertilizers, pesticides, farm implements) but contributed to only five percent of the total national production. Smallholder farming accounted for about 95 percent of all food crops and 98 percent of agricultural export commodities like coffee, but received less attention (EEA, 2005). Nevertheless, the regime also took important policy measures such as raising the portfolio of the Animal Resource and Fishery Development in the MoA to vice-ministerial level and the regime supported state-led and donor-supported projects on livestock development in many parts of the nation. For example, the impacts of projects like the Finland-supported Selale Dairy Development Project and Smallholder Dairy Development Project, as well as the World Bank-financed Fourth Livestock Development Project are among those that contributed to smallholder dairy innovation and improved milk production in the study area.

The current system (EPRDF-led government) differs substantially from its predecessor. It pays attention to developing the private sector through new investment policies with attractive packages for investors. The government is focusing on creating a free market environment at a macro level and this has stimulated innovation because of the increasing number of investors joining the dairy subsector. Because of these policies, several milk-processing plants, supermarkets, milk shops and feed manufacturers joined the dairy industry. For example, in the rural locations of the study area, 19 officially registered commercial dairy farms of medium to large scale were established. Another eleven private-sector dairy-processing plants (Table 16) and six feed industries have also emerged in the study area since 2005. During the Derg regime, only one state-owned milk-processing plant and one feed industry supplied services to the entire country. The new policies therefore introduced a competitive dairy economy that, in turn, provides better chances for smallholders to gain higher milk prices than before. During the

communist regime the state owned milk processing plant determined the price of fresh milk and this did not suit the smallholders. The changes are obvious contributions of the policies and actions of the current government. However, the current system also tends to provide less than optimal support to smallholder farmers and this is evidenced by the complete absence of smallholder dairy development projects (which were so common during the communist regime with the assistance of donors), downgrading the portfolio of the livestock development and fisheries division from vice-ministerial level to a small unit in the extension department (after almost 20 years, this was upgraded to a state ministerial position towards the end of this study) and closing down of the ranches which were supplying improved heifers to smallholder farmers on a subsidy basis.

6.4. Implications of dairy resources and technologies for innovation

The basic dairy resources addressed in this study are numerous. However, two important resources and technologies – improved dairy stock and feeds, are selected for discussion, because these issues have significant implication for dairy innovation at the grassroots.

The study established that the mean value for the total dairy herd size in the entire study area was 11.33/hh and the mean for exotic cattle ownership was 1.69/hh. In Sululta, the average dairy herd size/hh (14.42) and exotic dairy cattle population (3.6) showed significant difference when compared with Berek and Welmera. The Welmera total dairy herd size was slightly higher than in Berek, and no big difference was observed in the mean value for exotic dairy herd/hh in the two districts (Welmera1.32, Berek, 0.94). Possible explanations for the higher dairy herd size in Sululta are:

- The agricultural land in Sululta is less suitable for crop production because the majority of the area is wetlands. The wetlands in Sululta are used extensively for fodder production, which is often used as a source of feed for the entire milk shed. For example, in Sululta, crop residue as a source of animal feed is not so common despite the high number of dairy cattle it has. The mean amount of crop residues used by households in Welmera is 1.4 and 2.8 times higher than in Sululta and Berek, respectively. Welmera has a greater tradition of crop agriculture (mixed-farming system) than Sululta and Berek.

- The natural resources in Sululta, particularly the rich sources of hay from native pasture, and the traditional tendency of farmers for dairy farming are the main attraction points for many of the dairy-related projects sponsored by the previous governments, its donors as well as for the current intervention of NGOs in the dairy subsector. This has been a significant contributory factor for making Sululta a better place for dairy production.
- Competition of investors for land (industry, construction, agriculture and others) is much higher in Welmera and Berek than in Sululta. Again, because of the wetlands, the size of land utilized by investors in Sululta for non-dairy investments is limited. In Berek and Welmera, the expansion of real-estate projects, flower farms and establishment of industrial villages have effectively competed for land that could be utilized by dairy farmers. For this reason, the average landholding of smallholder farmers in Sululta is greater than in Berek and Welmera. Particularly, Sululta dairy farmers access more hay lands through rental arrangements.

Due to the presence of various dairy development projects in the past, mainly in Sululta but also in the study area in general, some improvement was observed in the productivity of dairy animals in the communist regime when compared with the imperial regime, in which smallholder dairy development was not a priority agenda. Holloway (2000) estimated the maximum milk production potential of crossbred cows under the management of farmers in the Ethiopian highlands may reach 2500 kg per 279 lactation days (about 9 liters/day). A particular study conducted on randomly selected 176 crossbred cows in the project area also showed the milk production of the dairy herds following the intervention of the Finland-supported projects was less than 1500 kg per lactation length (Tesfaye, 1992). According to the estimate of Tesfaye (1987), the daily average milk production of the cows during the project period was 8.87 liters/day in 169 lactation days, which is almost equal to the estimates of Holloway. The potential for lactation length estimated by Holloway was not considered in the computation; instead the actual information was taken from the study result of Tesfaye (1987) who did the research in similar locations to this study and with specific focus on lactation length of cross bred animals which were under the management of smallholder farmers (not commercial farms).

The results of this study (2009- conducted after 26 years) show, on the other hand, that the average milk production of the crossbred cows in the study area is 5.59 liters/cow/day. This was

computer generated, based on the data of this study as well by taking into account the 169 days lactation length suggested by Tesfaye (1987). The implication, twenty six years after completion of the donor supported projects implemented in the study area, the milk yield of the crossbred cows has declined markedly. At the same time the human population of Ethiopia has increased by almost 50 percent. The first comprehensive national population census in 1984 reported that the population was close to 42 million (Baker, 1990), while the current population is 84.3 million, based on a 2.6 percent population increase rate in Ethiopia, according to the CSA (2008a). This situation suggests that the innovation dynamics at smallholder level in the last 20 years has not kept pace with the potential increase in the demand for food and milk in the population. In the last twenty years the government initiated and donor-assisted smallholder dairy innovation support facilities (projects) have been largely absent, except the small attempt made in the early days of the current government; as a continuation of similar projects done during the Derg regime. Of course, unlike the period of the Derg regime, the intervention of NGOs in dairy issues in the study area has increased. However, except Land O' Lakes, which was doing some work on fodder development, all have been working on the markets, coops and improving milk quality. The programs of NGOs intervention to increase productivity have been limited except for the work of Agri Service Ethiopia on dairy bull services in limited parts of Berek.

The transfer of the dairy ranches from the state to the private sector was another reason for the low growth rate of milk production in the study area. In principle, the action of privatizing the ranches was expected to improve the supply of improved dairy heifers to farmers, even though the price was expected to increase, because of the removal of government subsidy. Nevertheless, the ranches were not in production for many years simply because the new owners did not pursue the business. This, coupled with the low rate of AI services in the study area, had significant negative effects on milk production. In some places like Sululta, investors in dairy production introduced highly bred bulls, the effect of which benefited the smallholder farmers. Farmers in Berek also benefited from the establishment of bull stations by the NGO, Agri-service Ethiopia, and Welmera farmers had access to a supply of culled cows and bulls from Holetta Research Centre. However, these were not enough to bring about system-level changes in improving productivity.

Another technological factor that has contributed to low productivity of dairy under smallholder management could be the low quality of the feed resources used by the farmers. Exotic-origin fodders like sesbania, fodder beet and tree lucerne, known for high protein and energy values, were introduced by the above-mentioned projects in the 1980s. The current study indicates that the level of utilization of those fodder trees and concentrate feeds by farmers in the study area is very low, despite the area being one of the main places for dairy production in the country. Most farmers depend on the low-quality hay they harvest from the wetlands. The empirical data from this study shows the average level of utilization of concentrate feeds and fodder trees by the rural households is 1.8 percent and 0.31 percent, respectively, of the total feed used on the dairy farms. The use of industrial by product feeds (which is very popular among commercial dairy farmers) is also very low in the study area. For example oil seed cake and brewery by-product feeds accounts for four percent of the total feed utilized in the study area while the consumption of urea treated molasses does not exceed one percent. However, the consumption level is still greater for Sululta than the two districts. This is also attested by the fact that the average holding of exotic dairy cows in the study area is grater for Sululta. The recent Livestock Survey Report of the CSA (2008b) generated similar empirical evidence on subsector performance. It shows that less than one percent of livestock-keepers use on-farm produced forages such as alfalfa and Napier grass, and the use of industrial by-products such as oilcake, bran and brewery residue has remained negligible (0.8 percent) (Tesfaye & Azage, 2010).

Agricultural land in the study area is another important resource that affects dairy development. The average holding of farmers in the study area (3.9ha/household) is quite large when compared to the national average land holding (0.5 ha/household). Of the 3.9 ha of land, not all is used for dairy farming except in Sululta where extensive grazing areas are available because of the wetlands. Most importantly, the growing expansion of investment in floriculture and construction is threatening the dairy industry in the suburbs.

There is no visible difference between the private landholdings of the respondents in the three districts (Table 18). The variation is mainly attributed to the land accessed by the farmers through rental or any form of temporary arrangement. The average land size used by a household in Sululta through rental or any form of special arrangement (1.9 ha), is almost twice as large as in Berek (0.95 ha/household) and Welmera (1.02 ha/household). There is also a

relationship between total landholding of the respondents and the available herd size. The higher the total exotic herd size, the greater the tendency of the farmers to have more access to land resources. The same relationship is also true of the total herd size (both local and exotic) and the total landholding.

The relationship makes more sense between the herd size and land accessed as a result of special arrangement: the larger the herd size, the bigger the interest of the respondents to access more land through rental or any other special arrangement. On the other hand, there is no relationship between herd size (in this case, both exotic and total) and privately owned land (personally owned during the time of land distribution/redistribution after 1974). In other words, farmers are motivated to look for additional land when they begin to have more dairy animals. However, farmers are only motivated to expand their dairy business when there is a secured market throughout the year. Given the current problems of access to markets in the study area, farmers are not expanding the dairy business nor are they willing to use modern inputs such as formulated feeds, because the market returns do not cover such input costs. This is a critical issue that slows down dairy innovation in the settings of smallholder farmers. Any attempt that makes dairy a lucrative business for smallholders (e.g., opening up of new markets) or reduce feed costs will positively contribute to dairy innovation.

In addition to the limitations of the basic dairy resources mentioned above, an important factor that affects growth of the dairy development in the study area is the interaction of actors for knowledge and information sharing and marketing. The critical resource limitations of feeds and improved dairy heifers could have substantially improved if better knowledge/ information flow and learning had been facilitated. Some of the important relational factors that affect innovation are discussed in the next sections.

6.5. Analysis of actors' interactions

Understanding the interaction of the dairy actors from different angles provides chances not only to explain how the system is structured but also to find out the leverage points for favorable system-level changes. To help unpack the key linkage issues, this study used two important tools: *hierarchy and relations* and *subsystem typologies* of the innovation system.

6.5.1. Hierarchy and relations

The hierarchal relations focused on selected indicators that reflect on the knowledge processes and power relations in the vertical order of actors' hierarchy. In this case three levels are identified: the grassroots systems, mid-level actors' linkage and higher-level actor linkage. The purpose of this discussion is to explain how the decisions of higher-level actors affect the knowledge and innovation processes at the grassroots, thereby showing the power relations and implications to dairy innovation. For the hierarchal analysis, four important indicators are used to understand the knowledge processes and innovation phenomena at every level: access to knowledge/information and technology supply; presence of effective innovation networks; availability of trained human resources; and opportunities for capacity development. The key findings of the analysis are presented in Table 30. However, reflections on selected interactions that could demonstrate the power relations and influences are presented here.

The social network of farmers is an example of grassroots-level interaction, which comes under the influence of the mid-level and higher-level actor clusters. Using key indicators derived from the innovation capacity assessment tools developed by Hall (2006) and CTA (2005), the empirical findings are presented in Table 30. The results show that farmers have a strong social network through which they gain important information on livestock feed, marketing, housing and other matters. The linkages smallholders have with traders, relatives, friends and other social actors had significant value in helping them run the dairy business. The extension system also has considerable influence on the grassroots-level interaction. The training modules developed by regional and federal experts are the main carriers of knowledge on dairy. Farmers have very little or no say on deciding the content of the training materials. This is one example to show how higher level actors exert significant influence on the grassroots systems. The extension agents often assume that knowledge and information is delivered to farmers mainly (if not only) through the formal extension system. In the case of dairying, farmers claimed that about 41 percent of their information came through their social networks.

Table 30: Selected system indicators and key phenomena at various levels of the innovation system

Indicators	Grassroots dairy actors (dominated by smallholder producers)	Mid-level cluster of dairy actors (dominated by commercial farmers and processors)	Higher-level cluster of dairy actors (dominated by public institutions, NGOs and international organizations)
Access to knowledge, information and technology	- More interactions with extension agents on livestock health - Strong social network to access knowledge on feeds, marketing and housing - Little access to improved dairy heifers - Farmers' use of improved feed technologies is very low	- Big farms recruit technically qualified managers - Have better access to NGO led networks on dairy - Have better access to inputs and technologies such as AI, veterinary medicines, heifers and feeds	- NGO initiated higher-level meetings and conferences - Government-initiated meetings/consultations and workshops on policy and strategic issues
Innovation networks	- Farmer Research Groups, particularly in Holetta - Community Learning Forum of farmers in Berek - Limited access of farmers to participate in innovation networks.	- SNV-led value-chain network - Meetings of various dairy associations (of the private sector) - Land O'Lakes-organized dairy bazaars - Land O'Lakes-organized meetings of contact farmers (twice a year) - IIRR- and ICCO-facilitated learning alliance project	- The State-led Farmer, Research and Extension Linkage Council - National Dairy value chain Forum, hosting meetings on all issues of dairy, including formation of dairy board. - ILRI-led fodder innovation roundtable provides platform - IPMS-led fora on dairy at policy level
Trained human resources on dairy in the system	- Three extension agents deployed by the government at *Kebele* level to run the farmer Training Centers.	- Highly trained staff in the NGOs, consults and people working for international organizations provides support	- Federal government staff working for MoA and EIAR - Livestock research in Holetta, Debre Zeit and Debre Berhan using the case team approach
Capacity development	- The ATVET colleges train extension agents assigned at the grassroots - FTC is potentially a good Centre of capacity development for farmers, which is established at grassroots level	- SNV and ICCO-supported year-long action-oriented training on value-chain development - Trainings provided by EMMTI - Consulting firms - Training programs of NGOs	- Universities offering BSc, MSc and PhD-level education - State-initiated and World Bank-supported Rural Capacity Development Project of MoA

Source: Derived by the author using capacity assessment tools developed by Hall (2006) & CTA (2005)

The ATVETs, also a mid-level actor, have considerable influence on the grassroots knowledge system, as this is where more than 60,000 grassroots extension workers were trained in the last six years for the entire country. The extension workers are the closest partners of the smallholder farmers in terms of information and knowledge sharing. According to the extension agents interviewed in this study, of the 25 ATVET colleges, only a few could provide practical training of an acceptable level, and the rest mainly deals with theoretical concerns, although the plan was to undertake 70% practical experiences and 30% theoretical discussions. The extension agents also lack important skills in communication, extension, facilitation and participatory approaches for development, as some of them (relevant to this study) were trained mainly on production technologies, in this case on animal production. Most importantly, the training on extension does not take sufficient consideration of the growing dynamics in the field (participation of the private sector and market issues) and thus focused on ToT for smallholder farmers, in a more or less formal education mode. The trainers are however expected to play a role as change agents, requiring high engagement in social processes with the support of the above-mentioned skills.

In accordance with the Government's research and extension system strategy, the only time farmers will have better chances for dialogue and learning is during the annual meetings organized by the Farmers Research and Extension Advisory Council. Nevertheless, these fora take the conventional approach of conference organization and are dominated by elites, while farmers and farmer organizations have little chance to benefit from the meetings and to contribute to the knowledge in the making. The research and extension system has scaling-up and scaling-out strategies as mechanisms for disseminating successful experiences. However, there is no work worth reporting in this regard in dairy development in the study area, although there are some developments in the crop subsector, such as wheat, potato and haricot bean (EARO, 2000).

The Oromia Region Animal Resource, Health Protection and Marketing Agency is another example of mid-level actors' interaction within a hierarchical system. This agency was among other things, established to enhance livestock marketing in the Region. This is indeed a very important organizational innovation for the Oromia regional state. Ethiopia is a country with abundant livestock resources but without a federal agency that takes care of these resources for

more than two decades (recent establishment of the state minister for Livestock resources in Ethiopia is encouraging) while in Kenya the country's livestock resource (by far lesser in number than it is in Ethiopia) is managed by fully mandated Ministry of Livestock resources. Despite the fact that the Oromia Region Animal Resource, Health Protection and Marketing Agency was found very important to the regions' livestock development and setting up of a good example to the rest of the country, the critical limitation it has is that only small impacts of the agency are observed at local level (smallholder farmers). The attempt of the livestock agency to facilitate linkages between the farmers and the private sector for supplying local Boran heifers is, for example, a noteworthy practice that could provide a lesson on how extension services should embrace involvement of the private sector more deliberately. However, farmers were hardly consulted and decisions were made at regional level, although the primary stakeholders at this connection are the smallholder farmers at the grassroots level. This has contributed to the failure of the Boran heifer supply initiative since farmers are not happy as many of the heifers failed to conceive.

The benefit that smallholders gain from networks like the SNV-led value chain is another example of mid-level actors' significant influence on the grassroots dynamics of smallholder farmers. The value-chain network operates at a national scale, and very diverse actors have taken part in the learning process over the last five years. Mostly the benefit that goes to farmers accrues at union level. The unions, with the support of innovation funds from the network drivers, give training to smallholders to improve milk quality. However, when compared to the funds allocated to run the value-chain networks, only few resources are going to farmers. For example, from the six projects approved by SNV management only two were directed to the unions to run short-term training of trainers on milk quality. SNV has made its position clear from the beginning that it would like to work with intermediary organizations such as unions and not directly with smallholders. More extension agents and smallholder farmers take part in the fora organized by Land O'Lakes. However, the focus of the Land O'Lakes fora is on technical issues and less on business promotion, solving marketing challenges, and advocacy and action research. These issues are better addressed at the SNV-led *fora*, although the participation of farmers is limited. Indeed, the two fora could have a complementary roles if they have closer

collaboration and joint planning experiences, which is however not common among many of the NGOs intervening in dairy development in the study area.

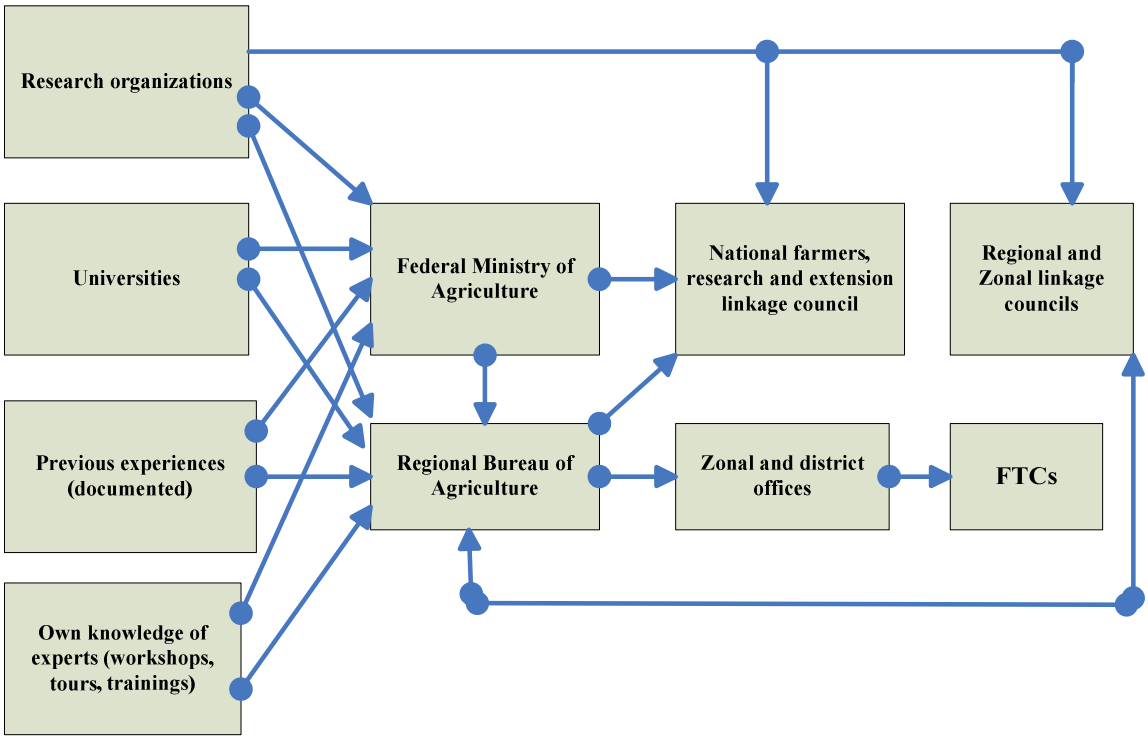
The case-team approach of research in the Ethiopian Institution of Agricultural Research (EIAR) and its relationship with other actors can be considered as one of the higher-level actors' linkage that could have an effect in the entire dairy innovation system. The case-team approach involves the formation of multidisciplinary teams to undertake research as opposed to the traditional system in which researchers conduct their study independently, despite the fact that the farming systems are diverse and complex. Although this measure is an improvement in terms of bringing diverse bodies of knowledge to address farmers' problems, the fact that it does not provide enough space for farmers, farmer organizations or other actors in the entire research process –is a serious limitation. Teams sets research priorities and makes all decisions related to technical matters. The establishment of Farmer Research Groups in some parts of the study area (especially at Holetta) provides a small opportunity for the farmers to participate in the technology process.

6.5.2. Subsystem typologies

The interactions/patterns created in the sub systems are characterized according to the main drivers of the innovation process. To avoid some of the conceptual fuzziness associated with analysis of "a system", Broström (2008) suggested moving the point of analysis from the level of a system to the perspective of a defined group of actors (actor-oriented analysis). Such an analysis was used in this study but it was taken even further into a subsystem typology analysis level. Four important subsystems with distinct features and goals were identified as conventional, commercial, community and competitive Knowledge and Information Networks (KINs).

Conventional KIN

State actors and farmers dominate the "conventional KIN". It is characterized by the ToT model, in which research organizations and universities are regarded as the source of knowledge, and the public extension organizations are the intermediary agencies that transfer knowledge to farmers (Figure 18). The regional bureaux of the MoA are the main bodies responsible for developing the packages for the training programs.



Source: Author's Construction

Figure 18: Conventional KIN

Note: The arrows show the supply of knowledge from a source to recipient

The commercial KIN: The "commercial KIN" presented in Figure 19 refers to the interactions of dairy actors who are engaged in commercial activities. They interact with each other and with the small- and medium-scale farmers. Their interactions are often informal, and information and knowledge sharing take place in the course of buying and selling products and with a stake in keeping partnerships alive, even when transaction of products is not involved. In this study, the main actors in the commercial-KIN are from the private sector, including small- and medium-scale dairy farmers. Interaction of state agencies with the private sector, particularly in the spirit of supporting knowledge and facilitating innovation, is not so common. Critical information on marketing, feed and health comes to farmers from the private sector actors rather than the formal research and extension.

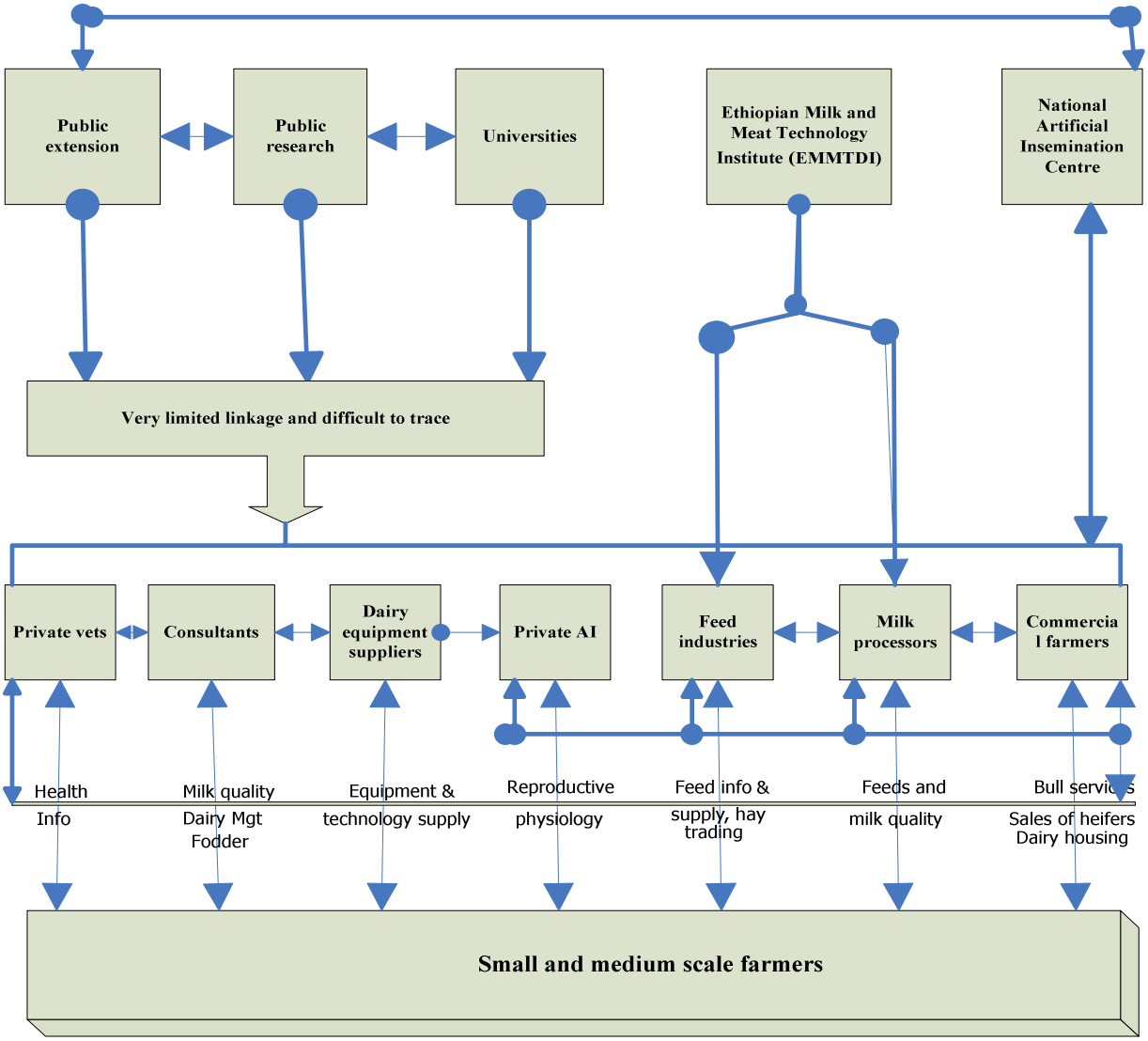


Figure 19: Commercial knowledge and Information Network

Source: Author's Construction

Note: The arrows between boxes with pointers on both ends indicate two-way relationships. Arrows with one pointer refer to one-way communication

Community KIN

"Community KIN" refers to the flow of dairy-related information through the social networks of the community (Figure 20). It can be considered as an informal network that fosters innovation,

without necessarily having a "known" facilitator. This network is less independent, as the community members (particularly those involved in dairying) are connected with many actors, mainly traders. Connections with such actors take place informally. The venues where they meet are not formally agreed and specified. Farmers do not plan for learning. The information exchange and knowledge sharing happens spontaneously at the unplanned meeting points.

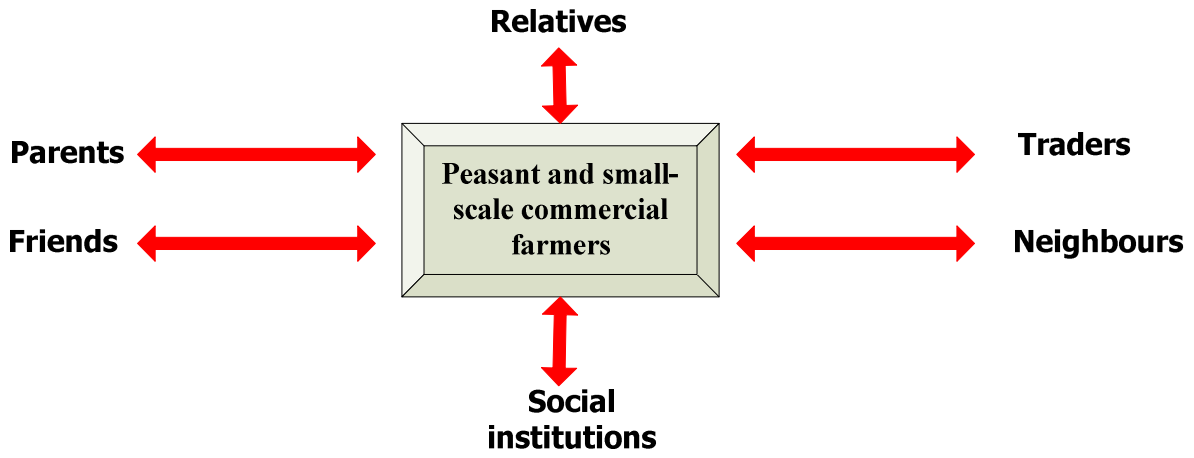


Figure 20: Community knowledge and information network

Source: Author's Construction

Competitive KIN: "Competitive KIN" refers to the value-chain networks that include various chain actors in the dairy industry. The SNV-led dairy value chain is a typical innovation platform that demonstrates an example for this model (Fig. 14). SNV as agency is the innovation facilitator. Such networks are competitive in nature because, the more an actor is involved in the functions of the network, the more s/he would benefit because accessing benefits from such networks requires the ability to prepare project proposals, lobbying capacity and knowledge of the network functions, rules and programs. There are other competitive KINs in the system, but the SNV-led competitive KIN model is the largest. The model in Figure 21 only shows the participation and benefits of the actors in the network. The bigger actors (in terms of capacity) such as the milk-processing plants and commercial farmers take active part in the network functions and are the network members that benefit most. Smallholders and extension workers

are too far from the network and benefit little through trickle-down effects. Value-chain financing is an important support provided by the SNV-BOAM project to the value-chain network through various funds. The leverage fund supports dairy actors who would like to invest but face financial limitations. The Financial Intermediation Fund (FIF) supports the chain actors to obtain loans or financial support from any source, by helping them draw up bankable business plans and projects.

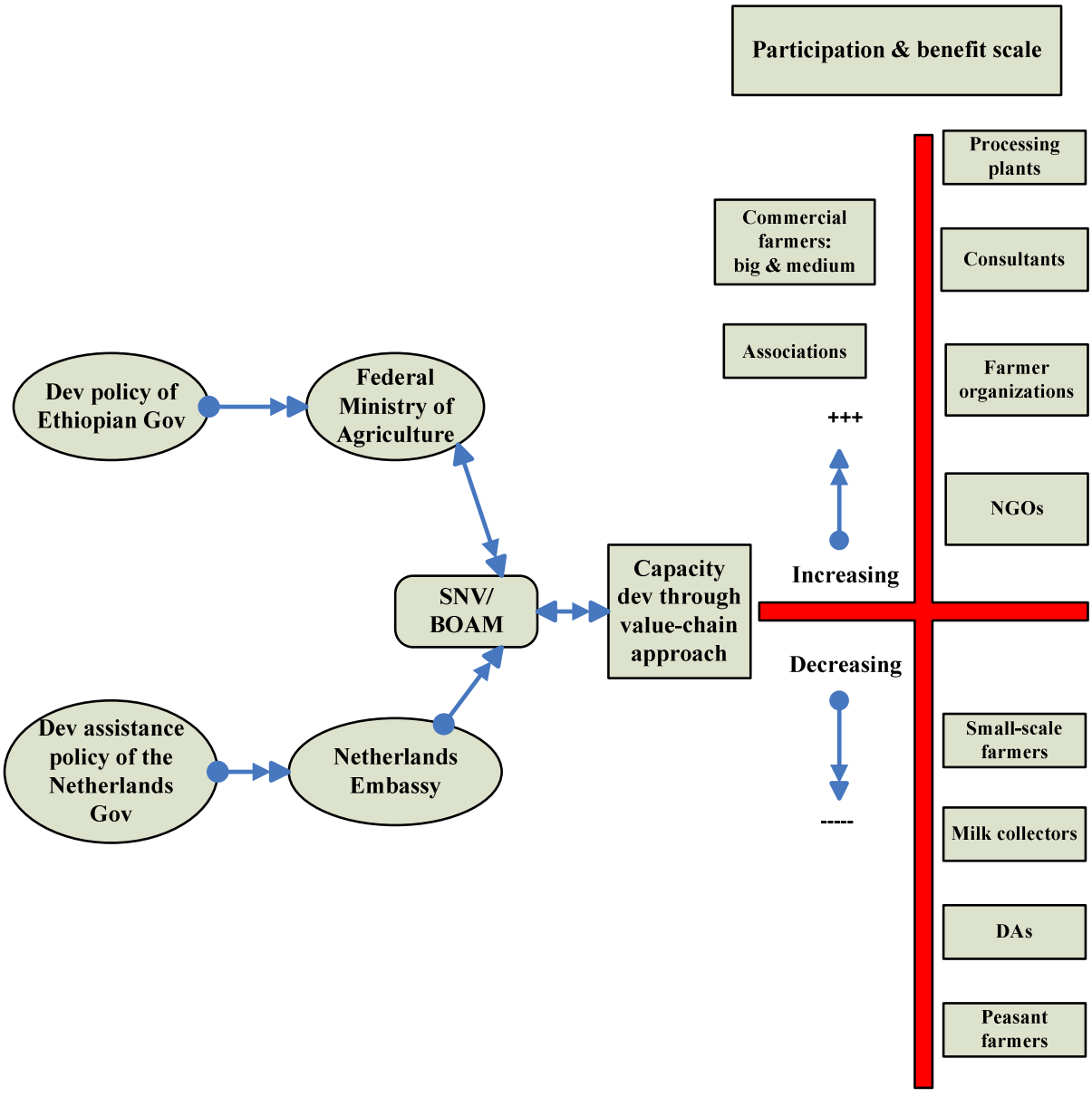


Figure 21: Example of competitive KIN: SNV-led value chain

Source: Author's Construction

6.6. Community resilience as a driver of innovation

Community members in the study area are involved in a number of innovative activities at an individual and group level. Sometimes a community innovates when challenging situations threaten its survival. Community resilience refers to the degree of response of the community to the prevailing challenges/threats, in an attempt to return to 'normality' that existed prior to the threat. Innovation refers to the ability of the community to interact in bringing new values/change that may result in community transformation for the better. The maximum leverage point for transformation could be achieved when the resilient response of the community is innovative (Figure 22).

One example from Sululta is taken to demonstrate how community resilience resulted in institutional innovation. Challenges to the dairy industry arose because of city expansion and the growing investment in floriculture and city-based construction in the three districts. Lessons can be drawn on how community resilience is necessary to react to the challenges imposed by the floriculture and the construction industries.

The actions taken by Sululta farmers, together with the rest of the farming community in the Selale plains to overcome milk price challenges is another case in point. The milk market problem was created due to the unilateral decision-making power of the two main milk buyers in Addis. In response, farmer cooperatives gathered and formed a dairy union (the first of its kind on dairy, in Ethiopia). The aim of establishing the dairy union was to negotiate a better price on behalf of smallholders. In the beginning, the establishment of the union did not add value in the milk market in favor of smallholders. This is because the milk-processing plants, which are also the biggest milk buyers for rural dairy farmers in the Addis Ababa milk shed, managed to increase the milk-buying price, managing to attract milk sellers and forcing the union to the periphery of the milk market. The milk-marketing channel was also restricted to the unions in the beginning because, after collecting the milk from the cooperatives, the union was forced to sell it to processors who are also their competitors in the fresh milk collection front. The union was therefore in a very difficult situation to cover its operational costs and make profits, let alone to impact on the milk market price in favor of the smallholders.

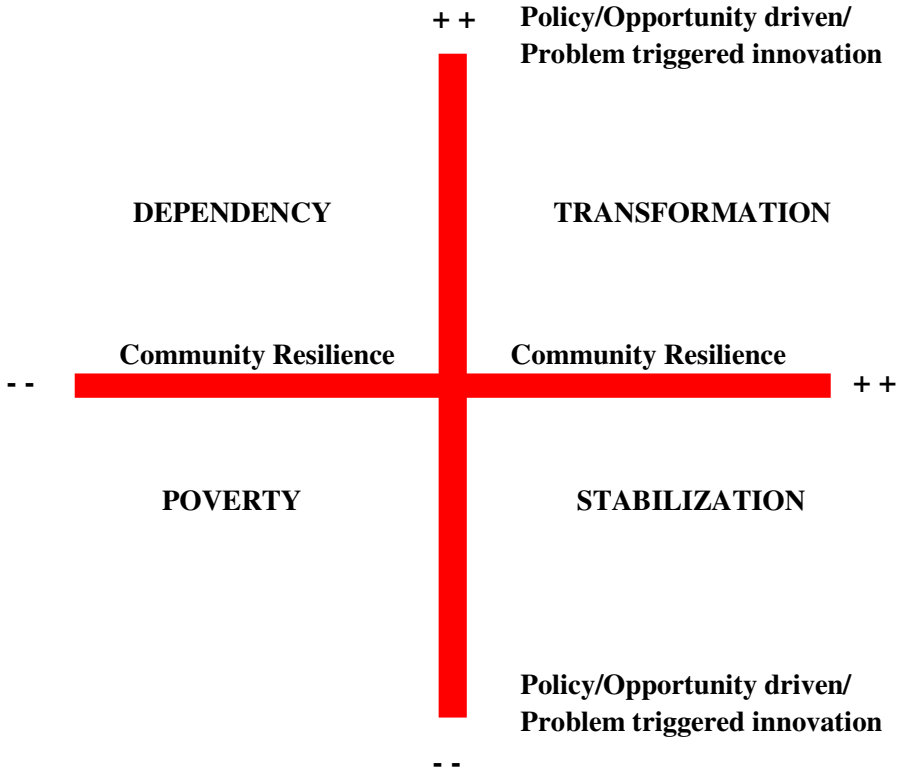


Figure 22: Innovation-resilience model

Source: Author's Construction

There was no easy way for the union to survive this situation until new buyers in Addis offered better prices. Gradually, the union secured loans from banks, bought trucks and managed to deliver the milk to the new clients at the agreed price. This changed the history of the union in that it became a strong competitor and had significant influence in raising the milk-selling price for smallholders. The former competitors of the union have agreed to collect the milk from the union in accordance with the new price set by the union and clients. However, the union decided to deliver milk to them only when there is extra milk collected beyond the needs of the new clients. The union had the capacity to collect up to 9000 liters of milk a day (Kibret & Amanuel, 2008).

More progress was made by the union to become an important actor in the milk market. It was finalizing negotiations with the banks to secure loans and establish its own milk-processing plant, which improved the milk-selling price for smallholders significantly. The union's struggle for survival and to meet the needs of its members during the entire process was a result of internal dynamics and leadership, without support from other agencies. The union receives

limited support only from NGOs like SNV and ACDI VOCA to provide training for farmers on milk quality, but these were not the key issues that resulted in positive changes in the local economy.

The expansion of the city to the dairy fields in the rural areas and new investment to establish an industrial village and real-estate projects in Berek, as well as the expansion of the flower industry and housing projects in Holetta is exerting serious challenges to the dairy industry. Such phenomena are less threatening to Sululta District. This is because of the water logging conditions in the area, which is not preferred by investors. The situation in Berek is worrisome, not only for smallholders but also for big commercial dairy farmers. The location of the planned industrial village is where most commercial dairy farmers are based. The Ethio-Turkey industrial village is a huge investment, capable of displacing hundreds of dairy farmers (big to small) in the area. The expansion of investment will affect the dairy industry by pushing the farms to a location further from the hot spot for milk markets (main road). The further the farm location is from the central market, the lower the selling price by the farmers to the market, because the milk collectors from Addis will be forced to travel extra miles and this increases their transport cost. Furthermore, farm management will change from an extensive system, which depends on the relatively cheap grazing lands, to an intensive dairy system because land is scarce. This would mean farms will be required to use high amounts of the expensive industrial-source feeds or change the enterprise. This is a critical time for the dairy farmers. New circumstances can be regarded as opportunity-driven innovations because new dairy actors and a higher number of milk consumers are also likely to come to the area. An innovative response of the local community and other dairy actors would help transform the smallholder dairy farmers; whereas low levels of resilience of the community and low innovation capacity could lead the smallholder farmers in to poverty (Figure 22).

6.7. Policies and Institutions that affects dairy innovation

6.7.1. Implications of contemporary policies for dairy innovation

There are diverse policy issues that could have direct and indirect implications on dairy innovation. The overarching policy of PASDEP/GTP, the long awaited Animal Breeding policy, the science technology and innovation policy and the controversial policy issues on city

expansion, industrialization and dairy development are among the important ones. The long awaited breeding policy has been discussed among the high level policy makers (MOARD, 2009) for many years but were never finalized or realized. Approval of this policy is likely to cause the formation of a national body responsible for livestock resources, the lack of which was considered until recently a serious institutional deficiency in the country. The recent policy action taken by the government to form a State Ministry for Livestock Development is expected to change this scenario. However, as a new ministry, it might require a long time to have an impact of enhancing livestock innovation in the country. The breeding policy is also expected to change the current work of breed improvement. Two key issues are included in the draft policy. These include selection and improvement of the indigenous dairy cattle and encouraging cross breeding of indigenous cows with exotic bulls.

The science technology and innovation policy (Ministry of Science and Technology, 2009) is also very critical in supporting technological transformation in the country in all aspects of development, including dairy. The research and university systems are expected to play a marginal role in the generation of technology but are likely to pay attention to adaptation of new technology and knowledge from elsewhere in the world. The challenge is however whether the development of a dairy sub sector will get priority. It is perhaps important to focus on the overarching policy - PASDEP/GTP and the city expansion and dairy issues for more detail discussion to see the most critical aspect of the policy on dairy innovation

The results of this study indicate that one critical policy issue- *emphasis on export commodities*, which is stated under the Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) for 2005–10 as well as the new five-year GTP for 2011–15, emerged as the main factors to impact the dairy innovation landscape. The GTP is not just a policy that guides a single sector in the government system but an overall framework which provides a foundation to the major government development policies. For example, commercialization of agriculture, with the aim of making the sector an important player in the export economy, is the main thrust of the PASDEP/ GTP. All other major policies, such as the Agriculture and Rural Development Policy, the Investment Policy and the state-owned Development Bank Policy reflect the same idea of supporting exportable goods and services. The policy is of course expected to bring important impacts on the other sectors and in principle, this policy has proved to be relevant to

the overall development of the country. However, some subsectors, such as dairy, which are not yet playing important roles in export markets, will remain without the attention they deserve, as the policy will continue to result discrimination unless the idea of "bridging policies" is considered to uplift those subsectors that have potential to join the export-economy. Currently a bridging policy of this type is missing in Ethiopia and the tendency is to pay less attention to those commodities, if they are not in the category of an export market or have important contribution for import substitution. Dairy is neither on the list of export commodities except for a small quantity of dairy products to Somali and Djibouti (Haile, 2009).

In the GTP, the Government has taken two important policy directions to support the livestock sector. One focuses on small ruminants and chickens as important contributors to the food security of rural households, as they demand little space and capital while providing quick returns. The other focus is on large livestock, particularly cattle (live animals and meat), for their export potential and contribution to commercialization of agriculture. The Government had specifically set a target in the PASDEP document to bring the total meat production up to 671,000 tons by 2010 from a level of 514,000 tons in 2005 (MoFED, 2006) and this target was almost reached by the government (PANE, 2010). Much bigger targets for live animals and meat was also set in the GTP document and the monitoring reports of the ministry of finance and economic development shows encouraging achievements thus far. However, neither the PASDEP document nor the GTP has paid attention to developing milk for the export or domestic market, despite its potential.

It is important for government to consider developing commodities with high export and import substitution potential. For example, in the history of the Ethiopian export economy, floriculture had previously not attracted attention, but now Ethiopia is among the biggest exporters of flowers. The factor that attracted the State to give extraordinary support to bring this subsector to its current level was not the abundant production, as in the case of coffee and sesame, but rather the potential, including Ethiopia's climate for producing cut flowers, its strategic location to the European markets and the strength of the Ethiopian Airline. Most of these factors could also work for other subsectors, including dairy, if they receive the kind of government attention enjoyed by the flower industry.

The other important and yet controversial phenomenon which requires a policy intervention is the issue of city expansion and industrial villages vis-a-vis dairy development (Tamerat, 2010). In principle, city expansion and establishment of industrial villages are by no means enemies of the dairy subsector, if it was not that they compete for land. Urbanization and industrialization potentially create more demand for dairy products.

The Addis City Administration is making tremendous changes in promoting new housing projects, constructing new roads and encouraging investment. For these reasons, many of the old settlements in the city are being displaced. According to Haile (2009), quoting the Urban Agriculture Bureau in Addis, about 50,000 crossbred cows estimated to be in Addis (about 12 percent of the total exotic and crossbred cattle population in the country) are the major contributors to the informal milk market in the city. The dairy farms are mainstreamed with the traditional settlements in Addis and the Government's huge city renovation program is therefore displacing the dairy farms. According to Girma Demissie (February 2010), the former head of the Urban Agriculture Bureau in Addis: "*In the response to the expansion request of the Sheraton Hotel in Addis, the city administration conducted a study to effect relocation of people settled in few hundred square meters around the hotel. The city administration came to know that six medium-scale dairy farms were present only in the small area requested for expansion of the Sheraton Hotel. This alerted the city administration to conduct a thorough study and map out the urban dairy business for relocation, as many more investment requests will have similar consequences. The city administration announced a bid to conduct the study with the support of consultants, but it was discontinued for unknown reasons*." As mentioned in the previous section, a great challenge to relocating the dairy farms could also be the expansion of the city itself in the suburbs and the establishment of industrial villages in the same areas. Land will remain a precious resource in the city and this will have a strong effect on the dairy industry.

As milk is a perishable product, dairy farms and businesses need to be located closer to the market. This makes the dairy business compete for land against the aggressive city renovation programs in Addis and urban growth. National planners and policy makers use an integrated planning approach so that urban development will not negatively affect food security, of which milk and other dairy products are part. Unless this challenge is mitigated, a serious shortage of

milk in the Addis Ababa milk-shed will occur, with imported milk products dominating the market.

6.7.2. Institutions

In this section, selected institutional issues that affect the dairy innovation system most directly are briefly considered. The participation of research, universities and extension organizations in the dairy innovation processes, the uncertainty of the milk market in Addis Ababa and some organizational and behavioral issues such as planning habits and mistrust among the dairy actors are discussed

6.7.3. Restricted interaction of research and extension agencies with actors in value chain

In the Transfer of Technology (ToT) model research, extension and farmers are the main players while the broad category of non-state actors are often not considered in the planned activities of public research and extension, unless there is a particular partnership arrangement. In contrast, in the innovation system scenario, the role of research and extension is expected to be part of the learning process. Again in the ToT, the state agencies also see themselves as leaders in managing development process while this is not always true in the innovation system model because the lead facilitators could be any strategically positioned actor including the private sector, NGOs, public research, community organizations and others.

In this study, the perception of the interviewed individuals reveals that the diversity of actors in the rural economy is changing. Smallholders are not the only actors as traders, big commercial farmers, processors, transporters, NGOs, input suppliers, equipment suppliers, consultants, farmer organizations, associations and so on also play important roles in the dairy subsector. However, despite the drastic change in the landscape of innovation, the role and development approach of the state agency remains unchanged. In principle, the government policy, aspiring to see changes from subsistence agriculture to market-oriented business, provides a very clear direction on how the research and extension agencies should respond to the changing context. It is therefore important for the state agencies to introduce institutional changes/arrangements that may help to host innovation system approaches, which take into account a better linkage between research and extension agents, NGOs, the private sector and smallholder farmers.

Application of the innovation system approach takes different forms depending on the economic and political contexts (Amanuel *et al.,* 2009; Spielman, 2005). Using innovation system indicators from Hall (2006), a framework of analysis was developed to look into the features of innovation systems based on political contexts and ideologies. For example, in developed countries, private sector actors are ahead in generating and using knowledge, through their own mechanisms. The types of innovation systems for developing countries are not similar to those in developed countries, as the contexts differ (Table 31). In developing countries, the role of the state in nurturing technology development is high and strong service delivery programs are needed to support the initiatives of poor farmers (Spielman, 2005).

The mixed scenario in Table 31 considers lessons from the developed world, taking into account the socio-economic and political contexts of the developing nations. The type of innovation networks one expects from the mixed scenario are driven by poverty reduction and environmental sustainability issues but equally acknowledge the important role of private-sector actors, NGOs and farmer organizations in the development arena.

Table 31: Innovation system models

Parameters	Market model	Popular model	Mixed scenario
Driving force	Market	Poverty and environmental problems	Multiple: poverty, environment, market
Major goal	Profit	Poverty reduction and sustainability	Fair trade, equitable profit, sustainability.
Prominent actors	Market forces	Public research and extension, community, NGOs, farmer organizations	All market and non-market forces
Sources of knowledge	Multiple, primarily private-sector actors and electronic media	Public research, indigenous knowledge, experiential learning	Multiple: predominantly actors interaction and experiential learning
Role of the state	Creating enabling policy	Creating enabling policy, financial support, facilitation role, knowledge and technology supply	Creating enabling policy, financial support, facilitation role, knowledge and technology supply
Equity concerns	Survival of the fittest	Subsidy to assist the poor	Capacity development of all actors and creating equal chances for all actors
Environmental concerns	High for food products and health when demanded by consumers and government legislation	High on soil, water and biodiversity issues, limited concern on food products and health	High concern for all environmental issues but no direct interventions except capacity development

Source: Developed by the author using innovation system indicators from Hall (2006)

Empirical findings in the study area show the public research and extension agencies are not adequately participating in dairy-related development networks initiated by other agencies. One change in public agencies should be to facilitate and systematically take part in commodity-based or issue-driven innovation networks. Participation means not merely attending meetings but committed engagement of actors with effective contributions to generating and sharing knowledge.

6.7.4. Demystifying the milk market problem

In this study, the paradox was that smallholders are seeking milk markets while the milk-processing industries are all operating below half of their capacity (see Table 16). Discussions with market actors revealed that, currently, the daily sales of the shops are optimal and many of them are not ready to accept more milk. The milk processors have also made it clear that their major challenge is a limited end market. The key marketing problem appears to be the lack of an adequate end market in Addis, attributed mainly to four institutional factors, which are described below:

Long fasting seasons: Believers belonging to the Coptic Orthodox Church fast for 196 days per year (EOC 1962), during which no animal products, including milk, are consumed. Some fasting periods last approximately two months. Unfortunately, most of the fasting periods correspond with the high-rainfall seasons, which correspond with high milk production in the rural areas.

*Milk-drinking habits of adults in Addis Ababa***:** Unlike many African nations, tea is drunk in parts of Ethiopia, e.g., Addis, without milk, although there are places like Bale Zone of Oromia Region, where tea is traditionally mixed with milk. Coffee is widely drunk (mainly in the coffee houses) with milk in the form of "macchiato" (strong coffee with some milk) and "café latte" (more milk with some coffee). Following milk, the most widely used dairy product in Addis is spiced butter and soft cheese (mainly during holidays). Milk is commonly drunk by children and patients on strict diets. Several key informants agreed that traditionally, in many parts of the northern Ethiopian highlands, adult men are attracted to strong drinks with high alcoholic content, and milk is a "soft drink" to be given to children. A legacy of this tradition is that many people in Addis, although they do not dislike drinking milk, are less interested in doing so. Only recently was public education started through public television and milk posters, with the support of Land O'Lakes. Education programs are few however.

High milk price: With the rising feed costs and other factors, several respondents in the survey confirmed that the high price of milk prevented many people from having milk in their daily diet. In addition to the lack of a tradition of milk drinking among the Addis citizens, the rising price of milk seriously limits the milk market. One liter of milk a day for a family of five means an annual milk consumption of 73 liters per year per person, which is quite close to the world average milk per capita consumption. However this costs 26 percent of the monthly salary of a middle income civil servant, and it is highly unlikely for most families to afford.

The major input that determines the milk price is feed. Producers always complain about increased feed cost. An advocacy group organized by the SNV led milk value chain network has managed to take the issue of Value Added Tax imposed on livestock feeds to the government. According to the network organizers the government has replied positively but implementation of the decision is taking time. However, improvement on the tax issue is likely to contribute very little to reduced milk prices. Solutions for this problem will arise though improved economic

growth, with a positive impact on increasing income of the middle class and lower class citizens. Ethiopia, being regarded as one of the fast growing economies in Africa, is indeed likely to expect that the emerging middle class will be able to positively respond to the raising milk price.

Dominance of the informal milk market: This issue is critical, as it has several implications not only for the market but also for policy, public health and other social dimensions. The amount of milk sold in the informal market of Addis is estimated at 70 percent (Genet, 2010). "Informal market" refers here to the unpasteurized fresh milk supply by dairy farmers in Addis to their customers, often on a contract basis through house-to-house delivery and without a business license. Many lower and middle-class citizens prefer to buy milk from the informal sector because they want to avoid the cost of processing, bottling and transporting. Secondly, consumers also believe they get a higher butter fat content from the informal market. Milk processors argue that the bulk of the milk supplied by urban dairy farmers in Addis to the informal market has prevented them from working at full capacity. In other words, the lack of an adequate end market for their products is the main reason for operating at reduced capacity. This has also contributed negatively to innovation in the area of processing plants in Addis. Every time a new investor shows interest in starting milk processing, he/she is highly discouraged by the low performance of the existing plants and dominancy of the informal market for dairy products.

The issue of informal and formal market supply is also a critical one in other countries like Kenya and Uganda. For example, in Kenya, where the dairy industry is relatively developed in sub-Saharan African terms, 60 percent of the milk is supplied to the informal market and, out of the installed milk-processing capacity of 2.2 million l/day (while that of Ethiopia is about 156,000 l/day), approximately 26 percent of this capacity is currently being utilized (Karanja, 2004).

6.7.5. Mistrust among dairy actors

Three important cases are chosen to demonstrate how mistrust affects the confidence of actors to engage in collective innovation processes. The most common scenario is mistrust between the milk producers and processors. Producers complain that milk price setting is unilaterally decided by the processors, who are the most important end market for fresh milk from rural producers.

On the other hand, processors complain of poor milk quality forcing them to reject or lower the price of milk and inconsistent supply, especially during the time of milk shortage. Several efforts have been made by the SNV-led dairy value chain network to overcome this, but the mistrust continues to challenge collective learning and innovation.

The second case of mistrust is found among the processors. Most of the milk processors are part of the SNV-led dairy value chain network, but some do not share information, because they consider it as a business secret. This was a very critical challenge to enhancing learning through experiential visits to each other. The management of the leverage and financial intermediation funds in the SNV-led dairy value chain was another source of mistrust. Some processors and commercial dairy farmers think that the support provided to members should never boost the market success of some actors at the expense of others.

Mistrust among the NGOs also has implications for the dairy innovation process, though it is a less serious problem. There is a growing tendency of NGOs working in the study area to support the private sector and smallholder farmers engaged in dairying. However, the work of the NGOs is not coordinated, and some NGOs show competitive behavior amongst themselves. For this reason, there is duplication of work. For example, the SNV-led dairy value chain has formed the EMPPA and Land O'Lakes has formed the Ethiopian Breeders Association. Some NGOs, like Self Help Africa, support the formation of dairy cooperative unions, which also target dairy producers. Among other things, these fragment the voice of smallholder producers, particularly smallholder farmers, who then have a fractured voice to influence policy and foster innovation. The fact that conflicting parties (producers and processors) are in the same association is also one cause for the limited progress of the EMPPA.

6.8. Summary

History provides lessons to the dairy subsector. The presence of a strong state agency during the Derg regime to promote smallholder dairy as well as the establishment of state enterprises during the imperial regime to develop commercial dairy were positive steps in the development of the dairy industry. Both showed good results in terms of addressing the designated target groups. On the contrary, the current regime does not have such agencies on livestock development except the recently formed Ethiopian Meat and Dairy Technology Institute (EMDTI), which

doesn't specifically focus on smallholder farmers and has limited influence on the dairy system because it has limited resources. Dairy development of smallholders has not shown progress therefore during the past 20 years. The current study shows productivity of improved dairy cow in the study area is lower when compared with the situation 20 years before. On the other hand, the population of Ethiopia has doubled in the interim and the need for food at the national level is rising. The free market policy of the current regime, on the other hand, has triggered dairy innovation. The innovation was however more effective in the processing and marketing side of the industry, with little spillover effects on rural dairy innovation. This demands better emphasis by the state to the dairy subsector, for greater results in rural innovation.

Technology and inputs are also expected to trigger innovation in the dairy system. Among the dairy resources: feed, improved dairy stock and land play important roles in dairy innovation. These three factors had very little effects to contribute to dairy innovation in the current system, simply because there is little supply of improved stocks and access to land is limited. Some of the inputs, such as formulated feeds also remain very expensive for smallholder farmers who at the same time complain of a lack of markets for their products. Land holding of smallholder dairy farmers and the presence of improved dairy stocks in Sululta is better than it is in Berek and Welmera. In fact some donor supported project interventions of the past regime made important contribution to increase the fodder base in the study area (new forage species were introduced) and to improve the breed composition of the stock in the study areas (high number of crossbred animals were introduced). The government decided to sell out all state-owned ranches thus there is literally no heifer supply from these ranches and dairy cattle improvement depends on the AI services, which farmers indicate are insufficient. The absence of responsible body (private/state owned) for forage seed production and distribution (emphasis of the government is on crop seeds) also affects the fodder innovation in the rural area. The extension agents are struggling to make changes with limited resources, which are mainly a legacy of the World Bank supported national forage development initiative called – *the fourth livestock project.*

Milk marketing is a critical challenge that affects many smallholders in the study area. A SNV-led value-chain network on dairy-related issues is an important avenue where several dairy actors interact and market issues of smallholders are addressed to some degree. However, smallholder farmers and extension workers are located outside the network. Only the big commercial farms,

processing plants, coop unions and other dairy actors are benefitting from the interactions. The participation of research organizations to support the knowledge and information exchange that take place in the arena of the private sector actors (e.g., the SNV led dairy network) is also absent. In other words, the current configuration of actors in the dairy industry requires the state to adapt a new approach to support the growing interaction of the various private-sector actors, including smallholders. The emphasis of the state policy on export commodities has also negatively affected the dairy industry simply because dairy is not yet important in the export market while the government gives priority to export commodities.

The milk market problem that challenges smallholder farmers, processors, supermarket actors and even consumers demands a new orientation of the research and extension organizations as well as the private actors to bring about innovative solutions. Four important factors – the long fasting traditions of Orthodox Christian followers, the low milk drinking habits of adults in Addis Ababa, the high price of milk in contrast to the low income of the majority of the population and the dominancy of the informal milk market, have complicated the milk market challenges. Unlike the traditional ToT model, these challenges require a continuous engagement of dairy actors to create a learning and adaptive consumer market. There is encouraging interaction taking place in this regard in the NGO-led networks. However, some critical factors limit the interactions of those networks, such as mistrust between various dairy actors and lack of important dairy development institutions from the State as well as the private sector.

The dairy innovation system in the Addis Ababa milk shed is found to be a function of the interaction and linkages of actors aligned around technological issues, market, policy and institutional factors that influence innovation. Five important clusters of actors including the Farmers (producers), Processors, Market actors, Policy actors and the Formal and Non Formal Knowledge and Extension Institutions are the key players responsible in the making of innovation in the Addis Ababa milk shed. This study shows the complementary actions of the actors helps dairy innovation to take place (Röling and Engel, 1991) and any failure or constraints in linkages within or between any of the clusters negatively affects the innovation process. In this study, the systems perspective was useful to look into the effective complementary actions, so that it is possible to encourage actions based on the success stories. From the systems perspective it is also possible to identify the constraints in the system and to

find mechanisms for addressing the problems. Using a systems approach has also provided opportunities identify *leverage points,* the most critical of which considered in the next chapter.

CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

7.1. Introduction

The Addis Ababa milk shed has been assessed as a "system" using the Agricultural Innovation Systems approach to explain how the system was developed over time and continues to function. Against this backdrop, it becomes possible to provide a new holistic framework for assessing the milk shed and identify areas for intervention that have not been made before. The thesis has identified five points - leverage points - at which changes can be proposed to improve the smallholder role in the Addis Ababa milk shed- learning from history, dairy resources, linkages, institutions and policy. Specific recommendations are given following the formulations of ideas around the leverage points. Finally, reflection is made on the theories used in this study**.** The new insights this study has added to the knowledge body of the Agricultural Innovation Systems are summarized, and areas of future research are proposed.

7.2. Learning from history

It is imperative to understand that history of improvement within a sector such as the dairy industry in the Addis Abba milk shed is seldom a linear process. Innovation in one era is not necessarily capitalized upon within another, but there are often important lessons to draw. Over the last 60 years, the dairy subsector has received various forms of support during the three regimes of Ethiopia. Common to all was the important role policy played to drive innovation. The orientation of the imperial regime policy was to promote new technology in livestock development through forming an agency responsible to promote dairy in Addis Ababa. Nevertheless, the benefits were less conspicuous for smallholder farmers and emerging commercial farmers. They could not compete with the advantaged elites and those from the feudal class who were close to the ruling family and had better access to information and resources. However, the purpose of the government was to introduce modern commercial dairy to the country for the first time, and in that respect the imperial regime achieved its goal. The current Government has followed a similar economic model, after the demise of the Derg regime. However, the context has changed significantly, as the population of Ethiopia has increased two fold since the time of the imperial regime. This demands the government to pay attention to smallholder producers who are strategically positioned to make significant difference

in the contemporary dairy industry. Unfortunately, government attention has focused on export commodities in other sectors of the economy with the result that the support given to the development of smallholder dairy farmers has been inadequate. The innovation process at smallholder level has been restricted and needs to be urgently addressed.

A second lesson that can be drawn from history emanates from failure and success stories of the communist regime. The success story is that the animal resources and fisheries development in the MoA was raised to vice-ministerial level and state-led interventions to support smallholder dairy farmers in selected areas managed to bring about innovation at this level within the system. This prompted changes in the local innovation system, as milk production increased from about 1.6 liters/cow (local) to 8.7 liters/cow (crossbred cows under traditional management). This momentum of growth in production did not continue into the contemporary era. This study, conducted 26 years after the projects of the communist regime ended, has shown reduction in milk productivity by smallholder farmers in the hotspots of the Addis Ababa milk shed. Average milk production of improved cows under traditional management does not exceed 5.59 liters/cow.

The lesson learned from the failure of the communist regime rests on its command-economy policy, which did not open up dairy markets, as was the case with other commodities. Many farmers were not encouraged to boost production because market outlets were limited. This was one of the undesirable effects of the macro economy policy, which was replaced by a more favorable free market economy policy by the current regime. The current regime is credited for introducing three important policies that have had a direct impact in changing the innovation landscape of the dairy industry. These include policies to promote a free market economy, privatization and investment.

The impact of these policy measures is evidenced by the mushrooming of commercial farming, new feed and milk-processing industries, new dairy equipment suppliers, the initiation of associations of private-sector actors, unions and the operation of several NGOs interested in the dairy business. Most of these actors were not present during the communist regime. These changes have marked a new phase in the development of dairy in the Addis Ababa milk shed and yielded several positive results. The assignment of a high number of trained extension agents in

the rural areas has also improved the interaction of farmers with extension workers. It is against this history that the first recommendation emanating from this work is proposed.

Recommendation 1

The government must form a national body to manage animal resources more effectively and equitably.

The recommendation made by the group who developed the ten-year road map for agricultural policy and investment in July 2010 (Demese, 2010) regarding the need for establishing a higher-level custodian for animal resources, is very appropriate and timely. Government of Ethiopia has announced the formation of a State Ministry for livestock development. The institutional change is necessary to contribute to the anticipated changes in livestock innovation. The formation of the new Ministry could act as a leverage point to enable the dairy subsector to make significant contributions to improved food security and job creation. It should also be able to create an enabling environment for the private sector to participate in the export of dairy products. This will help overcome the milk market problem facing smallholder farmers, especially during the fasting seasons. However, a balance between export market and meeting domestic food security needs should be carefully managed by the Ministry. Such a body can ensure these outcomes through lobbying at a systems level. It can facilitate the enactment of new legislation on animal breeding, the formulation of a livestock development plan and promote smallholder dairy farmer innovation support facilities, glaringly absent at this stage. The body must also facilitate the establishment of a national information and knowledge centre for livestock, which is absent at the moment and makes research and policy making a fragmentary and difficult task.

7.3. Dairy resources and implications for innovation

The processing and marketing wing of the dairy industry is showing better development than those working on the production side. Dairy production, particularly, at the level of smallholder farmers, receives inadequate attention in terms of introducing new technologies and new ways of organizing dairy business, despite the deployment of a high number of extension agents. The subsector is also increasingly suffering from critical shortage of improved heifers, rising prices of feeds, limited interactions with formal knowledge institutions and land policy that drives dairy

farmers to the margins of the economic landscape. The increasing price of feed resources, particularly industrial by product feeds and formulated feeds, has caused a dramatic increase in the milk price. The income of the milk consumers is not proportionate to the milk price, which is rapidly increasing. These all adds up to low level of dairy innovation because farmers are less motivated by the benefits they are making from dairy.

Recommendation 2

The Oromia Animal Resources, Health Protection and Marketing Agency must ensure strong participation of small-scale farmers (farmer organizations) in the decision-making processes related to "technology transfer" and input supply plans.

The facilitation role played by the agency for a massive supply of Boran heifer by the private sector actors to smallholder farmers is a good attempt that demonstrates how the private sector actors could support the extension program. Nevertheless, this initiative was not very successful because farmers were not consulted sufficiently and the heifers did not meet their expectations. It is also important for the public extension agency to find more private-sector actors who can supply improved heifers to farmers, instead of working only with local Boran heifers. The public extension agency and unions could encourage the creation of new players in the heifer market value chain. This new player could be specialized improved heifer production enterprises or intermediary agencies that may collect improved heifers from private farms elsewhere in the country and supply them to farmers through the unions as per agreed contracts.

A more systematic fodder innovation platform for the milk shed needs to be considered to improve the problems associated with livestock feed shortage. The ILRI initiative to create a fodder innovation platform is a good example in this regard, but improvement has to be done to make the forum less elite dominated and more inclusive of farmers and private sector actors. The price of industrial by product feeds is likely to drop over time along with the huge expansion of food and beverage industries in Ethiopia. This opportunity could be used for further innovation when the innovation platforms are seriously at work.

7.4. Dairy actors linkage, interactions and the innovation landscape

The key actors and the innovation landscape of dairy in the Addis Ababa milk shed can be characterized as:

- A high number of smallholder dairy producers mainly working with indigenous knowledge, very low capital and some information linkage with the private sector;
- Emerging commercial farmers with little connection to the formal knowledge institutions;
- Growing numbers of milk processors, highly dependent on their own experts and consultants;
- Increasing numbers of NGOs with significant interest in improving the marketing side of the dairy industry mainly from the commercial farmers interest perspective;
- Growing number of networks and forums on dairy, though not easily accessible to smallholder farmers and questions around sustainability because it is foreign funding dependent;
- High number of extension agents with limited focus on dairy market development;
- Little access of small holder farmers to dairy technologies, particularly on genetic improvement and feeds; and
- Very low involvement of research in the knowledge and innovation processes and absence of national government plans to develop dairy.

Actor interaction is an important issue across the innovation landscape. There are interactions that are particularly of concern, including the formal knowledge network, the non-formal knowledge network and the social networks at grassroots.

Formal knowledge network

Research has some presence in Holleta, while Berek and Sululta farmers have no direct working relationships with researchers, nor are farmers demanding their involvement. The absence of senior dairy scientists (except a few on forage) in Holleta, Debre Zeit and Debre Berhan Research Centers (some of the important livestock research centers found within a 100 km radius of the study area) and the limited engagement of the International Livestock Research Centre with farmers as well as with the emerging value-chain networks in the milk shed, hinders innovation based on access to new knowledge that could underpin innovation. No single example that demonstrates a research partnership between the public research organizations and

the private sector was found in the study and indicates low-level dynamics in the dairy innovation system. Instead, the contribution of the private sector actors in knowledge and technology transfer to smallholder is better.

There is also a growing tendency for the entire extension system to focus on the Farmer Training Centers (FTCs). This gradually causes a role shift of the extension workforce into a kind of "formal education" function, which gradually ignores most of the crucial activities of marketing, institution building, improving access to finance, networking etc., which are also important aspects of extension especially for small holder farmers. Most extension agents see themselves as trainers and their workstations are the FTCs. The real work of the extension agents, which involves communication and interaction with actors outside the FTC, is gradually fading away. On the other hand, the context change in the rural areas shows the emergence of more actors and factors and the situation requires more advanced skills of interpersonal communication and facilitation that go beyond the little world of the FTC.

Non formal knowledge network

The non-formal knowledge network on dairy-related issues is dominated by the NGO sector and local communities. These networks are not created by state agencies or not part of the mandate of any of the state agencies involved in research and development. The SNV-led value-chain network, Land O'Lakes' regular meetings of commercial and contact farmers, IIRR- and ICCO-led learning alliance, and the ILRI-led fodder innovation roundtable are the most important knowledge networks, which have had significant influence in advancing the dairy business in the Addis Ababa milk shed. However, most of the fora, notably the SNV-led value-chain network and the ILRI-led fodder innovation roundtable, are not addressing the issues of smallholder farmers well. The SNV-led value-chain network is restricted by its own policy to deal with intermediary agencies. Unions and cooperative are therefore representing the farmers but still there are few developing benefits for smallholder farmers.

Social networks

This study has confirmed that farmers have access to dairy-related knowledge and information, not only through the formal and non-formal systems mentioned above but also through the social networks, which is strong in some areas. It was found that about 37 percent of the information

obtained on feeds, health, housing and breed improvement is obtained through social networks and nearly 100 percent of market and business information is generated from these networks in Berek and Sululta. Understanding the social network process is helpful for actors who want to intervene from outside to strengthen the resilience and innovation capacity of the local systems. For example, of the different social network activities, 14 percent of the respondents from Sululta suggested that their own observation and experimentation were the best source of information and knowledge. This indicates that farmers also depend on their own knowledge generated by own experimentation and observation. Any support that builds on this will certainly bring to the farmers more capacity and confidence to take risk and to innovate.

Recommendation 3

Research based organizations and universities need to proactively improve significantly their participation and approaches within the existing networks and forums.

The recently issued science technology and innovation policy of the government also encourages these institutions to interact with the private sector actors in the country to achieve rapid and grater changes in technology transfer and innovation. The existing value chain networks and forums could be therefore entry points for such actions but new innovation platforms could be also initiated as the case may be. Here, the bottom line principle is equitable participation of all actors must be ensured and the power relations of the state and non-state actors need to be carefully managed. Heavy hands of the government in decision making, in voluntarily created learning and action platforms, will not help to bring good results.

The value chain/innovation networks also need to create more space for the participation of smallholder farmers, instead of limiting themselves to engage only with unions and coops. Smallholder dairy innovation cases could better be identified and supported if the forums/platforms are able to go down to the grassroots, instead of getting satisfied with the participations of the elites of the farmer organizations, who are more interested on organizational and administrative matters. The innovation out puts from the interaction of the forums and innovative smallholder farmers could be used as learning avenue for the entire system.

The Farmer, Research and Extension Linkage Council, which is the highest body in the formal system for knowledge and information sharing between state actors and farmers, is still important but needs some changes to make it more effective and responsive to the needs of smallholder farmers. This council could contribute more if commodity-based and decentralized networks are created for effective value chain oriented learning, rather than having a unified and cumbersome national level annual conference.

A new curriculum (revised curriculum) that takes into account important approaches such as value-chain development and innovation systems thinking is needed to improve the performance of the extension agents. Changing the mentality of the extension workers from being simply agents of technology transfer to becoming advisors of business and entrepreneurship development is among other things very critical. For example, an extension agent in dairy development should be knowledgeable not only in feeds, AI or cattle management but also he/she need to have the knowledge and confidence to advise farmers on how to run a profitable dairy business in the midst of the complex dairy market phenomena in the country.

Researchers and NGO experts could consider the experimentation and observation capacity of farmers as entry point to develop innovations, instead of considering farmers always as receivers of knowledge and technology from their end. Moreover, it is very important to look at the most resilient actions of the local people not only from a technological development point of view but also in the institutional, financial, and social fronts.

7.5. Implications of policies and institutional factors for dairy innovation

7.5.1. Policy issues

The findings on policy issues is summarized by reflecting on the limitations of the current policy-practice continuum and the overarching state policy on economic development and predicts the future from a point of view of implementation of key polices relevant for dairy innovation.

Policy–practice gap on commercialization

In the study area attempts were made by Welmera extension workers to provide market information to farmers, but this did not go beyond telling farmers about milk and butter prices.

The Ethiopian Extension System has no good records of market supports. Almost all of the dairy development projects mentioned in the historic timeline were not market conscious, rather production oriented. This has limited farmers not to enjoy the benefits they deserve. In the current system, the Government gives considerable policy attention to changing subsistence agriculture into commercial business. However this does not seem to be accompanied by market related programs and strategies, especially in relation to dairy. The formation of the livestock health, production and marketing agency in Oromia is indeed a great achievement in this regard. Nevertheless it is not possible to see the impacts of this agency in the study area (the study area is found in Oromia region) and this is mainly because a well thought through marketing strategies and programs has not developed. Simply the traditional extension supports are going on for dairy while a new organization is set up on livestock marketing.

Impacts of overarching state policies on dairy innovation

Export oriented development policy of the government should not have a negative impact on some sub sectors such as dairy. The export oriented policy of the government is a right choice for stimulating economic growth in general but care has to be taken not to affect the growth of some sub sectors like dairy (because they are not yet in the export market adequately). All the major state agencies are allocating their resources and energies to promote export commodities like coffee, cut flowers, haricot beans, meat, sesame etc. For example it is not easy for commercial dairy farmers (not processors) to get loans from state-owned development banks for expansion of their dairy business while it is easy for those engaged on export commodities.

Recommendation 4

The Oromia livestock health, production and marketing agency must make a shift to a more market-oriented approach in order to provide meaningful support to smallholder farmers.

The agency needs to reorganize the extension work to accommodate the interaction of diverse actors more reasonably through implementing various strategic and innovative ideas such as:

- Strengthen the bargaining power of farmer organizations in the market by helping them conducting feasibility studies on certain economic projects of farmer organizations (e.g. dairy processing project of Selale dairy union) and facilitating information for important business

deals between the coops/unions and other market actors. Actions need to go beyond the legalization support of the cooperative office, as it is so commonly done at the moment.

- Nurture the development of new dairy-related commercial activities required in the bigger market (e.g. commercializing fodder seeds, commercializing silages, facilitating butter cooperatives for women and others). Such activities can be developed through piloting, learning and gradual up scaling.
- Introduce innovative linkage models between milk producers, input suppliers, private AI, private vets milk collectors, milk processors and others, with a conscious emphasis to reducing operational costs and market challenges.
- Improve farmers' access to financial sources and low cost processing technologies.
- Support the formation of "dairy business hubs" in strategic locations of the milk shed to help farmer-organizations get access to low cost and privately owned dairy-related business (AI services, vet services, feed processing, feed trading, milk processing and trading). This may improve the services to the farmers and encourage dairy innovation in many accords.
- The government needs to consider a "bridging policy" in order to speed up dairy development without contradicting the government policy on commercialization of agriculture that focuses on export market. The bridging policy could pay attention on commodities having the potential to be competent in international markets. This requires not only policy attention but also a deliberate action to prioritize some of the commodities with high export market potential, like dairy. Those candidate commodities might not show quick results, like the flower industry did. The flower industry has a huge foreign market and a very small domestic market. On the other hand some commodities like dairy, which can be potential candidates for the bridging policy, need to take on the challenge to meet both the domestic food security demands and international market demands. The main benefits of these measures will be to overcome the milk market problems at different levels and to enhance dairy innovation by attracting more players, more technology and more creativity.
- The recent formation of a State Minister for livestock development is a very important step towards reinvigorating the livestock resources and innovation. The fact is that government is moving aggressively in the area of city renovation, urban development and industrial village building around Addis Ababa. These developments will have a sustained negative effect on the dairy product supply to the city. In the light of these dynamics, it is should be one of the

priority area of the Ministry to develop a dairy development master plan, that takes in to account the changing contexts. This requires lots of policy innovation because no one should dare to stop the ongoing changes in the city but to find a space to accommodate dairy as an important player in development. Creating more enabling environments and incentives for the private sector in the dairy business to take off could be a helpful direction in which to enhance innovation and ensure sustainable dairy product supply to the city (and contribute to the food and nutrition security).

7.5.2. Institutional issues

The key institutional issues that affect dairy innovation are related to farmers' market problems and the mistrust among several dairy actors

Farmers' problem with the milk market and the way forward

The milk-marketing problem of smallholder farmers in the study area is mainly caused by the inadequacy of the end market in Addis. The Government, specifically the MoA, has to be aware of the fasting tradition of many Addis citizens, their milk-drinking habits, the low income of most citizens, and the dominance of the informal market as the main factors that paralyses the end market of the formal milk-marketing system. For these reasons, all the milk-processing plants are operating under capacity and the milk intake from rural smallholders is decreasing. Some of the processors claim that low milk production from the farmers' side is a reason for operating under capacity, but the majority believes that the problem of the end market prevents them from processing beyond a limited amount of milk a day.

The milk-supply system in the Addis Ababa *milk-shed* is characterized by rural-based smallholder farmers supplying the milk-processing plants, while the dairy farmers in Addis (intra urban dairy) supply their products mainly to the informal market. The informal market controls the milk market in the domains of the lower- and middle-income citizens, which is indeed the majority. This forces the processing plants to limit their intake. The amount of products the supermarkets and milk shops in Addis are currently taking from the processing plants seems to have reached an optimal level. Unless the marketing side of the dairy industry makes some progress, any attempt in the rural area to increase milk production, as a result of introducing effective extension systems or emergency of new commercial dairy farmers, is highly likely to

end up with oversupply to the formal market. This will be frustrating, and many of the actors from the production and processing domain will be forced to leave the subsector. For smallholder farmers from the rural area, it is not easy to join the informal market in the cities (specially, Addis) because of distance, lack of facility, lack of organization and limited market information. On the other hand, although the informal market seems to be a lucrative business for many smallholder producers in the urban areas; public health concerns is always top on the agenda. The fear for the infection of Bovine TB cannot be undermined, particularly for those people who have a tradition of drinking raw milk.

Confidence building for increased mutual trust among Actors

The mistrust that exists between the milk producers (particularly farmer organizations) and milk processors, as well as between the milk processors themselves, is another challenge that prevents innovation in the subsector. Both depend on milk for their business, but animosity rather than partnership is reflected in many ways. Business competition is likely to enter into the network environment. Unless a carefully considered network policy is developed and implemented to prevent fierce competition and animosity, the chance of jeopardizing partnerships and learning processes is higher.

Recommendation 5

The Ministry of Agriculture, Addis Ababa City Administration and Oromia Region investment offices must develop incentive packages to attract investors in the milk processing business for the export market.

- New investors on the production side (even processors that targets the domestic market) could be discouraged by the seemingly saturated domestic market, and the milk-marketing problem of the farmers would continue to remain the same. The coming of export oriented dairy processors, on the other hand, will not only help to solve farmers' market problems but also encourage more people to join the dairy production side of the system and thus the entire industry will thrive and develop.
- Any upcoming programs of the government for dairy (e.g., the upcoming national livestock development master plan) need to take into account, not only the production

component but also the development of markets on dairy products. The opportunity created by the free market policy is favorable for creating a competitive dairy market. Government programs therefore need be concerned with opening up market outlets for smallholder producers and processors alongside their efforts to improve production and productivity. The increasing tendency of the Government to organize youth and women in the city around micro and small enterprises through facilitating access to financial sources could provide an opportunity to initiate market linkages between rural producers and some of these enterprises. The Government could support the small enterprises through providing working space (establishing milk distribution shops) in several strategic locations in the city, in addition to making financial sources possible. In addition, NGOs and the MoA could facilitate business linkages between farmers and the small enterprises in the *milk shed*.

- Public education is another important area that deserves very high attention to address one of the factors that affects low milk demand in the market: *milk drinking habits of the Addis citizens*. This factor could be significantly changed by providing well-thought-through educational programs using mass media. So far public education did not receive important attention, except the recent engagement of Land O'Lakes (now discontinued) in commercial works using national television and signboards. The educational programs or commercials need to aim at communicating information/knowledge to the consumers about the dietary role of milk and the health benefits but grate care needs to be taken not to mislead people in relation to sensitive medical information. It is, of course, necessary to recognize the possible health problems of some adults as a result of drinking milk, but so far this problem has very little public health importance in Ethiopia.
- The networks/platforms must be able to minimize conflicts among the dairy actors and contribute towards building trust in the system. In principle this could be done by focusing on the common goods such as knowledge/information generation and sharing, advocacy on policy issues, capacity development (training) on carefully selected issues, familiarization with new technologies, public education through various media and providing technical assistance to help entrepreneurs get financial access from different sources. In addition, if projects or initiatives are financed by the network itself, they must have a very transparent system and well-organized procedures – to help minimize

conflicts among members. Such investments could be also considered to be experimental projects to help the network members learn about new technologies and business models on the workstations of volunteer members.

7.6. Reflections on the theory

In this study, the dairy innovation system in the Addis Ababa milk shed has been viewed as a social system, and has been investigated from the points of view of the linkages of the diverse actors in the subsector and the institutional and policy matters that affect the linkages. This enabled an understanding of the key interactions of actors and how those interactions resulted in or blocked innovation processes in the dairy industry. The Agricultural Innovation System (AIS) was the main theoretical perspective used to analyse the problem situation of this study. In short, a study on AIS simply involves a critical look at the interactions of the diverse actors taking part in the different dimensions of the agriculture sector, including the production, the processing, marketing, policy and knowledge institutions. Inclusion of all these dimensions makes the approach similar to the value-chain analysis and development approach, which is becoming popular in Ethiopia and many parts of the world. Indeed, the structure of analysis and the actors that may attract attention in the AIS are quite similar to that of the value-chain studies.

The key difference is, however, that in the AIS, more emphasis is made on understanding the interactions of actors from the viewpoint of learning and innovation (knowledge development, sharing and practicing) while the value-chain approach pays more attention to marketing and the relationship of actors to promote a market norm that befits all the chain actors. Research, universities and extension agencies of state and non-state actors therefore hold marginal positions in the value-chain analysis and development framework, while the events that take place at the interface of the private-sector actors is the main area of analysis. In the case of AIS, these actors are considered part of the main body of analysis, as knowledge and innovation are key parts of the system.

A few additional aspects raised by this study can contribute new insights to the AIS, from the viewpoint of both diagnostic and operational frameworks. These include:

Converging Innovation and Resilience Capacities

The concepts of innovation and resilience are seen in this thesis as complementary processes in enhancing desirable changes at community level. Empirical evidence was used to explain the integration of the two concepts. In exploring the highest leverage points with the greatest impact on system-level changes, the meeting points of resilience and innovative actions are critically important. Resilience actions are not necessarily those characterized as a spontaneous response of people during shock situations but can also be seen as an embedded fund of energy which has accumulated over many years as a product of the dynamics in social capital. This fund of energy could be mobilized to cause transformation, even in times of no shock.

As depicted in Figure 22, the combination of high policy/opportunity-driven innovation and high community resilience results in transformation, while the consequences of low-level community resilience and low capacity of the community to innovate leads to poverty. It is therefore very important for innovation system studies not to consider that successful innovations are always externally driven phenomena. It is necessary to look at the resilience structure of the social system under consideration to maximize the chances of greater innovation outputs and outcomes.

Leverage points

The issue of leverage points is not new to system studies or to value-chain analysis. However, it is not very common to take the issue of leverage points as an important framework of analysis in the innovation system. For example, this point is not highlighted in the methodological frameworks of Hall and CTA to study innovation systems. This thesis has therefore borrowed the concepts of leverage points from the work of Meadows (1999), as well as Hodges *et al.* (2006), and used this as a framework of analysis, particularly to suggest the most important areas where intervention is needed to improve the innovation system. It is therefore useful to add this framework to the broader methodological framework used by Hall and CTA for better results.

Analytical tools

The analytical tools suggested by CTA and Hall are extensively used in this study and were very helpful for exploring several issues in relation to interactions and innovation. This study, however, used more analytical tools, such as hierarchy and relations analysis and subsystem

typology analysis. The outcomes obtained using these tools complemented each other and helped to show the different angles of the innovation system. Hierarchy and relations analysis is very important for understanding power relations of actors aligned on the vertical order of the knowledge hierarchy. Analysis of the subsystem typology also helped for focusing on homogeneous groups that might have greater attractions to each other.

7.7. Possible areas of future studies

After conducting generic studies on Agricultural Innovation systems (like this study), more focused work could involve specific economically and socially significant processes such as introduction of successful technologies or introduction of organizational or institutional change into the specific subsector. For example, feedstuffs which have impact in the production and market arena, a new AI technology which may significantly improve milk production, a creative marketing model on milk and milk products, a particular education and learning model related to dairy could be some of the cases. It is also very critical to see the issue of dairy development vis-à-vis environmental challenges. The gas emitted from livestock as a result of physiological process of the animals is among the highest polluters of the world. Concerns are rising on how to mitigate this challenge. With the increasing human population and emerging of a middle class economy in many countries, the demand for milk and milk products will continue to grow. The Addis Ababa milk shed is a typical example of such cases. Future research should look at how to meet the milk demand of the growing population without having significant negative effects on the environment. Much work of this type will certainly give rise to developing a framework to facilitate innovation processes, in addition to the specific values they could add to the system under consideration. Lack of a well-developed framework to facilitate innovation processes is still one of the critical limitations in innovation systems thinking in general.

The second possible area of study refers to the recent initiative of the Ethiopian Government on the Science Technology and Innovation Policy, which is already issued and is in the process of implementation. This policy cannot be implemented easily and successfully, as it requires significant attitudinal and habitual changes from the state agencies and other actors, because the traditional practices of the State in general is framed based on the ToT model, in which limited actors are considered in the knowledge hierarchy, and in a top-down fashion. Understanding the

leverage points to change the ToT model into an innovation systems model is therefore very critical to help the policy achieve its anticipated goals. More critical even is to look into the structures, principles and values of the innovation platforms the government anticipates to see functioning in Ethiopia. A learning platform is a voluntary action of actors and it is important for government agencies to learn how to facilitate innovation platforms, in the course of transforming technologies at a larger scale. Carefully designed studies on on-going learning platforms could provide lessons for policy makers and practitioners.

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APPENDICES

Appendix 1: Checklist for Key informant interview for innovation system appraisal

Interview No_____

Introduction

My name is Amanuel Assefa, and I am a program director of Agri Service Ethiopia, Addis Ababa, Ethiopia. I am conducting research in to the Addis Ababa *milk-shed*. The intention of this interview is to obtain information about the actors who participate in the dairy sub sector and understand the networks and the linkages exist between actors and the impacts of policies and institutions on developing and sharing knowledge in the sub sector.

I am asking you to be interviewed because of your knowledge and involvement in this sector. Your participation in the interview process is entirely voluntary and you can withdraw from the interview at any point. The information that you provide will be used as part of my work towards my doctoral thesis but at no stage your name will be used unless you give me permission and all the information supplied will be regarded confidential and it will not be possible for anyone to associate your information with any of the actors and their roles in the sub sector.

Profile of interviewee

Name of the contact person_____

Name of the organization _____

Position in the organization_____

Professional affiliations _____

Objectives of your organization_____

Involvement in the Addis milk shed 1. Berek ☐ 2. Sululta ☐ 3. Wolmera ☐

Others (specify) _____

Level of education:

Education	**Grade**	
Primary	0-6	
Secondary	7-12	
Tertiary	Diploma	
	Degree	
	Post graduate degree	

Address (telephone) _____

1. Actors Satisfying objective 2 _____

1. Objectives of the organization you belong to with specific emphases on the dairy component?
2. Please indicate the list of actors that you know who are involved in dairy production, milk processing and marketing within the Addis Ababa (AA) *milk-shed*
3. Indicate the key functions and roles of each as you understand them
4. Which actors affect the small holder dairy farmers in the milk-shed?
5. How do they affect these farmers?
6. With which of the actors are you strongly linked and why?
7. How do you explain the extent of the linkage (Linkage diagram)?
8. With which of the actors are you not well linked? And why not?
9. Are there forums, networks, platforms, learning alliances or similar bodies, where people exchange ideas, share knowledge and information on matters related to dairy
10. If yes, provide the names, champions/leaders, and their agendas
11. Are you part of any of the above-mentioned?
12. If yes, what is your role?
13. If not, why not?
14. What are the strengths and limitations of each?
15. How successful are each in supporting smallholder dairy farmers?
16. Why are they successful (indicate cases if possible)

2. Key innovation practices of actors: Satisfying objective 5_____

Please indicate the key innovation practices you are familiar with in the dairy sector. In this study *innovation practices* refer to the successful application or introduction of new or existing knowledge into the economic system in such a manner that it have benefited people or have the potential to make an impact in the dairy sector.

Innovative practice: [5]Technical,	**Description of the practice**	**Sources of innovation**	**Factors that triggered that**	**Factors that supported the**	**Factors that limited the entrenchment of**

5 *Newly developed and introduced techniques/technologies that brings added value to the existing practices*

[6]**institutional, [7]market related**			**innovation**	**process of entrenching the innovation**	**the innovation**

3. Policies and institutions Satisfying Objective 1

- Which policy/ies have and continued to provide key support to the development of dairying in the *milk-shed*?
- Which government policy/ies have been an obstacle to smallholder and commercial dairy development as well as to market actors
- Why?
- Which of the government policy/ies have not been effectively implemented/ communicated despite their supportive nature? Why not?
- What are the key challenging situations on the ground in relation to the dairy sub sector, to which the government has to pay policy attention?

6 New regulations, organizational forms, newly developed routines, habits and practices.

7New way of dealing with the market, including marketing strategies, promotional works, new partnerships, new ways of accessing resources and so on

Appendix 2: Questionnaire survey of smallholder dairy farmers

Interview No _____

Introduction

My name is _____ and I agreed with Amanuel Assefa who is the lead researcher of a study on dairy innovation systems in the Addis Ababa *Milk-shed*, to collect data on his behalf. The intension of the study is to understand the framework in which the dairy innovation system is operating and to identify the most important leverage points that could make important changes in the system, particularly in favor of the smallholder farmers. Learning about the basic resources of the dairy actors in the rural settings, the networks that involve dairy producers, processors market actors and others, the linkages that exist between the key dairy actors and the impacts of policies and institutions on developing and sharing knowledge in the sub sector are the key areas of emphasis in the study.

I am asking you to be interviewed because of your knowledge and involvement in this sector. You participation in the interview process is entirely voluntary and you can withdraw from the interview at any point. The information that you provide will be used as part of Mr. Assefa's work towards his doctoral thesis but at no stage will your name be used unless you give him permission and all the information supplied will be regarded as confidential. It will not be possible for anyone to associate your information with any of the actors and their roles in the sub sector.

A. Profile of interviewee (head of household)

1. Name _____
2. Sex _____
3. Age _____
4. Level of Education

Education	Grade	
Primary	0-6	
Secondary	7-12	
Tertiary	Diploma	
	Degree	
	Post graduate degree	

5. Family size_____
6. Means of livelihood other than farming _____
7. Leadership engagement in social and administrative organizations_____
8. Have you had a chance to live outside your village for several months or years? Yes____, No_____, If yes for how long?_____, where_____ and reasons for stay_____

9. Have you had any training on dairy related topics for more than a week? Yes ____, No ____, If yes indicate the topic_____, Provider_____ and period of time _____
10. Your address (district, *Kebele* and House number)_____
11. Date of visit of the enumerator: _____
12. Name of enumerator: _____

B. Resource base: Satisfying Objective 3_____

1. What are the resources you have for dairy production, processing and marketing?

2. What are the reasons that some farmers are not involved in dairy production despite the availability of these resources in this area?

3. **Herd size** and composition

Livestock herd	≤2007	2008	2009	[8]Sources from which animals were obtained)
Milking cows				
Heifers				
Calves				
Bulls				
Oxen				

Date refers to cattle population in September to August, for each year (Ethiopian Calendar)

4. Land resource

Ownership Status	Land size in ha			Major crops grown	Yield /ha	Implications on dairy
	2006	2007				
Own plots						
leased plots						
Special arrangement (please mention)						

5. Access to feed Resources

Feed type	Source	Quantity used per annum (Estimated, if records are not available)	Price estimate/unit measurement	Remark
Hay				
Green pasture (cut and carry)				
Grazing land				
Fodder trees				
Concentrate				
Cereal byproducts				
Oil seed cake				
Urea treated molasses				
Crop after math				
Brewery products				
Others (please specify)				

[8] For example **the ministry, market, parents or relatives**

6. Farmers access to veterinary and breeding services

Type of services	Most common Sources accessed (private, state, NGO support)	Distance in Km from the farm	Limitations of the services	Suggestions for improvement
Veterinary services				
AI service				
Bull service				
Heifer supply				
Hygiene and sanitation supplies				

7) Milk production and marketing record

Dairy products	Total production in lts/kg			Main customers, estimated share in percent and average price per liter (milk), per kg (butter and cheese)							
	≤2007	2008	2009	Coops (in 2009)		Processing plants (in 2009)		Snack bars (in 2009)		residents (in 2009)	
				% share	Price	% share	Price	% share	Price	% share	Price
Milk											
Butter											
Cheese											
Others (please specify)											

C. Sources of Knowledge/ information: Satisfying objective 5 _____

1. Technical information

Area	Specific information/technology /service	Sources	Means of accessing	Relative importance			
				Low	High	V. High	Extremely valuable
Breeding							
Feeding							
Animal health							
Milk processing							
Milk preservation							
Forage seeds/planting materials							
Housing							
Approaches/methods/techniques							
Others (specify)							

2. Market information

Information domain	Specific information obtained	Sources of information	Means of accessing	Relative importance			
				Low	high	V. High	Extremely Valuable
Price							
Market place							
Client							
Transportation facility							
Storage facility							
Credit facility							
Others (please specify)							

D. D. State/ NGO/private sector interventions to support dairy development in your area: Satisfying objective 1 and 5 _____

Areas of Interventions	Initiated by	Target groups	New knowledge /information acquired	Relative importance			
				Low	high	V. high	Extremely valuable
Marketing/market information							
Technology Familiarization/multiplication							
Organization development							
Research							
Capacity Development (training, material support, innovation support etc.)							
Improving access to finance							

E. Experiences of linkages in relation to dairy development: Satisfying objective 5 _____

Linkages: If linkage exists between the interviewee and the actors given in the first column, please indicate the intensity by using 1-5 scale. 0 stands for no linkage and 1 is for poor linkage that happens occasionally, without causing remarkable benefits. 2 stand for the type of linkage, which is more regular, but still the benefits are not easy to trace/ articulated, although one can make some sense out of it. 3 stands for good linkages, which are regular and outcomes of the linkage can be described easily. 4 denote strong and regular linkage, in which case both ends make greater economic and social benefits. 5 stand for extraordinary linkages, which are permanent in nature and which causes significant contributions to the economic and social lives of the partners. Breakage of such linkages may not happen so easily but if it happens the damage will be serious. (If the interviewee is illiterate, please use different color papers or different size of woods to demonstrate the scale)

Experiences on linkage in relation to Dairy development

Actors	Main linkage agenda (Specify)	0-5 scale	Reasons for the chosen scale	Impacts on improving the state of knowledge/ innovation				Suggestions for improve
				Low	High	V. high	Extremely Valuable	
Extension workers								
Researchers								
Relatives engaged in similar business								
Neighbors engaged in similar business								
Administration people								
Input suppliers								
Milk collectors								
Processors								
NGOs								
State owned business organizations								
Union								
Cooperatives								
Others (please specify)								

F. Innovation performances

1. Please indicate the key innovation performances (existing practice) you are most engaged in relation to dairy production, processing and marketing. In this study innovation performance refers to the application of new knowledge for better results or application of existing knowledge in a noble way (creative way) to improve business (production, processing marketing, organization) and create new economic/social values (by the individual, or together with other people).

Own innovation

Innovative action: Technical/institutional/market Related	Description of the practice	Source	Triggering factors	supporting factors	constraining factors

2. Please indicate the key innovations developed by others in your village in relation to dairy.

Others innovation

Innovative action Technical/Institutional/market related	Description of the practice	Innovators (men, women, commercial farmer, smallholder farmer etc.)	Triggering factors	Supporting factors	Your position on the innovation	
					Adopted (how? any modifications made)	Not adopted (why not)

3 Please indicate some of the innovative ideas (new ideas) you are just trying (experimenting) on Dairy for possible future practice

Innovative action	Description of the practice	Source	Current state of the innovation	Calculated risks

G. **Policies and regulations:** Government policies and regulations affecting dairy with which you are most happy or unhappy and those, which you think, are causing challenges to dairy. **Satisfying objective 6_____**

Policy/regulation	Happy with	Not happy with	Why

H. Challenges: The major challenges/ constraints you are facing in the Dairy business: Satisfying Objectives 6_____.

Challenges/constraints	Impact/implication

Appendix 3: Questionnaire on Habits and Practices of dairy actors in the Addis Ababa *milk-shed*

Interview number _____

My name is Amanuel Assefa, and I am a program director of Agri service Ethiopia, Addis Ababa, Ethiopia. I am conducting research in to the Addis Ababa *milk-shed*. The intention of this interview is to obtain information about the actors who participate in the dairy sub sector so as to understand what the key blocking and enhancing factors are for innovation to take place in the dairy sub sector. This questionnaire is restricted to deal with institutional and technical issues and not to the entire affairs of the dairy business. For example, issues like the use of veterinary drugs, is not covered as it is a fairly accepted practice at all level.

I am asking you to be interviewed because of your knowledge and involvement in this sector. Your participation in the interview process is voluntary and you can withdraw from the interview at any point. The information that you provide will be used as part of my work towards my doctoral thesis but at no stage will your name be used unless you give me permission and all the information supplied will be regarded as confidential and it will not be possible for anyone to associate your information with any of the actors and their roles in the sub sector.

1. Profile of respondent

Organization_____
Gender_____
Place of work_____
Position_____
Department/ Division _____
Level of Education

Education	Grade	
Primary	0-6	
Secondary	7-12	
Tertiary	Diploma	
	Degree	
	Post graduate degree	

Field of study_____
Years of experience in the current position _____
Total years of experience _____

Instruction:

Please read the following instruction before you start responding to the statements given below.

Please make √ in the box of your choice. The scale 1-5 denotes the following. If you *strongly disagree* with the given statement , please choose number 1. If you just *disagree* with the statement, please choose number 2. If you are not sure to agree or disagree with the statement because you have enough evidences to justify both choices (agree/disagree) or because you don't have enough information to make decision, please choose number 3. If you just *agree* with the statement choose number 4 . If you have a particular reason or supporting evidence to *strongly agree* with the suggested statement please choose number 5.

You are also kindly requested to give explanation for your choice in the space provided below the statements. This is very important for us to fully understand your thoughts and opinions on the issues raised. We expect explanations for all your choices but our expectation is much higher if your choices are number 1 or number 5.

1. In the absence of effective linkages between actors involved in technology generation, transfer, marketing and utilization, effective and quicker development is unlikely to happen.	☐	☐	☐	☐	☐
2. My responsibility is restricted by law/by job description and I don't want to cross that boundary even if I come across with a new and important work, which is not essentially part of my job description.	☐	☐	☐	☐	☐
3. These days (when compared to the situation, say twenty years ago) the number of actors that deals with agricultural development at grassroots level, has increased significantly	☐	☐	☐	☐	☐
4. The research and extension system is not responding to the changing situation in the grassroots environment (mentioned under question 3), because their interaction and engagement is still limited to a few actors (usually farmers) despite the growing number and complexity of actors	☐	☐	☐	☐	☐
5. The BPR that took place in most government agencies doesn't provide enough space to help the staff effectively interact with diverse development actors on important issues that may come to their attention, unplanned.	☐	☐	☐	☐	☐
6. Our main source of agricultural Knowledge/technology (> 95%) is the formal research system and we will continue to depend on that	☐	☐	☐	☐	☐
7. Although it is important and timely, we have a Blurred/ uncertain vision on how to align our works with the developing market situation	☐	☐	☐	☐	☐

8. Civil servants (Researchers and extension workers) are not yet equipped with the necessary knowledge, skills, attitude, and approaches to realize market oriented business in dairy	☐	☐	☐	☐	☐
9. I don't think small holder farmers could generate knowledge or new idea that could make meaningful impacts in the agricultural sector	☐	☐	☐	☐	☐
10. One of the possible reasons why our success rate in agriculture is so low is because we pay very little attention to the social dimensions and institutional development of agriculture	☐	☐	☐	☐	☐
11. Planning of agricultural extension activities is still mainly done at regional bureau level, allowing the grassroots extension actors little chance of flexibility to try new ideas	☐	☐	☐	☐	☐
12. Most of our agricultural institutions, including the national research system, public extension services, and higher learning institutions are highly dominated by people with backgrounds in technical agricultural sciences. Because of this reason the social dimensions of agriculture are not addressed well	☐	☐	☐	☐	☐
13. I don't think the private sector has enough confidence and trust in the capacity of researchers in the dairy sector, to enter in to research partnership - to solve their practical problems	☐	☐	☐	☐	☐
14. The quickly growing media technology in the world has significantly increased our access to knowledge (example internet). Gradually, this will make the role of Public research in knowledge production less relevant	☐	☐	☐	☐	☐
15. The fact that the milk processing plants in Addis operates under capacity (thereby low milk market), attributes to the low level of awareness of the Addis citizens about the nutritional value of milk.	☐	☐	☐	☐	☐
16. It is only the low level of milk production in the Addis Ababa milk shed (including the surrounding districts) that cause's a restricted milk market in Addis.	☐	☐	☐	☐	☐
17. Because there is no health inspection mechanism for milk in the urban areas, the milk sold in the informal market is Highly risky for consumers	☐	☐	☐	☐	☐

18. It is not possible to transform the subsistence dairy production culture in the central highlands (Addis milk-shed) in to market oriented business because of the limited resources (land, capital etc.) the smallholder farmers have	☐	☐	☐	☐	☐
19. Smallholder dairy producers are subsidized by the state because they don't pay tax for the business (except for the land), no matter how many dairy animals they are keeping	☐	☐	☐	☐	☐
20. It is highly unlikely to improve the livelihood of the smallholder farmers in the Addis milk-shed, unless the local dairy animals are replaced by highly productive exotic cattle	☐	☐	☐	☐	☐
21. Dairy for commercial producers is not a lucrative business because of the high feed price	☐	☐	☐	☐	☐
22. There is no forum created or platform to nurture exchange of knowledge between the private sector, state agencies, civil society organizations and farmer organizations	☐	☐	☐	☐	☐
23. The shortage of skilled human power in the dairy sector, particularly on milk processing related activities has hinder the growth of milk processing plants in the country	☐	☐	☐	☐	☐
24. Most of the milk collected from the rural Small holder farmers goes to the formal processing plants in Addis Ababa. The majority of the smallholder milk producers in the urban part of the Addis Ababa Milk-shed prefer to go directly to informal markets, by passing the milk processing plants	☐	☐	☐	☐	☐
25. Establishing a centralized milk marketing body in Addis may help to improve the seasonal market problems of farmers	☐	☐	☐	☐	☐
26. Unless quality based pricing system is institutionalized in the country, fair grounds of competition among the milk buyers is unlikely to take place	☐	☐	☐	☐	☐
27. It is very difficult to know the pedigree of the exotic heifers, cows and bulls in the market. Unless a mechanism is introduced to register the exotic breeds in the country, the market for heifers, cows and bulls will remain unreliable, with a negative effect for dairy development	☐	☐	☐	☐	☐
28. The main reason why the number of people involved in milk processing in the Addis milk shed is low, is because of the low level of milk produced in the system.	☐	☐	☐	☐	☐

Appendix 4: Sample points across the study area

Distribution of Sample points Across Woredas and *Kebeles* by Sex

Woreda	*Kebele*	Sex							
		Male			Female			Total	
		Count	Column %	Row %	Count	Column %	Row %	Count	Column %
Berek	Girar Berek	11	16.7	73.3	4	20.0	26.7	15	17.4
	Dire Sokoru	10	15.2	76.9	3	15.0	23.1	13	15.1
	Bura Alleltu	12	18.2	92.3	1	5.0	7.7	13	15.1
	Bura Jate Monjo	11	16.7	73.3	4	20.0	26.7	15	17.4
	Yeka sedene	5	7.6	62.5	3	15.0	37.5	8	9.3
	Lege Dadi	6	9.1	75.0	2	10.0	25.0	8	9.3
	Lege Bolo	3	4.5	75.0	1	5.0	25.0	4	4.7
	Mudda Godo Dhabbe	8	12.1	80.0	2	10.0	20.0	10	11.6
	Total	66	100.0	76.7	20	100.0	23.3	86	100.0
Suluta	Wassarbi Gutto	5	7.9	71.4	2	11.1	28.6	7	8.6
	Caanco Bubaa	8	12.7	88.9	1	5.6	11.1	9	11.1
	Warerso Malima	6	9.5	75.0	2	11.1	25.0	8	9.9
	Moyee Gojjoo	6	9.5	75.0	2	11.1	25.0	8	9.9
	Boquu Golba	3	4.8	60.0	2	11.1	40.0	5	6.2
	Gorfoo	6	9.5	75.0	2	11.1	25.0	8	9.9
	Wajju Dallota	8	12.7	88.9	1	5.6	11.1	9	11.1
	E/E/Baboo	7	11.1	77.8	2	11.1	22.2	9	11.1
	Lillo Chebeqaa	7	11.1	87.5	1	5.6	12.5	8	9.9
	W/N/M/Abichu	7	11.1	70.0	3	16.7	30.0	10	12.3
	Total	63	100.0	77.8	18	100.0	22.2	81	100.0
Welmera	Geresu Sida	6	9.7	75.0	2	11.8	25.0	8	10.1
	Wajitu Harbu	7	11.3	87.5	1	5.9	12.5	8	10.1
	Gefersa Guje	4	6.5	57.1	3	17.6	42.9	7	8.9
	Wetabich Minjaro	5	8.1	71.4	2	11.8	28.6	7	8.9
	Berfata Lemefa	8	12.9	88.9	1	5.9	11.1	9	11.4
	Berfata Tokofa	6	9.7	85.7	1	5.9	14.3	7	8.9
	Illala Gojo	6	9.7	66.7	3	17.6	33.3	9	11.4
	Bekeka	6	9.7	75.0	2	11.8	25.0	8	10.1
	Geba Robi	7	11.3	87.5	1	5.9	12.5	8	10.1
	Telecho	7	11.3	87.5	1	5.9	12.5	8	10.1
	Total	62	100.0	78.5	17	100.0	21.5	79	100.0
Grand total		**191**			**65**			**246**	

Appendix 5: Statistical values of comparison between districts on fodder diversity and estimated level of feed utilization per annum

(in Sep 2008- August 09 at district level and in the overall study area with t value)

Study District (Sept 2008- Aug 2009)	Berek vs Sululta		Sululta vs Wolmera		Berek vs Wolmera	
	Mean	T stat	Mean	T stat	Mean	T stat
Annual estimated hay used in kg	-1681.84	-1.40	2677.87	9.66	996.02	0.85
Annual Green pasture estimate through cut and carry in kg	-314.31	-1.19	278.17	0.13	-36.14	-0.17
Annual forage estimate from grazing land in kg	-719.94	-1.28	-3742.40	**-19.33**	-4462.35	**-2.01**
Annual oil seed cake used in kg	-970.09	**-5.28**	802.01	**2.15**	-168.08	-1.60
Annual concentrate feeds used in kg	-101.05	**-2.39**	-510.62	**-77.73**	-611.67	-1.65
Annual urea treated molasses used in liters	2.96	0.21	13.23	0.02	16.20	1.21
Annual estimated crop aftermath used in Kg	-184.38	**-1.96**	-1172.15	**-5.72**	-1356.53	**-1.95**
Annual estimated use of brewery byproducts in litters	-574.90	**-3.19**	399.04	**2.42**	-175.86	-1.39
Annual wheat bran used in kg	-335.80	-1.73	529.11	**13.21**	193.32	**1.84**
Annual estimated fodder trees used in kg	-50.13	**-2.28**	-24.00	-0.03	-74.13	**-2.21**
Annual estimated crop residues used in kg	-1443.17	**-2.89**	-1288.66	-1.40	-2731.83	**-3.23**

Source: *Survey data*

Appendix 6: Statistical values of comparison between districts on dairy herd size

Study District		Milking cows	T value	P value	Heifers	t value	P value	Calves	T value	P value	Bulls	t value	P value	Total herd size
Berek	Mean	2.94	3.33	0.0714	2.09	0.25	0.6172	2.28	6.31	0.0137	1.59	1.62	0.2083	8.90
	N	32			32			32			32			
Sululta	Mean	4.17	1.81	0.1816	2.52	0.01	0.9187	3.60	5.12	0.0258	1.50	2	0.1628	11.79
	N	64			63			63			62			
Wolmera	Mean	3.12	0.31	0.5806	1.71	0.13	0.78188	2.47	0.07	0.7945	1.62	0.04	0.8512	8.90

Appendix 7: Results of self-administered questionnaire on habits and practices

In the Likert measurement, which the results are described below, 1 and 2 refer to the responses "strongly disagree" and "disagree", respectively, to the posed statement, which is indicated in the first row of the first column . 3 was a value given for those who are uncertain about choosing to "agree" or "disagree" because they do not have enough information to make a decision or they have no idea about the statement. Responses 4 and 5 refer to the choices for "agree" and "strongly agree", respectively. This applies for all the tables presented under Appendix 7.

Actor diversity and response of research and extension to the changing actor scenario

Statement 1 Rising number of actors in agriculture in the rural areas	No. of respondents	Percentage	Statement 2 Research and extension organizations not responding to the changing scenario	No of respondents	Percentage
1	3	2.6%	1	10	8.6%
2	5	4.3%	2	20	17.2%
3	11	9.5%	3	23	19.8%
4	62	53.4%	4	49	42.2%
5	35	30.2%	5	14	12.1%
Total	**116**	**100.0%**	**Total**	**116**	**100.0%**

Planning tradition of the MoA and knowledge-sharing platforms

Statement 3 Planning done at regional level therefore extension workers have limited flexibility	No of respondents	Percentage	Statement 4 no plat form for farmers, extension workers, the private sector on diary	Count	Percentage
1	4	3.4%	1	2	1.8%
2	25	21.6%	2	8	7.0%
3	24	20.7%	3	15	13.2%
4	55	47.4%	4	74	64.9%
5	8	6.9%	5	15	13.2%
Total	**116**	100.0%	**Total**	**114**	**100.0%**

Farmers and researchers as sources of knowledge

Statement 5 Smallholder farmers cannot be a source of meaningful knowledge that impact development	No of respondents	Percentage	Statement 6 Research organizations are the main source of knowledge for agricultural development	Count	Percentage
1	32	27.6	1	12	10.3
2	54	46.6	2	17	14.7
3	7	6.0	3	16	13.8
4	15	12.9	4	48	41.4
5	8	6.9	5	23	19.8
Total	**116**	**100.0**	**Total**	**116**	**100.0**

Role of media technology on knowledge and confidence of investors on public research organizations

Statement 7 Increased role of media technology will affect the role of research institutions	No of respondents	Percentage	Statement 8 Investors have little confidence on the capacity of dairy researchers in the public intuitions to enter contract on research	Count	Percentage
1	18	15.5	1	9	7.8
2	36	31.0	2	23	19.8
3	26	22.4	3	24	20.7
4	27	23.3	4	49	42.2
5	9	7.8	5	11	9.5
Total	**116**	**100.0**	**Total**	**116**	**100.0**

Mainstreaming market issues on extension programs

Statement 9 Have no clarity how to link our business with the market	No. of respondents	Percentage
1	13	11.2
2	23	19.8
3	11	9.5
4	63	54.3
5	6	5.2
Total	**116**	**100.0**

Effects of milk processing capacity and level of production on milk market

Statement 10 Low capacity of the milk processors in Addis has caused low supply of milk and thus low nutrition of the public	**No of respondents**	**Percentage**	**Statement 11** Low milk production capacity of the rural area caused shortage of milk supply in Addis	**No.-of respondents**	**Percentage**
1	13	11.2%	1	13	11.2%
2	22	19.0%	2	30	25.9%
3	21	18.1%	3	18	15.5%
4	41	35.3%	4	45	38.8%
5	19	16.4%	5	10	8.6%
Total	**116**	**100.0%**	**Total**	**116**	**100.0%**