

**INCLUSIVENESS AND RESILIENCY COMPETENCES OF DAIRY FARMERS FOR SCALING UP
CLIMATE SMART DAIRY FARMING IN ZIWAY-HAWASSA MILK SHED, ETHIOPIA**



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September 2019

Van Hall Larenstein, Velp

The Netherlands

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A Research Project Submitted To Van Hall Larenstein University Of Applied Sciences In Partial
Fulfilment Of Requirements For Applied Research Design Module In Management Of
Development Specialization In Rural Development And Food Security

By

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This research has been carried out as part of the project “Climate Smart Dairy in Ethiopia and Kenya” of the professorships “Dairy value chain” and “Sustainable Agribusiness in Metropolitan Areas”.

September 2019

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The Netherlands

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Dedication

I DEDICATE THIS MASTER THESES TO MY FAMILY AND “YE FEYISSA MECHBAYE” GROUP.

Acknowledgements

First and Foremost, praise to Allah the most Gracious and Merciful.

This master thesis is the output of effort and support of several people to which I'm really grateful. First and foremost, I thank my supervisor Leonoor Akermans for her incredible help throughout the research process. It is really a privilege for me to work with you.

My earnest gratitude to the royal Netherlands government, and VHL for offering me the scholarship to pursue the course "master of management of development specialization of rural development and Food security". My sincere thanks also goes to CCAFS project in fundingmy .

Florence Aguda, I am sincerely grateful for your support. You have been a good friend and a great colleague

I would like Thank Mr. Shimelis Getachew, Assfaw and Hussein Bude for their support during the fieldwork.

National Fish and aquatic life research centre staff are and will always be like a family and friend. I am always grateful for your support. My special thanks goes to farmers and experts who participated in this research.

Lastly, I sincerely thank my family for your love and support I. And "ye Feyssa Mechbaye" group, you made me fell like I am not far from home I'm really grateful.

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List of Acronyms

AKIS-----	Agricultural Knowledge and Information System
ATVET-----	Agricultural Technical Vocational Education and training
CCAFS-----	Climate Change, Agriculture and Food Security
CSA-----	Climate-smart agriculture
CSA Ethiopia -----	Central Statistics Agency Ethiopia
CSD -----	Climate smart Dairy
DA-----	Developmental Agents
FAO-----	Food and Agriculture Organization
FGD-----	Focus Group Discussion
FTC-----	Farmers Training centres
GHGs-----	Green House Gases
ILRI-----	International Livestock Research Institute
Ma.sl -----	Meter above sea level
NAMA-----	Nationally Appropriate Mitigation Actions”
NWO -----	Netherlands Organization for Scientific Research
UNESCO-----	United Nations Educational, Scientific and Cultural Organization
VHL-----	Van Hall Larenstein

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1 Introduction

1.1 Background Information

Ethiopia has the largest livestock population in Africa. Among the livestock population, the cattle population in 2017 was estimated to be 60.39 million (CSA Ethiopia, 2018). 70 per cent of the total population of Ethiopia fully and partially depend on cattle for their livelihood as a source of income, feed and an physical and financial asset .so it is important in eradicating and reducing poverty, and achieving food security. (FAO, 2018; Guadu & Abebaw, 2016; FAO, 2012). Furthermore, the country has high potential for dairy development and 72 per cent of the countries' milk is produced in mixed crop livestock system where the majority are smallholder farmers (FAO ,2017:SNV 2008).

The agricultural sector in Ethiopia contributes 60 per cent of total Green House Gases (GHGs) emission, and about 90 % of these emissions come from livestock and related activities while the dairy cattle sector contributed 12.3 % of the total GHGs emissions (FAO, 2013) yet GHGs are the main cause for climate change. Climate change highly disrupts food systems, production, posing peoples to have risk in food supply and challenge to achieve food security. So, in order to reduce greenhouse gases emission and to meet food demand while increase adaptive capacity of people, Food and Agriculture Organization (FAO) launched Climate smart agriculture in 2012. Climate-smart agriculture (CSA) is targeted to improve the livelihood and food security status of farmers in the face of climate change through three dimensions: increasing agricultural yield and income, increasing their resilience towards climate change, and reducing greenhouse gas emission (Lipper et al., 2014; FAO 2017). To raise agricultural production, improve livelihood and increase resilience of farmers, dissemination and transfer of technologies, information and practices like climate smart dairy has great impact (Kilima et al., 2010). Further, for CSA we will need greater resilience in agricultural systems and also greater efficiency of resource use for both adaptation and mitigation (Zilberman, 2018) .In order to scale up the climate smart agriculture, increasing access to knowledge and education for women and youth is important/crucial since involvement of women has great association with mitigation and reduction of green house gases and empowering youth with knowledge and experience help to build strong development that contribute to inclusive and gender sensitive development (Mungai et.al, 2018) .

1.2 Project Overview

The Netherlands Organization for Scientific Research (NWO) is an organization working to ensure quality and innovation in science and facilitates its impact on society by funding scientific research at public research institutions. NWO works in collaboration with CGIAR research program on Climate Change, Agriculture and Food Security (CAAFS) to address the increasing challenge of global warming and declining food security on agricultural practices, policies and measures. NWO's research is connected to the CCAFS project "Nationally Appropriate Mitigation Actions" (NAMA) for Dairy Development. So the project aimed to identify opportunities for scaling up good climate smart practices. In order to do the research, the project selected two countries; Ethiopia and Kenya (NWO, 2017).

In this research project, two Van Hall Larenstein of applied university master students of management of development are involved to study inclusiveness and resilience of farmers to scale up climate smart dairy for Ethiopia and Kenya case. Additionally, 3 master student of

Agricultural production Chain Management will study more on dairy business model, green house gas emission and feed.

1.3 Problem Statement

Dairy farming is crucial in providing income, food, and creating job opportunities for many people in Ethiopia. However, the performance of the sector is low compared to its potential (Sintayehu et al., 2008). Climate smart dairy increases productivity, adaptation and mitigation of dairy farmers. Despite its importance, climate smart dairy is not scaled up in, Ethiopia and other developing countries due to low level of adoption by farmers (Pachico and Fujisaka, 2004). In order to produce food in a sustainable way for farmers, there is a need for relevant and accessible knowledge, skill, on best practices, and therefore, there is a need for improved knowledge on how transfers and adoption of knowledge, information can be achieved. Further, inclusion of all stakeholders especially women and youth in scaling up technologies and practices, and develop their capacities is important (Bernier et al, 2015; FAO 2014). Therefore, Van Hall Larenstein (VHL) University of applied sciences in collaboration with Climate Change, Agriculture and Food Security (CCAFS) lacks knowledge on the triggers influencing scaling up of good dairy practices and knowledge and information system, inclusiveness and resilient competencies of dairy farmers to scale up good climate smart dairy that entails to recommend VHL, for appropriate option or intervention to scale it up in Ziway-Hawassa milk shed.

1.4 Objective of the research

The objective of this study is

- To analyse the resilient competencies and inclusiveness of dairy farmers in agricultural knowledge and information network of dairy farmers in Ziway-Hawassa milk shed
- To recommend interventions or appropriate options to scale up climate smart dairy that support men, women and youth in Ziway-Hawassa milk shed

1.5 Research Questions

What are the factors that affect resilience and inclusiveness among smallholder dairy farmer in Ziway-Hawassa milk shed?

- What is the vulnerability context of men, women and youth dairy farmers In relation to CSD?
- What are adaptive capacities of dairy farmers (men, women and youth) that support resilience?
- What are the livelihood assets of dairy farmers that improve their adaptive capacities?
- How do stakeholders (Dairy farmers, research institutes, extension officers) perceive the concept of inclusiveness and resiliency?

What are the factors determining the level of information and access of farmers to scale up climate smart dairy?

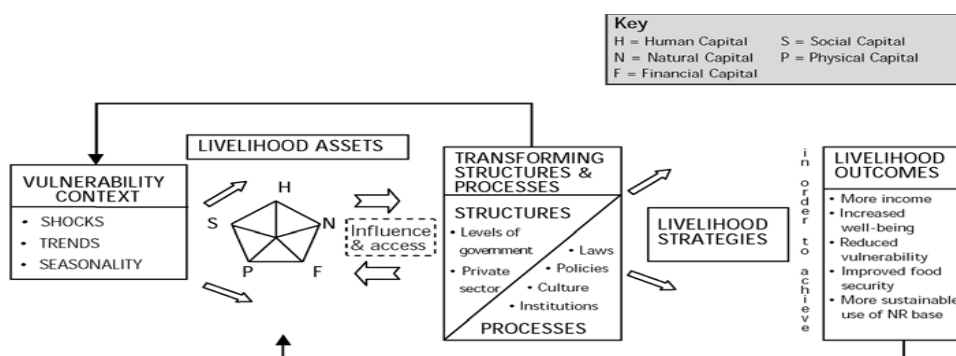
- What is the role of formal and informal knowledge, information and, training networks in which men, women and youth are involved?
- What are the strategies used by knowledge and training networks in order to scale up climate smart dairy?
- How women and youth are included in the existing dairy knowledge training networks?
- What is the perspective of men, women and youth in scaling up

2. Literature review and conceptual framework

2.1 Sustainable livelihoods framework

The sustainable livelihood framework is a holistic and people centre approach that helps to understand and address different factors that influences wellbeing and the relationship between these factors. This framework analyses resources or capitals that people have access to and use like resources, skills, knowledge, health, access to education, sources of credit and others. And factors like trend, shock and seasonality shift have direct impact upon the above-mentioned resources/assets. The extent of access to these assets is influenced by the prevailing social, institutional and political environment called transforming structure and process, which affects the way in which people combine and use their assets to achieve, their desired outcomes in life like reduced vulnerability (DFID, 1999). According to Ellis (2000) vulnerability context are external environment in which people exist where their livelihood and their assets are affected by trends, shocks and seasonality. Vulnerability context of farmers has influence on adaptive capacity of farmers and resilience.

Figure 1 Sustainable livelihood framework(DFID, 1999)



2.2 Concept Of Resilience

Globally, there is rising attention in increasing resilience of people, households and communities. However resiliency has diverse meanings and different studies understand resiliency depending on the context in which they used.

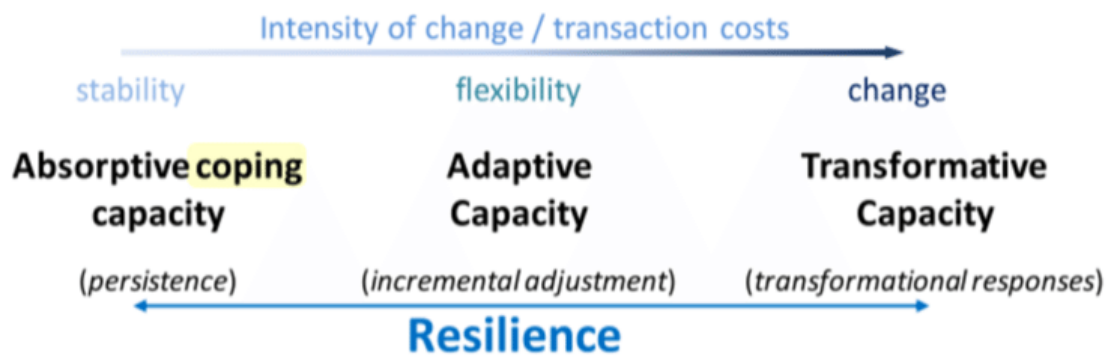
The level of resiliency might vary across different people, households and communities that depends on the resources they have and access to like skills, service, infrastructure, labour and so on (Buckle et al., 2000; Burns and Anstey 2010).

A resilient farming system is defined as having the ability to buffer and respond to change which is considered as key trait to help farmers deal with future challenges and shocks (Crawford et al., 2007; Darnhofer et al., 2010) and continuing and sustaining systems through shocks and adapting new systems when its needed (Darnhofer et al., 2010).

According to Bene et.al. (2012) Resilience is a combination of absorptive, adaptive and transformative capacities. Each of theses capacities is leading to different to responses where

absorptive capacity leads to persistent; adaptive capacity leads to incremental changes and adaptation, and transformative capacity leads to transformational responses.

Figure 2 The 3D resilience framework (Bene et.al 2012)



Adaptive capacity resilience dimension is selected for this study because it works on climate change projects where incremental adjustment is done to reduce and address vulnerability (Bene et.al, 2016).

Literatures and studies also show that for adaptive capacity, various types of resource are regarded to be important in different conditions (Ellis, 2000;Plummer and Armitage, 2007; Preston and Stafford-Smith, 2009;Brown et al., 2010; Nelson et al., 2010; Schirmer et al., 2016):

- ✓ Financial resources (economic resources): are financial resources that people use to achieve their objectives like monetary and non-monetary resources, access to financial service, saving and income,
- ✓ Human resources includes skills knowledge, health, education, psychological resources (having a strong sense of determination or optimism), labour of people
- ✓ Social resources represents social connections and networks, social cohesion to provide a critical source of support, knowledge and access to broader resources that in turn enables adaptation to change, relationship of trust and membership of formalized group
- ✓ Physical resources includes infrastructure, services, producer good (tools and equipment) that helps to people to be more productive
- ✓ Natural resources includes environmental health, natural resource like land, water forests that can be used to produce goods and service

2.2.1 Key approaches of resilience

Psychological resilience: the 'resilience resources' approach

Resilience resource theory argues that a person's resilience depends on their ability to access and draw on key resources that facilitate successful adaptation to difficult times and positive outcomes especially focused on as having a strong sense of optimism and determination or control over of behaviour (Burns and Anstey, 2010).

Socio-ecological systems: exposure, sensitivity, adaptive capacity and thresholds

This approach mainly focuses on human and environmental resilience in natural and environmental change situations. Socio-ecological researchers mainly define resilience as the

degree to which individuals, communities or household are exposed to change and how they are vulnerable to the impact of the change. Exposure means the extent of change that have growing effect over time whereas vulnerability is about sensitivity and adaptively capacity to the change (Adger et al., 2005; Gallopin, 2006; Smit and Wandel, 2006; Mumby et al., 2014; Jacobs et al., 2015).

Adaptive capacity: sustainable livelihoods and human capabilities

Adaptive capacity is all about resources or capitals needed in order to successfully adapt to changes. In order to achieve the desired life outcomes of individuals, communities and households, understanding of their capabilities and capitals are important (Robeyns, 2005). According to Ellis, (2000) adaptive capacity is the degree to which people has access to different “capitals” to achieve positive livelihood outcomes that enables to do different livelihood strategies. This approach helps in identifying farmer’s ability and resources to peruse their livelihood outcome like resiliency that depends on the accessibility of resources. The access to different resources and capitals that helps to adopt situations is therefore essential aspect of resilience. Other study by Berkes et.al (2003) define adaptive capacity of the system as “ the capacity to learn, combine experience and knowledge, adjust responses to changing external drivers and internal processes, and continue operating ”. For this study resilience will be defined by combining Ellis (2000) definition and Berkes et.al. (2003), which is the ability to learn, combine experience, assets, and knowledge, adjust to external and internal process and drivers (vulnerability conditions) and continue operating. And in the context of rural households, adaptive capacity can be see as adoption of new farming techniques, the diversification or adjustment of household’s livelihood activities (Headey et al. 2014) and the decision of taking out loans, or connecting to new social networks (Fafchamps and Lund 2003).

2.2.2 Characteristics of Resilient Farmers

According to different studies two types of farmers are identified with regards to resilience; high resilient and low resilient farmers (Darnhofer et al., 2008; Darnhofer et al., 2010; Parsonson-Ensor and Saunders, 2011;Shadbolt et al., 2015). Their main different traits that will be used for this study;

- Adaptability of strategies of geographic diversity to spread risk and create buffer
- Skill, information and environment that ensures adaptive capacity
- Management of financial and debt planning
- Adaptation and implementation of successful technological innovation
- Ability to adapt to shifts in the environment and capture the opportunities that might arise from disturbance

2.2.3 Climate smart Dairy practices

In developing world, climate change poses high risk for framers by impacting their yields, water availability and increase weather uncertainties. Adopting new technologies and practices has potential to reduce adverse production impacts and have a potential to reduce carbon emission from agriculture (Rosegrant et al. 2014). Further climate smart agriculture practices help to increase resilience, reduce green house emission and increase productivity while achieving food security. According to CGIAR (2015), Climate smart Agriculture practices that are especially work on dairy includes

- Breed improvement
- Herd reduction

- Improved forage production
- Improved feeding management
- Proper manure management and
- Record keeping

2.3 Concept of Inclusion

In much of the literatures inclusion has not been defined in its own rather it is defined in relation to exclusion. In many of exclusion literatures inclusion is simply implied or stated. According to (Cameron, 2006), because of inadequate understanding of inclusion, the attention has been emphasized on the excluded and inclusion concept failed to provide it own concepts. Likewise (Atkinson et al., 2005) defines inclusion as tackling of exclusion through integrating or preventing from exclusion.

Inclusion is integrating people into society who are unable to be full member of society (Bhalla & Lapeyre, 1997; Atkinson et al, 2005). The United Nation defines inclusion as an instrument to improve participation through improving opportunities, access to resource, voice and respect for rights for those who are disadvantageous or vulnerable with regard to Gender, ethnicity, and so on. According to Labonte et al.(2011), inclusion focus on the state and process of leading to it. Therefore the study will use definition of (Labonte et al., 2011) where they stated inclusion as the process to be included as;

- Access to material resources, information asymmetry, technology and infrastructure
- Access to educational and health opportunities
- Participation in social networks
- To have voice or power to influence government policies

2.3.1 Dimension of inclusion

Inclusion is a multi dimensional concept however the most important dimensions are economic, employment and social dimensions.

Economic dimension focuses on people who do not benefit from the wealth of society, because inaccessibility of adequate resources. This dimension helps people to enjoy the benefits of economic growth. It also links social and economic policies in social inclusion policies and has therefore often related economic problems (Daly, 2008; Peace, 2001; Atkinson, 2002; Vanhercke, & Lelie, 2012).

The Employment Dimension puts emphasis on the importance of work to be a full part of society since being unemployed has bigger risk to be excluded. Therefore in this dimension employment can be an assurance of inclusion. So labour market and inclusion policies can be strongly interrelated (Dieckhoff & Gallie, 2007; Atkinson, 2004).

The social and cultural dimension is concerned with issues to what extend an individual is enabled to live a life worth living inside the society. In this dimension social and cultural problems, which can cause exclusion, should be tackled. It looks if an individual can access the benefits an individual should have from living in a society. (Room, 1999; Peace, 2001).

2.3.2 Inclusiveness indicators

Inclusiveness has been related to community empowerment, voluntary association and civic participation, and sustainable community and economic development (Laverack, 2006; Jackson,

2007). . Further other studies define and measure inclusiveness in terms of opportunities, eligibility, decision-making involvement and participation of individuals or communities. So proportion of individuals that participate in community process with equity and equal opportunities are regard as indicators of inclusiveness (Lloyd et al., 2006; Dewhurst et al., 2014).

2.3.3 Youth and Gender in scaling up climate smart dairy

According to United Nations Educational, Scientific and Cultural Organization (UNESCO), youth is defined as a period of transition from dependence of childhood to adulthood between the ages of 15 to 24 and according to African youth charter youth are those aged between 15-35. However for this study youth will be defined according as individuals between 15 and 30 years of age.

In adopting climate smart production, including and investing on training and education of young rural people is crucial. Further gender is important dimension that influences opportunity to build and utilize capacities of farmers especially youth in agriculture (FAO, 2017). In practicing CSA analysis of gender will help to understand different roles of men and women, their priorities, access to information, benefits and engagement of men and women in development and adaptation of CSD (Schnetzer, 2016).

2.4 Competencies And Scaling Up

Lai (2013) defines Competence as “ combined knowledge, skills, abilities and attitudes that make it possible to perform appropriate tasks in line with defined requirements and targets". Competencies are used to investigate human behaviour concerning knowledge, feeling or attitude and practice (IDAF, 1994).

Knowledge is something theoretical or academic on the other hand skill is the ability to solve problem in practice while attitude is willingness to use knowledge and skill (Ton de Jona et al., 1996; Vik & Straete, 2017).

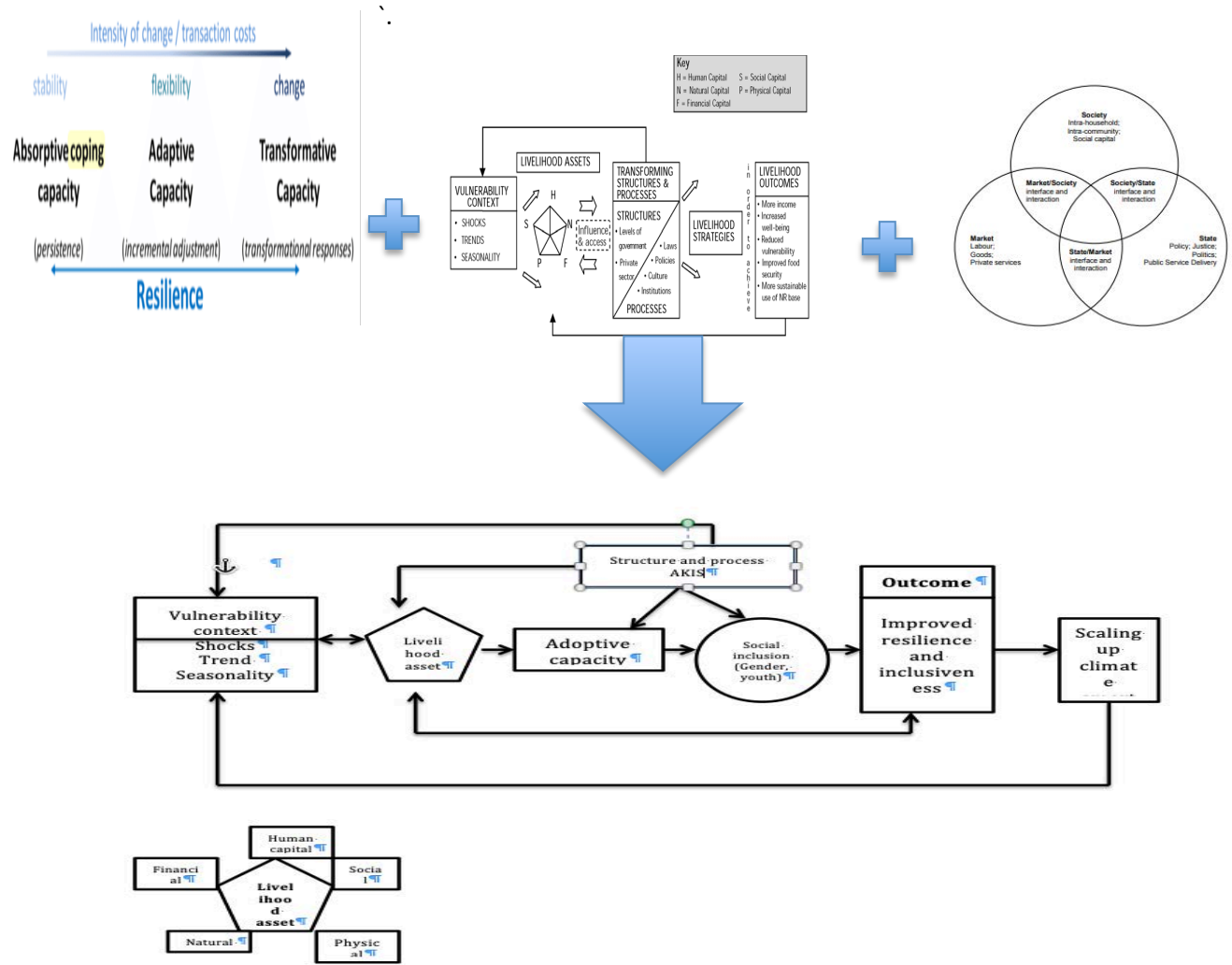
In scaling up new technologies there are different types of processes. However scaling up pathway is more strategically where it shows how changes happen. And according to the pathway of scaling up process, access and implementation of knowledge and information that successfully designed in pilot and in wide range is important and crucial (Linn et.al 2011).

2.5 Conceptual Framework

Three theoretical frameworks will be used to come up with the conceptual framework of the study. These are the sustainable livelihood (DFID, 1999), the 3D resilience by Bene et.al. (2012), and the social inclusion framework (DFID, 2003). Adaptive capacity resilience dimension is selected for this study because it works on climate projects and issues this will help to incorporate both resilience and inclusion concepts together (see figure 3)

The framework helps to understand factors affecting scaling up of technologies especially climate smart dairy. It analyses resource or capitals that an individual or communities have to improve their adoptive capacities which entails to improve resilience and inclusiveness. The accessibility of the resource is influenced by the structure and process, which is the social, institutional, organizational environment. Further the vulnerability context influences on adaptive capacity of farmers and resilience. The study will focus e adoptive capacity of resilience dimension since it works on climate change projects where incremental adjustment is done to reduce vulnerability of farmers like climate smart dairy

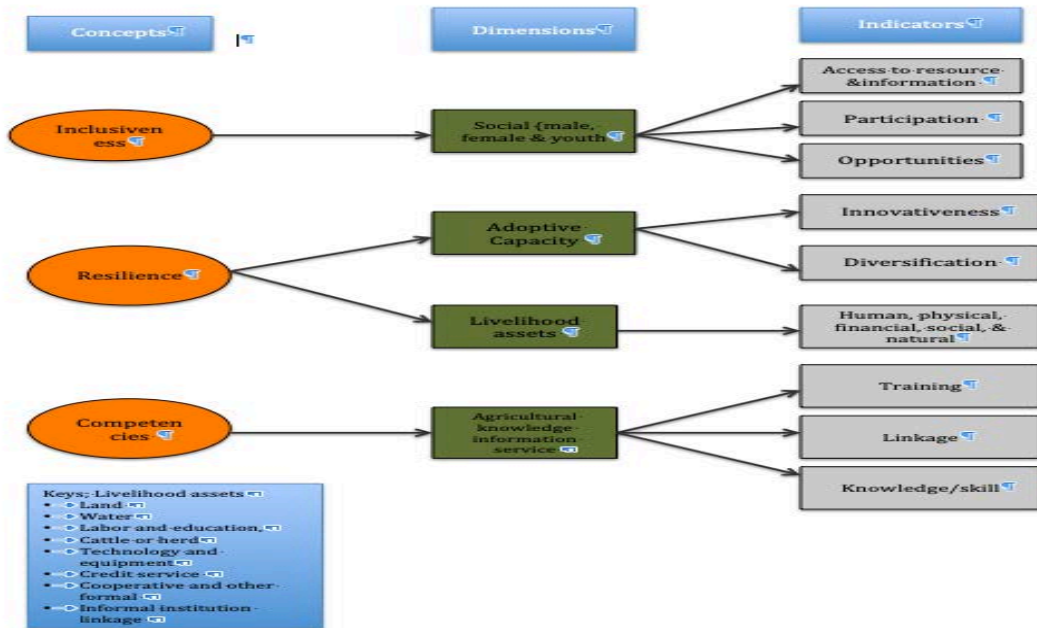
Figure 3 Conceptual frameworks adapted from SLF, resilience and social inclusion (2019)



2.6 Operationalization of concepts

Concepts are clarified and unravelled in to dimensions and indicators to answer the main and sub question of the research.

Figure 4 Operationalization of concepts



3. Methodology

3.1 Description of the Study area

The study was conducted in Ziway -Hawassa milk shed in Ethiopia that is located 160-273 south of the capital, Addis Ababa. The shed altitude lies between 1500 to 2600 ma.s.l in the central rift valley of Ethiopia (Negash et al. 2012). The farming system in the area is mixed crop and livestock production where livestock especially cattle has a crucial role. Ziway, Arsinegele, Shashemene and Hawassa are towns located in the milk shed. The total estimated amount of milk produced annually along the shed is estimated 9.6 million litres where subsistent dairy farmers milk produce is used for household consumption or traditional processing. Further, apart from milk production, crops like Teff, Sorghum, Wheat, Maize, and tuberous crop like Potato and Sweet Potato are the major crops grown in the milk shed along with Vegetables cultivation (Chalchisa et al., 2014, Negash et al. 2012).

Figure 5 Map of Ziway-Hawassa Milk Adapted from nationalonline.org



3.2 Research Design

A descriptive research design was conducted where a case study was carried out to assess in-depth factors that affect inclusiveness and resilience among small-holder dairy farmers and factors that determine the level of information and access to climate smart practices that help in scaling up sustainable climate smart dairy in Ziway-Hawassa milk shed. In-depth information/understanding of dairy farmers regards to their opportunities and constrains to scale-up climate smart dairy were gathered through qualitative research approach where interview, focus group discussion and observation are used as a research method.

3.3 Sampling Procedures

Based on milk potential and the interest of the commissioner Ziway-Hawassa milk shed was selected. From this area dairy farmers were purposively selected as sampling frame. The dairy farmers then were stratified into strata with similar characteristics like sex and age. A total of 12 dairy farmers, 11 key informant interviews and 5-group discussion were conducted (see table 1). Since the researcher is not familiarized with the research area, one the researcher from Adamitulu research centre and developmental agents of the area introduced the dairy farmers.

However, the researcher encounter difficulties in getting respondents with each characteristics due to the translator doesn't know the area and which farmers have dairy or not. Therefore, in order to get each respondent with their characteristic, we had to get to each district office of the selected districts and go with the DAs. Arsinegele, Shashemene, Adamitulu, and Ziway districts were the selected districts for the fieldwork. These districts were purposively selected by the interest of the commissioner and to cover the whole milk shed. The study mainly targeted population units especially for farmers who are young female, young male, adult female and adult male of dairy farmers.

Table 1 number and characteristic of respondents for semi-structured interview

Units/sample characteristic for dairy farmers		
	Female	Male
YOUTH <30	3	3
Adults >30	3	3
Sub Total	6	6
Total	12	

Source: Author

3.4 Data collection methods

The source of data to gather information for the study was primary and secondary source where semi structured interview, focus group discussion key informant interview, observation and desk research from relevant literature were used.

Desk research

Desk research was collected through a review of relevant literature from secondary data sources such as reports, journals, and books and credible online sources such as Google scholar, Greeni and others Internet source. Desk study on concept of inclusiveness and resiliency and its indicators and dimensions was carried out with the support of relevant literature.

Semi –structured interview

Semi-structured interview for farmers was conducted by using open-ended interview questionnaire. This helps to get information about key actors, institutions, groups that provide specific services especially knowledge and information about climate smart dairy for farmers, The interviews also helped to get data on the perception of women, men and youth to scale up technologies climate smart dairy. Further, the interview find out access to resources and services and vulnerability context of dairy farmers especially shocks, trends and seasonality at individual/household level. The sample size for semi structure interview was 12. Smaller sample size was selected since the researcher uses translator and getting respondents with each characteristic is difficult. Further, the study was qualitative and responses from different respondents were redundant and the researcher thought 12 respondents were enough to get the information needed to answer the questions.

Focus group discussions

The focus group discussion was conducted in five rounds. For the purpose of getting extra information and validity of data, the FGD participants were dairy farmers who were not selected for interview. The first round FGDs participants were male dairy farmers that consists both adult and youth whereas the second FGDs participants were young and adult female dairy farmers. The first and second round of the FGDs were conducted after the semi-structure interview of half of the dairy farmers to validate and get extra information while the third and forth FGDs were done after completion of the rest half dairy farmers.

Table 2 numbers of participants in FGDs

FGDs	Age		Total number of participants
	Youth	Adult	
FGD 1(Men)	4	6	10
FGD 2(Women)	3	5	8
FGD 3 (Men)	5	7	12
FGD 4(Women)	3	4	7
FGD 5(Both)	2	6	8

Source: Author

The topic guide (see annex 3) used for the 4 FGDs helped to see the overall knowledge and training linkages or platforms that dairy farmers are participating on and their perspective on inclusiveness. It also helped to understand and identify the resource needs and access to services of women and youth. The discussions was also assisted to collect in-depth data on vulnerabilities and capacities of dairy farmers by identifying their opportunities (market, new technology, partners), climate related shocks and stress, major life events that affect farmer's capitals and their resilience and how they cope with such situations. At the final round, preliminary outputs of the study were presented to the farmers, researchers, and agricultural experts by the research team for feedbacks that helps to improve validity of the research findings and asset pentagon and livelihood framework were used to see asset and vulnerability of farmers.

Picture 1 Focus Group discussion done with male, females and preliminary result discussion

Source: Author

Key Informant Interviews

Interviewing relevant stakeholders who are involved in dairy and agricultural knowledge and information platforms was done through key informant interviews. Data was collected on their perception and concepts, experience of climate smart dairy, inclusiveness and resilience of dairy farmers. Furthermore strategies used to share knowledge and information and the inclusion of women and youth on their policies and strategies. The key informant for this research were representative of Adamitulu research center, International livestock research institute forage seed multiplication, Two development agents (Arsi-negele and Ziway), three agricultural office (Shashemene, Negele and Ziway livestock and fishery office) Alage ATVET, Oromia state University, NGO (SNV), District Energy office in total 9 institution or organization that are involved in dairy sectors especially who support the farmers by providing knowledge and

training (See table 3). The interview questions were tailor made checklist and additional information was asked during the interview.

Table 3 List of Key informant interviewee

Interviewees affiliation	Position of interviewee	Number of interviews
Adamitulu Research Center	Dairy researchers team leader	1
District livestock and fishery office (Negele and Ziway, Shashemene)	Dairy expert and livestock and fishery department team leader	3
Farmer Training Center (Shashemene and Ziway)	Developmental agents	2
ILRI	Technical assistant	1
Oromia state University	Agri-business and value chain department head	1
Alage TVET	Technology multiplication and transfer vice dean	1
NGO (SNV)	Project coordinator in one district	1
Energy office	Department team head	1
	Total	11

Source: Author

Observation

Participatory observation was conducted to see resilient activities and practice in farms using observation checklist (see annex 2). Observation took place after the interview in cattle hubs or grazing lands to see the role, capitals (asset) and practice of dairy farmers/farming. It helped to triangulate and build validity the data obtained through semi-structures interviews.

Picture 2 observation made in cow shed



Source: Author

3.5 Data analysis

In this study the data was coded and categorized by key words in the sub question like adoptive capacity, asset. Records from interviews, observations, and FGDs were organized and grouped to see patterns, trend and gaps to identify same information appears in different places, check contradiction with different groups, methods, and see where information is missing. After organizing the data, key themes that summarize important groups were pin pointed and written. The data was analysed by Venn diagram of institution analysis tools to identify the key actors, institutions, groups that provide specific services especially knowledge and information about climate smart dairy and see their linkage and relationship with target group in visual based on Male versus female, and youth versus Adult. Further Asset pentagons, sustainable livelihood framework and Harvard analytical tool will be used to compare the capital women, men and youth endow and their accessibility and vulnerability and capability of dairy farmers. The main analysis cluster for the study is men and women, and youth and adults. The interpretation of the analysed data helped to prove a point/view where alternative explanations for anything claim to be true by the researcher were given. Further, the interpretation of the data was checked with other peoples to get their perspective and viewpoint that helped to improve the quality of the research. Finally, the data analysis was presented in qualitative explanatory or narrative way.

3.6 Operationalization of Research Method

Table 4 Research methods operationalization

Sub Question	Key word	Source of information	Data collection method	Data Analysis	Expected Outcome
What are the livelihood assets of dairy farmers (men, women and youth) that improve their adaptive capacity?	Livelihood assets and adaptive capacity	Semi-structured Interview, FGD, observation	Observation checklist FGD topic guide Open and fixed Questions Key informant interview checklist	SLF, Asset Pentagon Harvard Analytical Tool Venn diagram	Asset level Resilience and Inclusion of dairy farmers (men, women, youth) Perception on resilience and inclusion
What is vulnerability context of men, women and youth dairy farmers?	Vulnerability context		SLF, Venn diagram		
How do the stakeholders (Dairy farmers, research institutes, extension	Inclusiveness and resilience concepts perception	Semi-structured Interview, desk study and key informant			

officers) perceive the concept of inclusiveness and resiliency?		interview	
What are formal and informal knowledge, information and, training networks in which men, women and youth are involved?	Knowledge and information network	FGD and interview	AkIS role
What are the strategies used by knowledge and training networks in order to scale up climate smart dairy?	Knowledge and information system	Key informant, desk study, FGD	AKIS how it operates
What is the perception of men, women and youth in scaling up CSD?	Perception of climate smart dairy	Interview	Role of dairy farmers in scaling up
How women and youth are included in the existed dairy knowledge training networks?	Inclusion in knowledge and training	Key informant, Interview, FGD	Driver to scale up

3.7 Validity and reliability of Data

This research used different methods for triangulation to enhance the reliability and validity of both the data and findings. The researcher uses multiple methods and sources of data collection in order to ensure that consistent and verifiable results are obtained. Further, sample size and, validity and reliability of the research has directly proportional. In the study the number of dairy farmers interviewed was small (no=12) even if high number of sample size and validity and reliability of the research is directly proportional. However, the study used FGDs and key informant interviews to validate the information and results.

The study especially the dairy farmer interview and Focus group discussion involved someone as an interpreter to ask question to the respondent. Before, the data collection stage, purpose of the research and the issues that will be investigated was discussed with the interpreter so as he understand the questions and the issue. And before the focus group discussion main themes and terms were further explained to the interpreter.

In interview and FGDs of the study, the interpreter only helped to translate what the respondent has said by translating the exact word of the respondent rather than giving meaning to what the interviewee has said. Additionally, the researcher was audio recording the conversation and scripted it in another local language (Amharic).

3.8 Ethical Consideration

According to Anderson (2013), in research process ethical consideration is described in to three stages. These are at research design and planning, data gathering process and after data collection.

At research design and planning process, asking for consent for the research to participate in the research, respondent anonymity and confidentiality of the data gathered was explained and dealt with the dairy farmers and key informants.

The second stage is the data-gathering process. Locations outside the house where we can see the assets and if possible walking around the dairy hubs were places used to conduct interview where the interviewee can openly speak. The respondents were also asked permission to record the interview and took pictures. In addition, anonymity and confidentiality of the respondent was emphasized here so the respondents can openly talk and respond.

After data-gathering stage is the last stage in the ethical consideration. First the transcripts of the interviews were shown and explained to farmers who can't read or sent to respondents as an opportunity to see the record of the data or transcript in which they can verify the information after sometime of the interview. Finally, no personal information was shared with anybody and that the information was confidential and was only shared with the supervisors and project coordinators of the University.

4. Results

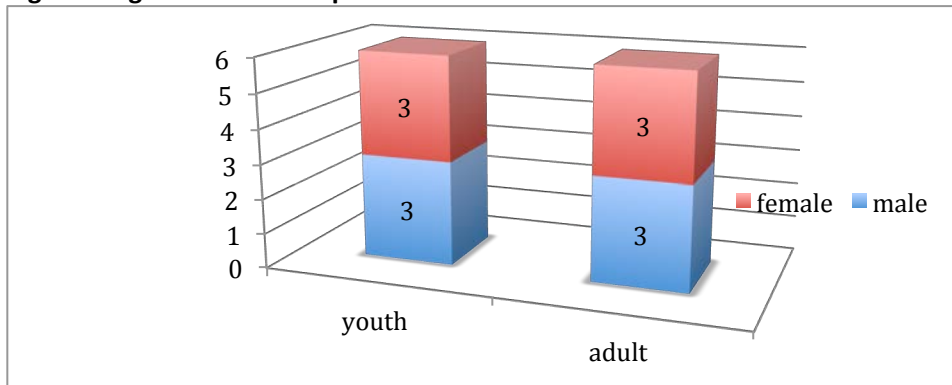
In this chapter, findings from the field research are presented. The data presented in this chapter were collected using a mix of methods including dairy farmers interview, focus group discussion, observation and, key informant interviews. Qualitative data were processed using themes and results were presented more in narrative form tables. Figures were also used where it is applicable.

4.1 Demographic characteristic of respondents

4.1.1 Age and sex of respondents

Figure 6 shows out of twelve respondents, six of the interviewed dairy farmers are female, of which three of them are youth that are aged below thirty. Whereas, the remaining 6 interviewees are male of which three of them are young. There fore, the total number of youth dairy farmers interviewed was six.

Figure 6 Age and sex of respondents



Source: Author

4.1.2 Education level of the respondents

The education level of the households shows, the women respondents have low education level as compared to the men in which all men respondents have either primary or above primary level of education. The education level of youth have no much difference as compared to youth except one youth has an education level above secondary school.

Table 5 Education level of the dairy farmers

Level of Education	Sex		Age	
	Men	Women	Youth	Adult
Primary	3	4	3	4
Secondary	2	0	1	1
University/College	1	0	1	0
No formal education	0	2	1	1

Source: Author

4.1.3 Source of income for the household

Table 6 below shows source of income for the interviewed respondent. It shows interviewed women either involved in mixed farming and other business like making of traditional alcohol called “Areke”. Further, none of the women has petty business with small shop. Whereas the male interviewed respondent have either mixed farming or petty business with small shop. On the other hand, all interviewed youth in the study are involved only in mixed farming. The adults are involved in farming and petty business.

Table 6 source of income of the interviewed

	Male	Female	Youth	Adults
Mixed farming (Dairy and other crop and vegetable production) only	4	4	6	2
Petty business (small business)+mixed farming	2	—	-	2
Other (traditional Alcohol) + dairy farming	—	2	-	2

Source: Author

4.2 Vulnerability context of dairy farmers

The vulnerability context, an element of SLF refers the Seasonality, trend, and shock that negatively affect the dairy farmers to improve their livelihood. Information on vulnerability of farmers was collected especially during focus group discussion and farmers interview. Proxy indicators were used to explain what seasonality, trend and shock meant.

Seasonality

For all except one male respondent who have formal market linkage, milk and milk products like butter and cheese price will decline in fasting seasons. However, the price for butter and cheese increases in holydays especially on Ethiopian Easter and Christmas time. In the study area farmers who don't cultivate crops will purchase crop residues from market. In wintertime except for the two female respondents who doesn't have farming land, crop residues like Maize and Teff straw will be finished. However, there is more green forage and high milk yield in wintertime.

<.....>The crop residue I get from my own farm will end at this time (winter time for planting crops). So it is really difficult to get dry forage since last year harvested crop residues will be finished. However during this time because of the rain the cows will find green forage so they can graze it.

Male Respondent

During the four focus group discussions, farmers indicated that natural water bodies like river and ground water supply would decline in summer time and in wintertime rain pattern has declined. Further, during hot times the cattle are prone to disease like Anthrax (Abasagna).

Shocks

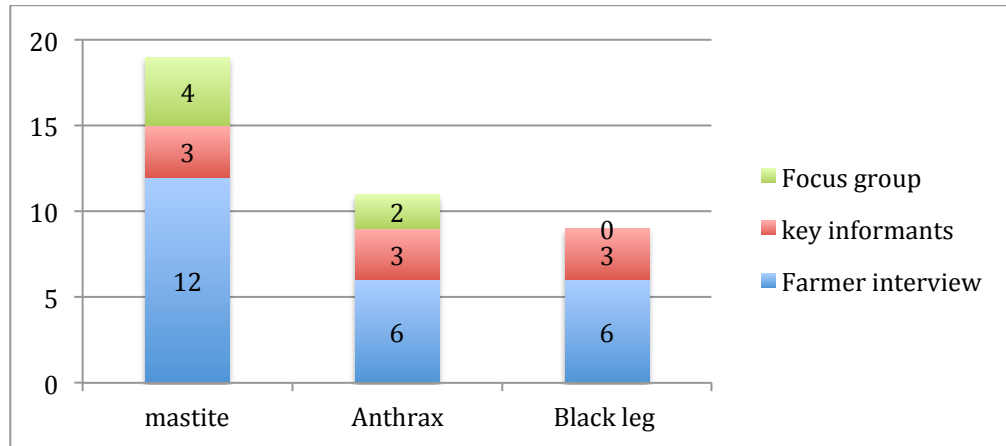
Health of a dairy cow is the most predominate effect for high yield of milk. Disease like Mastitis, Anthrax and Black leg have great impact on the production of milk. Mastitis is mentioned by all most all respondents and during Focus group discussion. Further 6 respondents (3 adult male, 1 young male and 2 young female) and 3 key informants mentioned the disease called Anthrax

(Abasagna) and Black Leg (Aba gorba) are a threat for the cattle (see figure 7). Further, the researcher also observed a crossbred cow in one the male farms, lying down in the ground for about 15 days waiting for its death.

<.....>There is one disease, which is really a threat for the development of the dairy farms. It especially affects the nipple or udder of the cows (Mastitis). Even if this disease affects one cow it is big loss. Even after vaccination and medication, the disease last long to heal. The worst thing is it might spread cow to cow

Male youth Respondent

Figure 7 Health problem mentioned from different data collection methods



Source: Author

Trend

Land and feed are considered as constraint for the dairy farmers. Price increase for feed especially for fodder, concentrated feeds, “Fagulo” a linseed meal, Furshika” wheat Bran is a challenge for dairy farmers. The entire respondent from the interview mentioned price of feed is increasing over the year. Moreover, almost all except one adult men, availability of land for pastureland, proper dairy house to be able to increase milk production is difficult due to increase in population. Additionally, land is gained through inheritance from family that makes it land to be fragmented.

<.....>Milk production at the time of my father was very high even though they use local breeds. The main difference now and then is land. We don’t have enough land only for our dairy cows. My father used to have a lot of land and all of his children inherited his land get a smaller portion.

FGD Male

4.3 Adoptive Capacity of Dairy Farmers

Knowledge, information and asset of dairy farmers enable them to cope difficult times. Adoptive capacity of dairy farmers found in the interview and focus group discussion are use of communal land, milk value chain, manure management, health and cleaning

Using of Communal Grazing land and other bi-products

From the farmer interviews, all respondents indicated that the main problem to increase their milk production is lack of feeds. This idea is also shared during the four focus group discussion.

They don't have enough land to produce fodder to feed the cattle. So they use the communal grazing methods so as the cattle can find something to eat and drink. In addition, almost all of the respondent use their bi-products and crop residues as a feed for the dairy cows.

Milk value addition

Due to the limited of market for fresh milk, the dairy farmers process the milk into butter, cheese or ghee as a marketing strategy for nearby towns.

<.....>All the people in the community here all have dairy cows, which may be used for household consumption or sale. No one will purchase milk since they all produce. There fore, the only chance we have to generate income is to process the milk into butter and traditional cheese and sell it in market days. Processing is one way of keeping the milk to last long.

Female Respondent

Manure management

Mixed farming system is the dominant form of farming system in Ziway-Hawassa. The manure from the dairy cattle is mostly used for maize, Teff, and vegetable production. Seven respondents highlighted that they use dried cow dung as a source of fuel with one respondent indicating using it to produce biogas for his farm workers to use it as fuel for cooking. The practice of manure management of each farmer respondent has been checked through observation .

Strengthening the social connectedness and network

The income generated from the dairy production for female household is spent on home utilities, feed and for participating in traditional social organization like "Equb" a revolving traditional saving among friends, family or neighbours and "Edir" monthly contribution and receive payment to help cover funeral or weddings. The income generated from the dairy products is spent and controlled by the female except for one male respondent. However there is no much difference between the youth and the adults in strengthen the social connectedness.

Health and cleaning care

All respondents clean and take care of the health status of the cattle especially the dairy cows since health of the dairy cattle have great effect on the production of milk. However, it is observed that nine of the dairy farmers have no cattle shed with concrete ground (sludge) with a structure that separate dung with urine. This makes it difficult to clean the cow dung. Only three of the respondent cows are dehorned.

<.....>The most important thing for high yield is the health of the cattle. If I don't clean them everyday they are susceptible to disease and they won't eat anything. Which results to decrease the yield of milk.

Male respondent

4.4 Livelihood assets of dairy farmers

The five assets dairy farmers livelihood is built up on in the milk shade are Human, physical, Social, natural and financial capital. Almost all of the findings are derived from interview and verified through observation and focus group discussion

Table 7 assets of dairy farmers

Human Assets	Physical Asset	Social asset	Natural Asset	Financial Asset
--------------	----------------	--------------	---------------	-----------------

Education level	Dairy and other animals	Member of group cooperative	formal or	Natural Water bodies like river or lake	Saving
Labour force	Land occupied	Member of informal organization		Communal land	Informal and informal credit and financial institution
Skill and knowledge of dairy farming	Road and market accessibility	Linkage with institution and organization			
Physical Asset	Tools and equipment				

Source: Author

4.4.1 Human Assets

Education level of the respondent is one of the indicators to see the human assets of the households. 4 female respondents have primary education and the other 2 female have no education level. Whereas 5 male respondents have primary and secondary school and one have diploma or attend college. In addition to the education level of the respondent, all the children of the respondent's are studying in school or have education level above secondary school (see table 5).

For most of the respondent labour force for the dairy farm is family labour especially the wife and female children are the one who are more involved in milking, cleaning feeding the cattle. Whereas the dairy farms with farm workers, the workers are the one doing dairy activities like milking, shepherding, feeding and cleaning.

Knowledge and skill for most of the dairy farmers is indigenous that they got it from experience and family. According to the focus group discussion, dairy farmers have indigenous knowledge on how can they operate in difficult times like in fasting time and how to increase their milk production. Further, they have traditional and modern knowledge on how to use manure for composting and fuel.

4.4.2 Physical Assets

Physical assets are assets that help them to be more productive which includes land, dairy and other animals, Tools and equipment, and Infrastructures like road and market.

Dairy and other animals

Both male and female respondents have dairy animals like cows, heifer and calves. Among the respondents, one male youth have the highest number of dairy animal, which is 24 and followed by an adult woman with 14 dairy animals. One adult male have the least number of dairy animal, which is only one dairy cow (See table 8).

In the focus discussion with different target group of interviewed farmers, female farmers only have local dairy breeds of Arsi or Borona. On the contrary, results found on individual interview shows only three of the dairy farmers have only local breed and the rest 9 of the interviewed respondents have either cross breed only or both cross and local breeds. Further other animals like calves, heifers, bulls, oxen, donkey, horse, goats, sheep, and chicken are also kept.

Table 8 No of dairy animals kept according to sex and age

Respondents	Number of dairy animals kept (dairy heifer calves and cows,	Cows	Calves	Heifers
Young man	24	16	5	—
Young man	6	4	1	—
Young man	10	3	3	4
Adult man	4	2	2	—
Adult man	6	4	—	2
Adult man	1	1	—	—
Youth woman	5	3	2	—
Youth woman	5	2	2	1
Youth woman	8	4	2	2
Adult woman	6	3	2	1
Adult woman	3	2	—	1
Adult woman	14	10	1	3

Source: Author

Land

Table 9 shows land occupied by women and men dairy farmers. All male respondents from the interview have more than 1.5 hectares of land where the highest land occupied is 10 hectares. Where as, the female households all have less than 3 hectare of land where the least land occupied is 375m².

Table 9 Land occupation by sex and age

Respondents X-cs	Female respondents
Young Man	5 hectare
Young Man	2.5 hectare
Young Man	1.5 hectare
Adult Man	1.5 hectare
Adult Man	1.5 hectare
Adult Man	10 hectare
Young woman	0.5 hectare
Young woman	1 hectare
Young woman	3 hectare
Adult woman	3 hectare
Adult woman	375 m ²

Source: Author

Infrastructure

Road and market accessibility for the dairy farms depends on the distance of the dairy farm from the road and market. For almost all-respondent marketplace for milk, butter, ghee is far from the farm. Donkey cart is used as transportation mode to reach market places. Further except for one young male respondent all the interviewed respondents don't have formal market linkage where they can sale their milk and its product. This information was also reflected on the focus group discussion of both male and female.

<.....>I don't have any market linkage. So milk is difficult to sell here unless it is processed and sale in market time on Saturday and Thursday of each week.my daughter or I always go to there to sell it but it is really far from here and you might not also sell it. If it is not sold at the market place, we will use it for our own consumption.

Young Female respondent

Tools and equipment

Tools and equipment are used for milking, processing, storing of milk, keeping and feeding of dairy cattle. All of the dairy farmers were using hand milking method since they don't have a milking machine. And only one male youth respondent and old female household have container called milking and transportation container (MTS) used for milking, storing and transporting milk. Other respondents use metal and plastic buckets and traditional clay pots for milking and storing. Only one male household have modern processing machine where as the other have traditional churner (Ensira) made of clay. Two male respondents have brick house and concrete floor (dairy barns) where there is a structure where urine and the dung of the cattle can be separable. However for the rest of the respondent the housing is made of clay or mud or only small closure made from branch of trees where they can rest at night (loose housing). 5 respondents have Trough made from wood or brick where others have any kind of wide bowl for feeding.

4.4.3 Social Capital

The social connectedness of the dairy farmers among themselves, friends and neighbours is very strong. This helps them to cope at difficult times and get knowledge and information. Further, most of them have linkage with the "Kebele's" (smallest administrative unit) developmental agents even if the linkage is weak. All of the dairy farmers are part of the social organization called "Edir" and most of the females have "Equb" rotating saving.

None of the respondents are a member dairy cooperative. However most of the respondents (5 men and 4 women) are member of cooperative for vegetables and crops that help them get seed, fertilizer (DAP and urea) and market linkage. And most of the female respondent have consumers' cooperative (enterprise owned by consumers) where they can get sugar and oil for home consumption with appropriate price.

4.4.4 Natural Capital

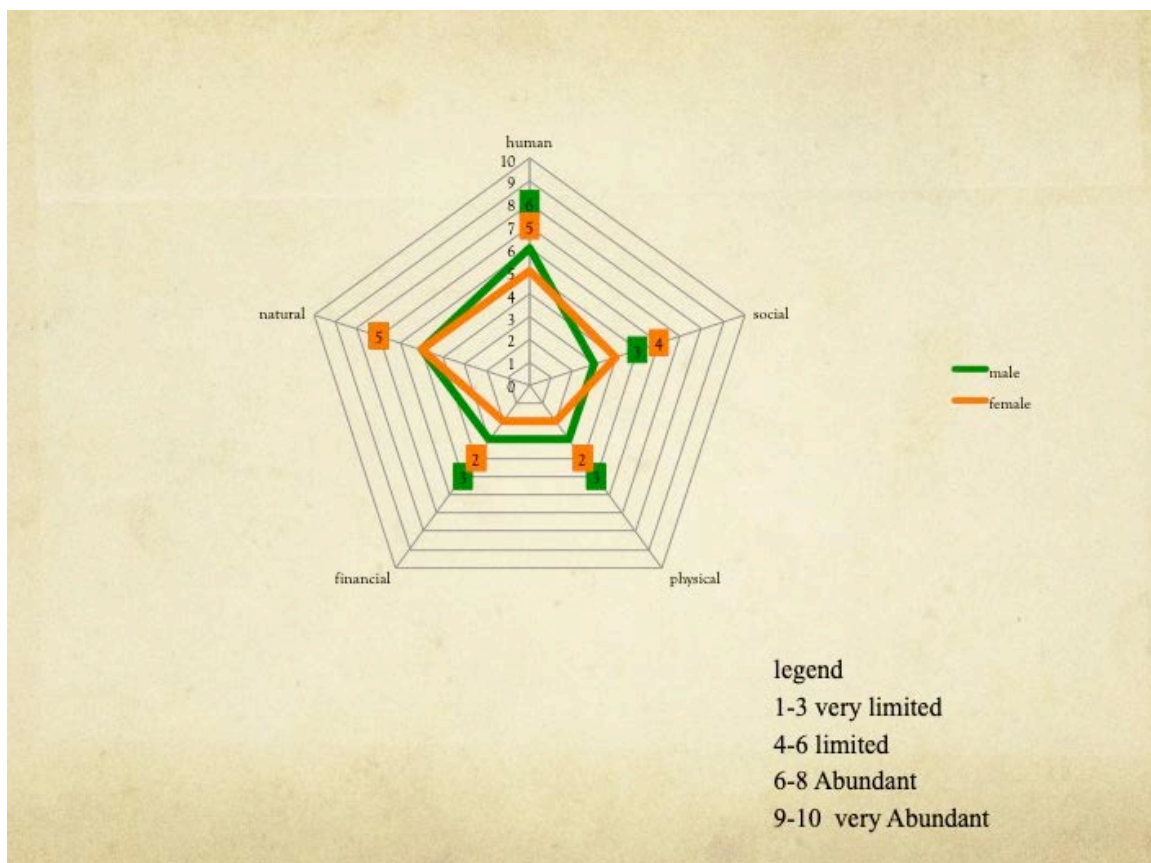
The natural asset that dairy farmers in the milk shed depends on place where the farm is. Most of the respondents use river or lake as a source of water for the cattle. The distance of the lake for 7 respondents is far but they still use it since their cattle graze in communal lands. For two male respondents river is found in less than 100-meter distance. Moreover, 7 respondents use communal land for grazing.

4.4.5 Financial capital

Saving, accesses to informal and formal credits are primarily referred as financial capital. None of the respondent has loans from the formal financial institute and either due to collateral or religion. Further, except for two male respondents, none of the respondents have saving bank account except for 2 male respondents. However, 5 of the female respondents have traditional saving method called “Equb”.

In the focus group discussion for validation of findings from the field, asset pentagon of the dairy farmers was drawn. The pentagon is drawn based on the findings presented and from farmers who were participating. According to it, both male and female natural capital, human capital, social capital of the dairy is limited whereas financial and physical asset of dairy farmers is very limited. However, male respondents have higher financial, physical and human capital as compared to females. In contrast, women have higher capital in social.

Figure 8 Asset pentagon of male and Female Dairy farmers



Source: Author

4.5 Understanding of Inclusiveness and resilience among Dairy farmers and other stakeholders

8 of the respondents from the interview not heard of the concept of resiliency and inclusiveness. However the four of respondent define resilience related to being able to cope with difficulty and being able to operate. This difficult thing might be during when feed is not available, market inaccessibility or lack of infrastructure. During this times being able to find away to solve it pass through it. Moreover, four respondents belief inclusiveness in dairy as

being able to be included whether in getting information and market especially for those who involved in dairy farms regardless of anything.

4.6 Agricultural Knowledge and information Networks of Dairy Farmers

Formal and informal knowledge and information networks in the milk shed found in key informant interview or interview are Adamitulu Research centre, Alagea Tvet, ILRI, District Agricultural office, Developmental Agents work in farmer training center (FTC), non governmental organization like SIDA and SNV, Energy development department of the zone, Oromia state University, farmer group. For all respondents friends and family is the main knowledge and information network that provide them knowledge, information, and productive assets. From the dairy farmers interview, farmers to farmer group was mentioned three times, Developmental Agents were mentioned 6 times. However, their performance is not effective since farmer are only aware of one DA is assigned for them but they don't have much relation with him/her. It is also observed that, the developmental agents that were used as translator were introduced to the farmers during the fieldwork. Moreover, only two female dairy farmers mentioned Adamitulu research centre as a source of knowledge and information network.

Adamitulu Agricultural research

Adamitulu Agricultural research centre is one of the 17 research centres under the Oromia agricultural research institute that is located in the milk shed. The main mandate for the centre is generating and adopting agricultural technologies and information that improve farmer's livelihood. The centre has different departments with different disciplines. Dairy and health, and the Extension department are working together on research activities and transferring of this research information and technologies for dairy farmers. Further, the centre has been giving trainings for farmers and developmental agents on feed preparation, breeding, health and milk product handling. The centre has also given crossbreeds and forage seed for farmers especially for female-headed households. The research centre has farmers research groups where researcher and farmers do problem-solving research on farmer farms and dairy cows where the farmers get technical support and training from the researcher. Further, the farmer's research group mainly depend up on the lifetime of the project implemented. In establishing the farmers research group, first farmers who have dairy farms and enthusiasm to work will be selected and are given a start up training. The centre will support the FRG until the research project phase-out. Final training or workshop is provided before completion of the project. The research centre creates linkage for them with the district agricultural office and cooperative agency where they can create a cooperative to continue operating.

Alagea Agricultural technical education and training (ATVET) College

Alagea ATVET is one of the agricultural technical vocational education and training college established under the ministry of agriculture. The college is qualifying technically equipped development agents and agricultural experts. Moreover, the college is adopting technologies done by research institute and transferring agricultural technologies. Apart from giving regular training at diploma level, the college is also giving short-term training for farmers, DA, and other small enterprise.

The college has 4 departments among them the animal science department has been giving trainings on feed, housing management, breeding and record keeping for 13 administrative

units dairy farmers. The trainings are delivered consistently at least between 5 to 6 times per year through demonstration, leaflet, and hand on training or video. Further, the college has been giving improved bulls for Farmer training centre and improved heifers for farmers. In addition to this the college is providing service on synchronization of dairy cows for farmers.

The college is also doing climate smart agriculture linked with the indigenous knowledge of farmers like water harvesting, terracing and planting of trees. Further, the college had done research on climate change and its mitigation on animal production, natural science, irrigation and plants where 4000 farmers benefited from it.

International livestock research institute (ILRI) Forage seed bank and production

ILRI works on agricultural research and development especially focusing on researches intensification of agricultural systems by increasing productivity and value chain development. The institute has seed bank in the milk shed, which serve as research site for forage, distributor of forage seedlings for farmers and research centres. The site don't have a training curriculum however farmers who came to take forage seedling will be given instructions and practical information on how to plant and harvest the seedling. Moreover students from different higher education institute visit the site for one-day excursion or field visit.

Agricultural office (livestock and fishery office)

Livestock and fishery office is working on 6 packages namely dairy, Apiculture, poultry, Aquaculture, beef, and livestock health and feed. Each of the packages has its own team with different experts from extension to health. Trainings provided by the office for farmers and DAs are on breed, urea treatment, ration formulation, housing and management of cow and health. Additionally, the office creates market linkage for feed supply. The office also provides artificial insemination and health care for dairy cows.

Experts from the agricultural offices get training from different research institute and the developmental agents get training from the district livestock and fishery office. The office also monitors developmental agents activities.

Farmer Training Centres

Under the livestock and fishery office of each district, there is Farmer training centres for each small administrative unit (kebele). For example in one of Ziway district there are 43 administrative units in which, each unit have its own FTC. In each FTC, there are 3 or 4 developmental agents that are specialized in animal health, plant science, and natural resource and animal production. The developmental agents are the nearest formal knowledge and information linkage. Service provided by the developmental agents in FTC and other places are training, technologies transfer and provision of seedling for forage. The Farmer training centre is also a site for both developmental agents and research institute to demonstrate their technologies and transfer it to the farmers. For three district of the study area, highest academic qualification for the DA found was diploma and their number is low as compared to the area they should cover and reach.

Non-governmental organization

SNV and sustainable environment development action (SEDA) are the two NGO found in the study area, which provide support for farmers. SEDA had been working in dairy development until it phase-out in 2018. The project had been supporting dairy farmers by providing exotic or improved heifers, distributing forages plants, and creating market linkage. Since the project on dairy is phase out it is now working on Apiculture, poultry, and vegetable. The project

constructed retailing house where smallholder dairy farmers can sale their milks however the municipality of the area demolish the house for other purpose.

After the completion of “Enhancing dairy sector growth in Ethiopia project” funded by SNV, Building rural income through inclusive dairy business growth in Ethiopia was launched and has been working on dairy in the milk shed for 6 months. The project is funded by the Netherlands development organization where they provide input for dairy farmers (feed, MTS), create market linkage by strengthen processing of milk products and value addition, provide trainings on calf cow management, animal health, and forage development.

District Energy development office

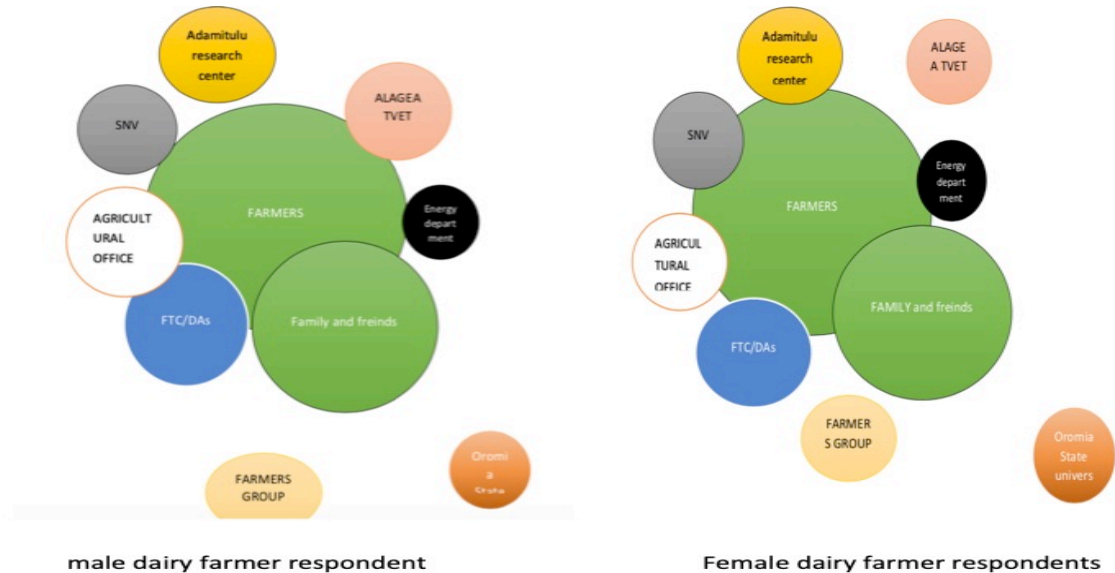
The energy development office is one of farmer’s knowledge sharing platforms. The office provides trainings on using of manure especially for biogas. Further the office also provides training on solar systems and technologies that save energy.

Oromia State University

Oromia state university is offering experiences and competent students from the civil servant and public officials. The university has different departments. Among the department agri-business and value chain management have been equipping students on agri-business and value addition at bachelor degree. Further more, the department is also providing short term training on agri-business value chain and conducting research on selected thematic areas. However, the department hasn’t started providing training for farmers and Developmental Agents. Nevertheless, the department has a plan for next budget year, which will start on September 2019 to conduct short-term training for farmers, communities, and DAs.

Figure 14 shows Venn diagrammed of the institutions and organization involved in the knowledge and information system. The bigger the size of the circle, the higher it influences. For both male and female dairy farmers family and friend have higher influence in getting information compared to the formal structures. None of the male respondent mentioned Adamitulu research centre, there is no interaction with the farmers even though it has great influence in dairy research. Further, one to five development groups have less influence and interaction especially in transferring knowledge and information for both male and female dairy farmers. NGOs like SNV have more interaction to women dairy farmers as compare to the male farmers. Whereas, one male respondent mention Alage ATVET, in which none of the respondent have mentioned it.

Figure 9 Venn diagram perceptions of dairy farmers relation to knowledge and information networks



Source: Author

Role of knowledge and information networks

Table 10 shows the role and strategy of formal knowledge and information networks.

Table 10 role and strategy of knowledge and information networks

List of institutions and organization	Role	Strategy used to deliver knowledge and information	Farmers knowledge and use of different delivering methods
Adamtitulu Research Center	Generate agricultural technologies and scientific information Short term trainings for farmers and Developmental agents Demonstrate and transfer agricultural technologies and information	Demonstration sites and field day Farmers research group Brochures, leaflets Proceeding, manuals	<div>?</div> <div>X</div>
	Qualifying technically equipped agricultural experts and Developmental agents (regular	Demonstration Hand on trainings Field days	<div>?</div> <div>X</div> <div>?</div>

List of institutions and organization	Role	Strategy used to deliver knowledge and information	Farmers knowledge and use of different delivering methods
	diploma program) Adopting and transferring technologies from research institute Provide short term trainings for Farmers and Developmental Agents Provide improves bull for FTC and improved heifer for farmers Provide synchronization (AI service)		
ILRI forage seed multiplication	Research site for forage Distributing forage seedlings to farmers and research institutes Provide practical information on forage planting and harvesting for farmers	—	
Oromia state University	Train Regular bachelor degree students Conduct research Consultancy work on	—	
Developmental Agents	Provide trainings and Extension service Provide seedling of forage like Elephant grass, Alfa Alfa etc.	Farmer training center (demonstrating site) Home to home visit Group training Hand on demonstration	<input type="checkbox"/> X <input type="checkbox"/> X <input type="checkbox"/>

List of institutions and organization	Role	Strategy used to deliver knowledge and information	Farmers knowledge and use of different delivering methods
		Farmers to farmers	?
SNV	Provide Dairy Extension service Provide training for selected districts Provide forage seed and industrial bi-products Provide nitrogen container for AI service for agriculture office Create market linkage for dairy farmers Provide inputs like feed and milking tools Provide forage seed	Monthly information forums Electronic media Leaflets and manuals	? x ?
District Energy	Provide information on manure management for the purpose of Energy Provide energy saving technologies	Home to home information exchange with beneficiaries	X
Agricultural office	Provide training and extension service Provide AI service Provide health care and vaccination service	Through DA Subject matter specialist (experts monitor and evaluate developmental agents) Farmer training center (demonstrating	? ?

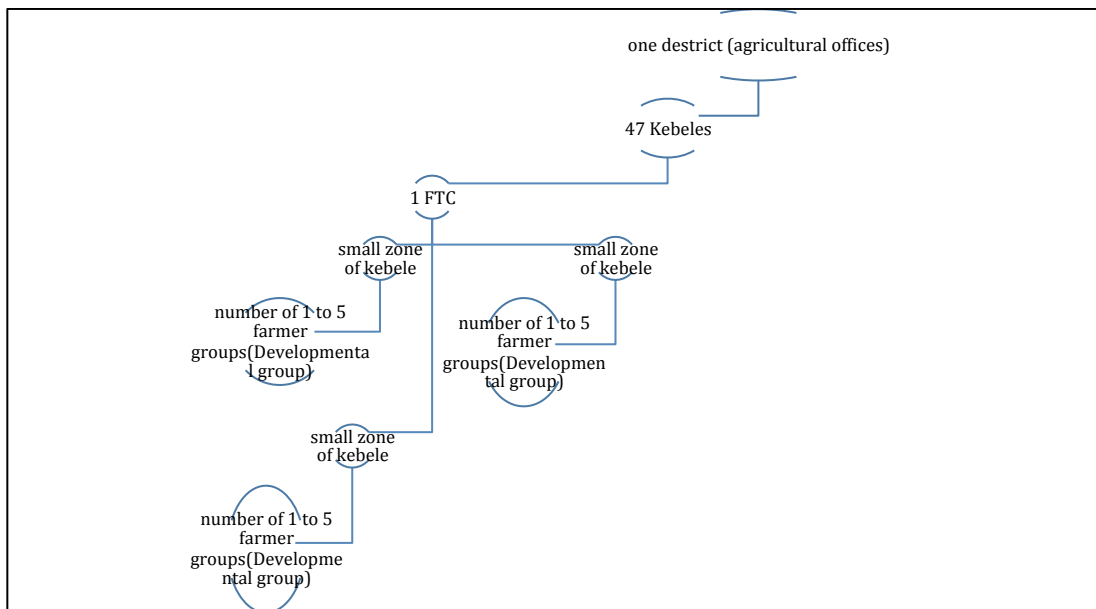
List of institutions and organization	Role	Strategy used to deliver knowledge and information	Farmers knowledge and use of different delivering methods
		site) Electronic media video and mass media radio Leaflets and manuals	X ?

4.7 Selection of dairy farmers in knowledge and transformation platforms

Different platforms use different approaches to select farmers for their support and trainings. District agricultural offices, select farmers based on the number of dairy cows a household have. Report on the number of dairy cows available in the district will be reported by each of developmental agents in the small administrative offices (Kebele). Most of the time, model farmers from each Kebeles are select for trainings. The SNV Adamtulu research center, Alagea ATVET have selection criteria like characteristic of farmers they want to train, and the Woreda agricultural office working with the DAs select farmer with those criteria. DAs select farmer from 1 to 5 developmental groups. In the 1 to 5-farmer group, DAs prefer model farmers to be the leader. However model farmers don't want to be a leader since they are busy with their farms. Further, farmers think the structure has political agenda and don't want to participate on it. On the other hand, research institute and agricultural offices complain same farmers are always selected by the DAs for trainings.

For SNV project, location and farmer selection was done with some selection criteria. The Kebele selection criteria for SNV project are Kebeles's with milk market potential, land for forage development, feed potential and have good infrastructure. Regards to farmers' selection, farmers who have cross breeds will be selected as beneficiary for the project. Selection of farmers and location for the project is done together with district Agricultural offices and DAs. Further, women with local breeds sometimes will be beneficiary and youth are more involved in market chain rather than in the production.

Figure 10 Hierarchy for selection of farmers by Agricultural offices and DAs



Source: Author

In Adamitulu research center, farmers who have available assets to conduct farmer research group will be selected. For instance, farmers who have available land and equipment will be selected. However, female-headed household will be given priorities in trainings and FRGs.

4.8 Inclusion of Youth and women in dairy and, knowledge and information networks

Inclusion of youth and women in dairy farm depend on participation level of them in dairy farm, having access to knowledge, information and technologies.

Women in the milk shed participate in almost all-dairy practice from feeding to selling of milk and milk product. However dairy farmers who have large farms use young Men workers for taking care of their cows. Further, men are participating purchasing and transporting feed and choose the type of breed to be kept. The women don't have power to sell the milking cows without the consent of the men.

<.....>Dairy cow in the household is kept for women. Milking, processing, selling of milk product are for women. In our culooture, Men are not allowed to milk
Male respondent

The knowledge and information networks all give priorities for women and youth who want to be involved in dairy farming. Further the policy of the government of Ethiopia is working on empowering women and youth by integrating gender issue in most of governmental organizations. However, ensuring women and youth to attend training and information is difficult since women are busy in taking care of their homes and youth are not much enthusiastic about farming and dairy. Most of female participants in the Focus group discussion were also doing their reproductive role as a woman. 5 of the Key informant from the study indicated that women accept and adopt new technologies especially in dairy since they are more involved in dairy activities as compared to men. Moreover, youth are using modern technologies and Internet to get information. This information can also be validated from the

observation the researcher made where, a young model farmer is using Internet for getting information.

Access and control of resource men and women

Table 11 Access and control of resource of men and women

	Access	Control
Land	M	M
Dairy farm Labour	M	M
Dairy cows	M/W	M
Equipment	M/W	M
Training, extension and knowledge	M/W	M/W
Education	M/W	M/W
Social networks	W	M/W
Income from dairy	M/W	W
Exposure to new ideas	M/W	M/W

Source: Author

4.9 Perspective of dairy farmers to scale up climate smart dairy

Climate smart practices are important in improving resiliency of farmers and increase their productivity. However, most of the smallholder farmers don't practice climate smart dairy activities like manure and dung separation, good cattle housing, financial and insemination record, planting of forage, and water harvesting technologies. Further, none of the farmers have heard about climate smart dairy even if most of the dairy farmers use manure for composting. Reduction of herd especially for male is difficult situation since number of cattle is seen as wealth of the household and prestigious. Moreover, adopting of climate smart practice is economically difficult for them since exotic breeds and land for planting forage is expensive and seed of forage is expensive and difficult to access.

From the focus group discussion and interviews, farmers believe local breeds have better disease and drought tolerant than the crossbreeds. They believe local breeds have a capacity to tolerate when feed and water is unavailable. Further, female respondents who are processing milk believe local breed milk give better butter compared to the crossbreeds.

5. Discussion of results

This chapter builds up on the finding chapter and compares it with research and literatures done on similar topics of the study.

5.1 Vulnerability context of Dairy farmers

Identifying of vulnerability context of dairy farmers can minimize and build higher resilience and improve livelihood of dairy farmers. The Vulnerability context of dairy farmer that affect the dairy farms in this study are feed unavailability, high feed price, milk and milk product price fluctuation especially during holydays and fasting time, climate change, unavailability of land for pasture or planting forage, and disease and death of dairy cattle.

Fasting seasons and religious festivals are the main factor for price fluctuation of milk and milk product in the study area. Other studies (Belete, 2006: Adebabay, 2009: Negash, 2012: Tarekegn, 2016) also indicated during the fasting time milk and milk product price declines while, during religious festival, price for milk product especially price for butter and cheese increases. Fasting seasons and religious festival have significance in the milk market since more than 200 days in Ethiopia is fasting days. In this study the main reason for the fluctuation of milk price is culture whereas in Kenya the main factor for the milk and feed price fluctuation is due to import of milk from neighbouring countries (Aguda, 2019). However, dairy farmers who have formal market linkage especially farmers who sell their milk to the hotels don't encounter price fluctuation since the price is standard.

Availability of feed resources and pastures for dairy has great importance in increasing milk production. This study shows most of the dairy farmers have limited pasture land or land for planting fodder to feed their cattle since the price of feed is increasing over time. Concurring with UNIDO, (2009) and (Ibrahim, 2000) the main constraint in increasing milk production for dairy farmers are inadequate feed and increases in feed price. The study also shows limited land availability is also factors for inadequate feed for dairy cattle. However, this study shows one farmers with 10 hectare of land, do not plant forage for his cattle due to low awareness about forage plant. Shrinkage of grazing land due to over increasing of population has an effect on amount of animal feed. Therefore, volume of milk produce is reduced since availability of required amount of feed is limited.

This study shows health related challenges of dairy animals like Mastitis, Black leg and Anthrax affect productivity of the dairy cattle. Prevalence of different cattle diseases affects the dairy development through disturbing the productivity and reproductively efficiency of dairy cattle (Lemma et.al, 2000).

5.2 Adoptive Capacity of dairy farmers

Adoption of new farming techniques, adjustment of household activities, connectedness to social networks to cope with different factors affecting the dairy farmers were the indicators for adoptive capacity of dairy farmers in this study.

For dairy farmers who don't have market access for fresh milk, process and sell it to informal market is important adoptive capacity of farmers especially for women dairy farmers. The study also shows the dairy farmers have indigenous knowledge on how to process milk. Other studies

indicated in livestock production, farmers have indigenous knowledge on dairy processing and preservation of milk (Belete, 2006).

Farmers in the study area have knowledge effect of hygiene on the health of dairy cattle. In the semi structure interview, all respondents said they clean the cowshed every day. However, It is observed famers have no proper housing with out concrete floor, cleaning the shed is difficult. So, milking of the dairy a cow is done in farmer resident compound out side the cowshed. This concurs with the study done by Tarekegn (2000).

Dairy farmers in the study keep dairy cows mainly for the purpose of milk and to use the bi-product for crop production. Manure from the dairy cattle is mostly used as a fertilizer of farms. Jagisso (2019), and Ndambi et.al (2019) found that farmers with mixed agricultural production, manure is applied to increase soil fertility and production of crop, which help them to get both food for them selves and enough crop-residues. The findings also shows some of the dairy farmers use dung cake as a source of fuel. According to (Ndambi et.al 2019), dung cake is used as a source of fuel especially for preparing food.

5.3 Dairy farmers asset

Human Capital

Dairy Farmers have heterogeneous asset endowment in which each farmer have different asset. Dairy farmers have indigenous knowledge and skill that is gained through experiences and family. Labour force for most dairy farms is a family labour in which women are more involved in activities like cleaning, milking, processing and retailing of milk and milk product. Similar studies done in Debremarkos, Ziway and Gojam of Ethiopia shows, men are involved in selling, breeding activities while youth especially male children involved in cattle keeping where women involved in routine dairy activities like cleaning, milking and processing (Weldeslasse *et al.*, 2015; Yayehe *et al.*, 2017; Wendatir, 2010).

Physical capital

From the focus group discussion land endowment for women, men and youth have no much difference but in semi structure interview women have less access to land especially due to culture for inheritance. And decision-making and land ownership of is for men. Report from GTLN, (2014) showed men exclusively own and access land through inheritance. The findings of this study shows land to develop improve animal feed and access to grazing land is also the major constraint in dairy farm for women, men and youth.

In the farmer's interview and focus group discussion of men dairy farmers, it is revealed that dairy farmers posses cross breed cattle. However, during the focus group discussion of women, none of the participants owned cross breed. Survey done by (CSA, 2018) showed that 98.24 per cent of the total cattle of Ethiopia are local breeds.

Dairy farmers in this study don't keep their dairy cattle in improved and proper housing where dung and urea are separable. This is similar to the study done by (Gizaw et.al., 2016) where rural dairy farmers don't have proper feeding barns and improved housing. This is due to the capacity of dairy farmers to build a proper house especially financial capacity.

Research done in Kenya shows farmer group help farmers to improve their market access and avoid market intermediaries (Munyua, 2011). However this study reveals, farmers research group neither create market access nor provide knowledge and information for most dairy

farmers. It also shows both male and female dairy farmer don't have formal market access where they can sell fresh milk or milk products.

Social capital

According to (Emana, 2009) in Ethiopia, cooperatives that are engaged in milk production and marketing consists only 0.74 per cent of the total number of agricultural and non-agricultural cooperatives. This study also shows dairy farmers in the study area are not member of cooperative. On the other hands, similar study done in Kenya shows men dairy farmers are member of dairy cooperative in which this cooperatives create market linkage and are source of information (Aguda, 2019). Social capital for women dairy farmer is higher as compared to the men dairy farmers since they have more exposure and better organize to their neighbours especially by participating in social organization. However, this network is not used for transferring knowledge and information about agriculture or dairy.

Natural capital

Dairy farmers in the area have limited natural resources due to population increase and climate change which is different from the study done in Kenya where soil fertility and water bodies for dairy farmers is rich (Aguda, 2019).

Financial capital

The importance of the financial institutes in any of agricultural production is undeniable. Traditional ways of saving like rotating saving provide financial support and social connection for farmers. An important finding is that women dairy farmers participate more in traditional social organization like Edir and Equb. This is similar to the finding found in the literature where participation of women in Edir and Equb is high (Kedir;2011). However, both Men and Women don't have credit access due to collateral issue. Further, land ownership is in the hand of Men, access to credit for women is also difficult. Further, dairy farmers have low financial capital to increase physical especially proper cowshed and better breed.

Financial capital of women compared to men is low since men especially participate in crop production that make better income compare to small business which women are participating.

5.4 Agricultural knowledge and Information system

During the field study, formal governmental and non-governmental institutions and informal networks are involved in the provision of knowledge and information for dairy farmers. The formal institutions are mainly target in the provision of service that will help to improve production and productivity of dairy cattle like AI and health provision. This finding has similarity with the study done by Debele and Verschuur (2014). Adamitulu research center, Alage ATVET, ILRI forage seed multiplication, Oromia state university, SNV (NGO), Energy development and Agricultural offices especially livestock and fishery offices were identified during the field study as knowledge and information plat form. However, most dairy famers believe they don't have much support especially information and knowledge from these formal institutions mentioned above.

From Focus group discussion with both female and male dairy farmers, and farmer's interview, dairy farmers get information from their families and neighbour. Family and friends are the major source of information, knowledge and reproductive resource for dairy farmers. Land for men and dairy cattle for women are given as inheritance or dowry of marriage. However, this informal knowledge and information networks are linked or given attention by the formal networks. Further, developmental agents are the next source of information for dairy farmers. This is supported by previous studies by Ayalew (2017) and Van Crowder and Anderso (1997).

Various means to transfer information and technologies like demonstration, field days, and farmer research group, written materials (brochure, manuals, leaflets, proceeding) and mass media were identified. This study also revealed demonstration and field days were mentioned a lot especially by research institute and agricultural college which imply its importance in transferring technologies and information. Dairy farmers also prefer methods where they can practically see technologies that are in the ground. This is inline with Aflakupui (2007) and Ayalew (2017) study, which manuals, organizing field days and demonstration increase technology adoption that ensure productivity. Demonstration and fieldwork for dairy farmers especially for those who have low education qualification helps to get practical knowledge and information. Further, dairy farmer who are able to get knowledge and information from formal organization is mostly from short-term training specifically in one subject.

Planting forage seedling as a source of feed is not only climate smart, but also economical feasible since it will decrease cost of feed for the cattle. However, both men, women and youth dairy farmers have no forage planting. This is due to the cost of forage seed or lack of knowledge about its importance. Further, dairy farmers have low awareness about what service and support the formal knowledge and information networks provide. For instance, farmers around ILRI forage seed multiplication are not aware of the fact that it provide forage seedling free of charge.

5.5 Inclusion of women and youth in Knowledge and information system and dairy

Women in the study area are involved in many of dairy activities especially in managing of the dairy cows. Further, formal institution like Adamitulu research centre, Alage ATVET, agricultural offices mentioned they support women and youth since policies are favourable for them. In addition, some female dairy farmers mentioned this formal institution compared to male dairy farmers, which imply they are incorporating gender issue on their policies or projects. According to National action plan for gender equality, all federal, regional governments as well other stakeholders implement gender mainstreaming and initiate their plan that are inline with gender equality and women involvement.

Youth are more reluctant to learn agricultural skill and they show low interest in taking up dairy or agriculture. This coincides with a study done by Bezu, (2014), which youth are not aspire to engage in agriculture since there is lack of role models who have succeeded in agriculture. Despite this, the field study shows youth are possessed and use technologies like phone, Internet to get access to technologies and information.

According to FAO (2018), Women and girl in agriculture encounter challenges related land access, productive resource managing income, and information. However, this study showed not only women but also men and youth faces challenge related to access to land, productive resources financial service and access to information. However, control over and decision making power on productive assets like tools, equipment, dairy cattle is on the hand of men where women in this area have no control over resources except in managing of income from dairy. On the contrary, a similar study done in Kenya shows men have control over power in managing income from the dairy farm (Aguda, 2019). For the Kenya case, men manage the money due to higher return from milk production. Whereas, for this case women are managing the money since the production of milk is low.

5.6 Perspective of women and youth to scale up climate smart dairy

In the study area, women are participating mainly in dairy. Management of the dairy farms is on the hand of women. Since women are involved in dairy production, they believe, adopting climate smart dairy would help them.

5.7 Reflection as a researcher

In the study of Inclusiveness and resilience of dairy farmers to scale up climate smart dairy, I had a lot of challenges and learned a lot from it. Beginning from proposing of the thesis to write up confronting with challenges helps me to learn and become more experienced.

In writing the proposal of the thesis, understanding of the main concepts like resiliency and inclusiveness was a major challenge since my specialization is a little bit far from the concepts. However, reading literatures, asking lecturers and colleagues who are specializing in this concepts help me a lot.

In the fieldwork I presented my self not as staff member of a research institute instead I presented my self as a student. So the farmers were not expecting anything and were explaining what they felt with out any influence. During the field, one of the knowledge and information network staff (DA) was a translator. The translator was exactly translating what they have said even he was translating that they were not getting any support from him.

Finding data and information for research or else is not an easy task.in order to find dairy farmers and key informants, going to the rural area with donkey cart and motor bike is good experience I got from the field work. Dairy farmers go through those difficulties to improve their livelihood throughout the year.

Facilitating the focus group discussion with out the help of my previous colleagues is new experience that helps me to improve in my leadership skill. Further, during the focus group discussion, I could see improvement in each FGD especially in involving and participating all farmers in the discussion.

In the fieldwork of the study, finding the selected sample units was difficult. However, after meeting the DAs finding the farmers was easy. In finding the selected farmers, I coincidently met information and knowledge network platform, which I didn't include in my proposal like ILRI, Energy development office and Oromia state University. Additionally, extra two FGDs were added in the fieldwork so as to increase the validity and reliability of the information collected.

Selected sample unit farmers for the fieldwork were randomly selected. However none of the selected farmers have consistent support from the formal knowledge and information network. The main limitation of the study was, not able to include and select farmers who had consistent support from this networks or beneficiaries of projects.

There was a challenge in translating words from English to Amharic. For instance, most farmers who speak either Amharic or Afan Oromo would understand the word "support" as only social safety net or financial support. There fore, list or explanation of the word was given for them so as they can give appropriate answer.

Keeping the collected data from the fieldwork safely whether it is written document, picture or record is feature of good researcher. However, I failed to keep my pictures I took during the

fieldwork when I lost my phone. Duplicate the pictures in two or more places after the completion of each interview should have been my prior thing to do to not to lose it.

6. Conclusion and recommendation

6.1 Conclusion

The following conclusions are based on the main findings and discussion of this study.

Dairy Farmers in the Ziway-Hawassa milk shed have different knowledge, experience, assets that enable them to adjust themselves from various vulnerabilities and continue operating. This knowledge, experiences and assets help them to be more resilient by improving their adoptive capacities. However, asset endowment for dairy farmers is the main constraint they face in up scaling their dairy farms and to be more resilient. Physical, financial, human, natural, and social capital of women, men and youth in the milk shed is limited. However, financial, human and physical capital of men is little bit better than women and female dairy farmers have more social capital compared to the male dairy farmers.

Further, dairy farmers are affected by seasonality, trends and shock like high price and unavailability of feed, fluctuation of milk and milk product price during fasting days, Disease, climate change (erratic rainfall), land and unavailability for pasture and forage planting are the main factors found in this study. Since vulnerability context are factors that are not within the farmers to control, there is no much different between men, women and youth.

Knowledge and information networks of dairy farmers found in the milk shed are formal and informal networks. The informal knowledge and information networks for dairy farmers are family and friends. Whereas the formal knowledge and information networks include Adamitulu research center, Alage ATVET, ILRI forage seed multiplication, SNV (NGO), Energy development and Agricultural offices especially livestock and fishery. Knowledge and information system in the formal network is well-structured hierarchy. However, the effectiveness of the structure is doubtful since there is inconsistency of support and training for farmers. Most of the time, Dairy farmers in the milk shed don't get much information and knowledge from formal institution, as compared to what these institutions perceive to have given to the farmers. Further, agricultural offices, research centres, NGO are mainly working with model farmers or farmers with productive assets who are more likely to adopt technologies. This affects the inclusion and technology adoptability of most dairy farmers who have limited assets. Further, there is loose relation ship and linkage between the formal and informal knowledge and information networks.

Women in the study area are involved in many of dairy activities. Female dairy farmers are provided support from knowledge and information networks as compared to men especially from Non Governmental organization, research institute and agricultural college. Further, government institution like Adamitulu research centre, Alage ATVET, Agricultural offices incorporate gender issue in their policies which is including 50 per cent of women and youth especially in transferring knowledge and information. Dairy farmers in the milk shed mainly get information and knowledge from informal linkages like from friends and family. Further, DAs are the closer formal networks which farmers supposed to have. However, DAs are not reaching farmers due to low practical knowledge about climate smart and their number.

6.2 Recommendations

Based on the conclusion of this study, the following recommendations were proposed.

- ✓ Agricultural offices, Adamitulu research centre and Alagea ATVET better Provide consistent capacity building training on climate smart dairy for Development agent to upgrade their practical skills and that enable them to provide proper advice and awareness to dairy farmers.
- ✓ SNV and agricultural office should work on market linkage for dairy farmers by creating cooperative where they can sell their milk and find appropriate price for feed.
- ✓ The ministry of agriculture create better coordination among the knowledge and information networks and also work together to strengthen the informal knowledge and information networks of dairy farmers.
- ✓ Strengthening the farmer developmental group by giving them consistent training and capacity building on climate smart dairy practices and activities by all stakeholders
- ✓ Provide capacity building trainings and incentive for youth and women especially along the value chain which will make them empowered financially
- ✓ Adamitulu Research centre should Strengthen the Focus on research and technologies that are affordable by poor dairy farmers and strengthen value addition of milk that are climate smart since most of the dairy farmers don't have much the financial and physical asset.
- ✓ All knowledge and information networks better work on Strengthening the 1 to 5 farmer developmental group by giving them consistent training and capacity building.
- ✓ Create opportunities where model farmers who are trained by the formal knowledge networks to transfer their knowledge to other dairy farmers by making mutual agreement
- ✓ Adamitulu research center and Alage ATVET Provide trainings and knowledge on the importance of financial institutions and
- ✓ Adamitulu research centre in collaboration with ILRI forage seed multiplication should create awareness for dairy farmers about the importance of forage planting and distribute forage that need small lands which will contribute to solve the problem of inadequate feed.

Recommendation for Commissioner

It is recommends further researches to be carried out on the effectiveness of informal and formal knowledge and information networks in scale up climate smart practices.

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Annexes

Annex 1. Semi structure interview questions

General background

1. Gender of the respondent
2. Sex of respondent
3. Occupation of respondent
4. Respondents position in the household
5. Highest level of education attained

Household socio-economic background

1. No. Of people in the household
2. Age and current education level of people in household
3. Size of land occupied
4. Type of land ownership
5. Sources of income

General

1. When did you start dairy farming
2. Type of ownership of the dairy farm
3. Who manages the farm
4. Prior knowledge of dairy farming
5. How did you start dairy farming
6. What was the motive behind setting up the dairy farm
7. Do any of your family members practice dairy farming

What are the livelihood assets of dairy farmers that improve their adaptive capacities?

- No. of dairy animals
- Breed of cows kept
- What breeding techniques do you employ in your farm (artificial insemination as part of provided options)
- Other livestock in the farm
- How did you get the dairy animals
- No. of workers
- Workforce gender ratio
- Type of grazing
- If grazing land available: have you undertaken any land improvement and conservation measures during the last two years; type of grass grown
- Type and quantity of animal feeds
- Do you belong to a cooperative or any farmers group?

What is the vulnerability context of men, women and youth dairy farmers In relation to CSD?

- Do you have enough fodder for your animals across the year
- Do you experience any shortages (If yes, during which months/ season)
- Alternative sources of food

- Do you have enough water for your animals across the year?
- Source of water
- Do you experience any shortages (If yes, during which months/ season)
- Cost implication of the feeds
- What milking mechanism do you utilize
- No. of times cows are milked
- Do you experience high and low seasons in milk production across the year
- What factors contribute to the low milk production
- Do you plan to increase your milk production (if yes, how)
- Is your business profitable throughout the year (if no, how many months do you receive positive cash flow)
- During low periods, how do you get additional funds to supplement your business
- Do you keep written financial records
- How do you share income from dairy farming
- How do you spend income from dairy farming
- Are women and youth included in dairy farming and
- What incentives are there for women and youth to engage in dairy farming
- What are the major constraints you experience in dairy farming

What are adaptive capacities of dairy farmers (men, women and youth) that support resilience?

- How do you select the breed?
- Are you aware of the concept of smart dairy farming?
- How did you get the information
- Have you adopted any of the smart dairy farming practices? (if no, why) (if yes, what are the benefits you have noted)
- Do you have any specialized training in dairy? (Where when and by whom)
- Are there technologies that you have adopted in your dairy farm
- In what aspects of your dairy farming have you adopted the use of technology (transportation, storage, milking, breeding, others) and to what extent
- How frequent do you conduct healthcare checks on the animals
- Are the animals vaccinated
- Who carries out artificial insemination and at what cost
- How frequent do you conduct cleaning and maintenance of your farm
- How do you utilize the manure collected from the farm
- What safety measures do you implement regarding the animals
- No. Of years living in the study area

What is the role of formal and informal knowledge, information and, training networks in which men, women and youth are involved?

- Do you get any government support for your dairy farming (if yes, what kind)
- Do you get any other kind of support for your dairy farming (if yes, what kind, how)
- How frequent are these support initiatives
- How important is this support for your dairy farm

What are the strategies used by knowledge and training networks in order to scale up climate smart dairy?

- How did you get information about dairy farms?
- Is it consistent? If so how consistent

How women and youth are included in the existing dairy knowledge training networks

- What are the factors that could affect access to support program me
- Do you have access to dairy information?
- What community activities are you involved in and you role?
- Do you attend farmer's trainings?
- What kind of knowledge information or skill did you get? From where? How relevant it is
- What incentives are there for women and youth to join dairy farming?

What is the perspective of men, women and youth in scaling up CSA?

- How do you see scaling up of climate smart dairy
- How has you implementing this view
- What were the major problems you encounter before, during or after implementing climate dairy? Or what do you think...
- What was/will be your solution

How do stakeholders (Dairy farmers, research institutes, extension officers) perceive the concept of inclusiveness and resiliency?

- Have you ever heard about inclusiveness and resilience?
- How would you characterize resilient dairy farm?
- How would you characterize inclusive dairy systems?
-

Suggestion for improving the dairy farming system

Annex 2: Observation Checklist

No	Activity	Remark
1	Productive role in dairy like, Who is milking, processing, selling, feeding cattle (sex and age)	
2	Equipment and tools	
3	Animals (indigenous or exotic)	
4	Number of Animals (herd)	
5	Feeds (fodder, grazing)	
6	Selling of milk	
7	Manure use	
8	Availability of water in near by area	
9	Improved infrastructure (near by market, road)	
10	Record keeping (financial and cows insemination day)	

Annex 3: FGD Topic Guide

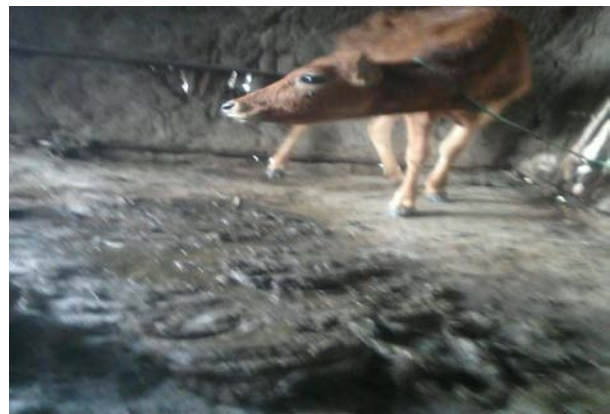
No	Activity	Remark
1	Draw livelihood assets pentagon	
2	Vulnerability and capability matrix	
3	Who support the dairy farm (list governmental and non governmental)	
4	What are their roles	
5	How important is the support and provision of this institutions	
6	How do you access information and knowledge	
7	How effective it is the way institution give their service and why do you think	
8	What are the constraints and opportunities to adopt and not to adopt technologies and information?	

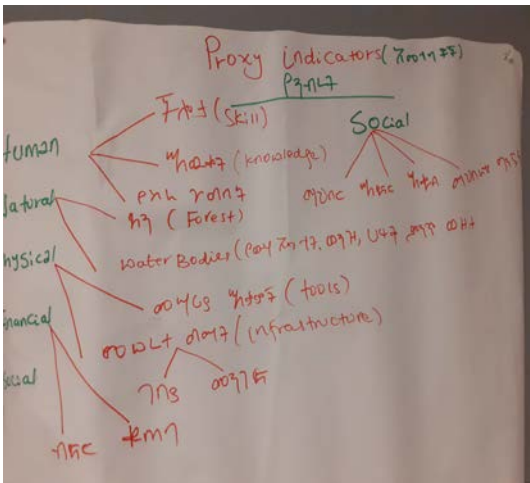
Annex 4: Key informants interview checklist

No	Activity	Remark
1	Name of Interview and sex	
2	Name of institution	
3	Position of interviewee	
4	Main task of the institution	
5	Type of service provided	
6	Types of training, technologies provided (in which area and for whom)	

7	How is information and knowledge is transferred	
8	Who are the partners	
9	How do you define inclusiveness and resiliency	
10	How important it is for your institution and farmers	
11	How technology reaches the farmers	
13	What type of climate smart dairy information have you provided before	
14	Service they provide	
15	How long are the services	
16	How they select farmers for service provision or information	
17	Consideration of youth and women in trainings and information development	
18	Role of women and youth in dairy and their special need for training or adoption and Why	
19	How are responsibilities established and enforced? Are they reflected in policy/legislation?	
20	How do you measure your performance in proving your service and how effective do you think your performance is	
21	Existing gaps and opportunities in transferring technologies and information	

Annex 5: Field Pictures





Vulnerability & Coping

Vulnerability factors

- Human health
- Natural Shocks/Catastrophes
- Livestock disease
- Economic Shocks (Price Variation/Fluctuation)
- Conflict
- Introduction of Technologies
- Loss in main income sources
- Making adjustments
- Access to & use of natural resources
- Things got worsened
- Water availability for next year