ILRI DISCUSSION PAPER 39

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Melkamu Bezabih[1], Delelegn Abera[2], Aberra Adie[1], Nicole Lefore[3] and Chris Jones[1]

1. International Livestock Research Institute
2. Hawassa University, College of Agriculture
3. Texas A&M University, Collage Station

November 2020

ILRI thanks all donors and organizations which globally support its work through their contributions to the CGIAR Trust Fund.

This work was sponsored by the Innovation Laboratory for Small Scale Irrigation (ILSSI) as part of the US Government's Feed the Future initiative.

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover photo—ILRI/Apollo Habtamu

ISBN: 92–9146–626–8

Citation: Bezabih, M., Abera, D., Adie, A., Lefore, N. and Jones, C. 2020. *Analysis of stakeholders roles and relationships in the feed value chain in Ethiopia*. ILRI Discussion Paper 39. Nairobi, Kenya: ILRI.

Patron: Professor Peter C Doherty AC, FAA, FRS
Animal scientist, Nobel Prize Laureate for Physiology or Medicine–1996

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock

ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia
Phone +251 11 617 2000
Fax +251 11 667 6923
Email ilri-ethiopia@cgiar.org

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Summary

Livestock is the most important subsector in the economy of Ethiopia. The country has the largest cattle population in Africa with an estimated herd of about 60 million animals. Despite the head count, the sector's performance is far below its potential. This is because of multifaceted challenges including: (i) low production and productivity, (ii) low value addition and commercialization, and (iii) weak private and public institutions. The dominant factor that affects livestock productivity is shortage of feed (quality and quantity). Several studies have been conducted to analyse issues related to animals feed and feeding. But most of these studies have focused on the biological aspects of feed and animal responses to feed. Evidence is patchy and limited on key stakeholders in the feed value chains and their roles, feed supply, processing and marketing.

This study, which was carried out in Ethiopia's Amhara and Southern Nations, Nationalities, and People's Region (SNNPR), aimed to empirically examine stakeholder roles and relationships and the implications of these on the development of feed value chains in Ethiopia. In particular, the study addressed the following five research questions:

1. How is the feed value chain structured and organized in the study area?
2. Who are the stakeholders involved in the feed value chain?
3. What are the diverse functions of stakeholders within the feed value chain?
4. Which institutional networks exist between the different groups of stakeholders within the value chain?
5. What are the major constraints in the production and marketing of feed in the study area?

The study used qualitative research to address the research questions. Qualitative data was collected through focus group discussions (FGDs) and key informant interviews (KIIs) with existing stakeholders in the feed value chain.

Our analysis of the data was informed by two important analytical frameworks: value chain analysis and stakeholder analysis, mainly the Process Net-Map approach. Our findings show that two types of feed value chains are dominant in Ethiopia: the fodder value chain and the agro-industrial by-products (AIBP) feed value chain. The main types of feed resources utilized in the study areas are crop residues, hay, improved fodder, enset by-products, atela, and industrial by-products. Crop residues is the primary feed source (62%) identified by farmers in the study areas followed by hay (15%), improved forage (13%) and AIBP (5%). The fodder value chain consists of four core processes namely seed supply, fodder production, marketing (retailing) and end use. On the other hand, the AIBP value chain includes five main processes: production (crops), marketing, processing, retailing and end use. The dominant stakeholders in the processing of AIBP are agro-processors (unions). This class of feed is expensive and often used in small proportion by dairy producers in the urban and peri urban area.

Results on the Process Net-Map exercise revealed that three main types of institutional linkages/flows between stakeholders are distinguished in the feed value chain. These are fund flows, knowledge and technology flows and business/trade linkages. The funds flow entails money's movement in relation to the need to undertake desired activities that help upgrade the feed value chain in the study areas. Knowledge flows entail institutional linkages in information exchange, technical assistance, technology flow, and extension and advisory services. Business linkages,

on the other hand deal, with networking in the transaction of feed and other business services within the value chain. The woreda livestock agency is the most influential stakeholder followed by research institutions in Hossana site. In the Bahir Dar Zuria site, research institutions are the most influential stakeholder in upgrading and enhancing the performance of the feed value chain. The key constraints in the feed value chains identified in the study include shortage of improved forage seeds, poor fodder storage and utilization practices, lack of awareness in improved forage production, shortage of supplementary AIBPs, high prices of formulated feeds in marketing and limited private sector investments. These findings suggest there is huge scop for improving the sustainable production of animal feeds in Ethiopia if strategies are put in place to address constraints at different levels. One way to upgrade and enhance the performance of the country's fodder value chain would be establishing woreda-level forage development platforms. The stakeholders with higher influence such as research institutions and woreda bureaus of agriculture together with the private sector could play a key role in leading these platforms. For the AIBPs feeds value chain it is necessary to develop the market network and linkages with active engagement of the private sector through regulatory incentives. In line with these, specific recommendations are suggested.

1. Introduction

Driven by rapid urbanization and rising per capita income, food systems in sub-Saharan Africa are undergoing fundamental changes (Minten et al. 2016; Tefera et al. 2019). This change is often characterized by increased consumption of animal products (dairy and red meat) and fresh vegetables. This rising demand for animal products could be good news for smallholder livestock producers. They can benefit by ensuring their increased presence in the dynamic urban markets and obtaining higher prices for their products. However, smallholder producers face multifaceted problems in accessing remunerative markets. They often lack appropriate resources such as quality feed to produce demanded animal products and link them to modern markets. In addition, low production and productivity of livestock due to disease, weak veterinary services, and low genetic potential of local breeds (e.g. dairy cows) negatively affect the sector.

In Ethiopia, the livestock subsector plays a pivotal role in the livelihood of smallholder farmers. It serves as a source of food, services (transport and traction), cash income, manure (for soil fertility and fuel), saving and employment. Ethiopia holds the largest cattle population in Africa with an estimated herd of about 60.4 million heads (CSA 2018). There are about 12.4 million indigenous dairy cows yielding 3.3 billion litres of milk per year, with national average milk production of 1.37 per cow per day (CSA 2018). Despite the large livestock population, the sector's contribution at the micro and macroeconomic level is well below its potential. This is due to mainly feed shortage (quality and quantity) and diseases (Bezabih et al. 2016). These problems are exacerbated by the inefficiencies in the input supply chain, weak coordination and integration of actors and weak value chain support services.

In this exploratory study, we focused on feed value chains and feed related issues. The major feed resources in Ethiopia include natural pasture, crop residues, green fodder, hay and agro-industrial by-products (Gebremedihn et al. 2009). Nationally, the production practice and contribution of improved forages to feeding livestock is very small. In the crop-livestock mixed system (i.e. highland areas) crop residues are the dominant feed resources, which account approximately 60% of all feed given to livestock (Gebremedihn et al. 2009). In the pastoral areas (lowlands of the country) natural pasture is the major source of feed. Agro-industrial by-products (AIBP) are often used in urban and peri-urban dairy production systems.

An increasing number of empirical studies have been conducted on fodder production, management and use in Ethiopia. However, the focus of the studies has been limited to the biological and nutritional aspects of feed resources and animal responses to types of feeds and feeding practices (Dejene et al. 2014). Very few studies have addressed feed value chain-related issues such as feed supply and marketing. Evidence is scarce on stakeholder roles and integration within the feed value chain and the implication of this on smallholders' livelihood. Using a qualitative approach, this study assessed the attributes of the feed value chain by characterizing stakeholders and their roles and networks, with special emphasis on the two regional states of Amhara and SNNP. Specifically, the study sought to gain better insights about stakeholder roles and relations, forage seed supply, improved fodder production, fodder marketing, and constraints in fodder production and marketing.

In the present study, stakeholder analysis is crucial. This is because it helps to (i) characterize and map stakeholders in the feed value chain, (ii) identify relationships between different stakeholders and pattern of interactions, (iii) better target interventions, and (iv) start understanding the needs and interest of the key stakeholders.

This study addressed the following five research questions:

1. How is the feed value chain structured and organized in the study areas?
2. Who are the key stakeholders involved in the feed value chain of the study areas?
3. What are the diverse functions of stakeholders within the feed value chain in the study areas?
4. Which institutional networks exist between the different groups of stakeholders in the feed value chain in the study areas?
5. What are the major constraints in the production and marketing of feed in the study areas?

The report is structured as follows. Section 2 highlights the brief account of the theoretical framework used in the study. Section 3 provides a short summary of the current status of feed value chain development in Ethiopia. Based on a literature review, an overview of recent development and important issues in the feed value chain are presented. Section 4 presents a brief description of the data and methods used in this study. The description consists of study sites, sampling procedure and number of farmers, stakeholders and other respondents interviewed, and the types of data collection tools used. Section 5 presents the results of the study: First, the exploratory results and findings on the structure and organization of the feed value chain; second, the empirical results on flows and institutional linkages; and third, the results on cross-case analysis.

In general, the main issues analysed included farmer's socio-economic characteristics, livestock holdings, access to institutions, fodder production practices, types of improved fodder grown, feeding and feed management, participation in collective action institutions, stakeholder mapping, stakeholder roles in the value chain, and constraints related to feed production and marketing. Finally, section 6 presents conclusions by summarizing the study's main findings.

2. Analytical framework

The conceptual framework of the study consisting of the concept of value chain and value chain framework and the stakeholder analysis using the Process Net-Mapping approach are briefly discussed to guide the empirical investigation of the attributes of stakeholders. The attributes analysed included the roles of stakeholders and the network relationships within the feed value chain in the study areas.

2.1 Value chain development

Three concepts are important in using the value chain framework in research: the value chain, value chain analysis and value chain governance. Most simply, a value chain describes the overall value-adding activities that are required to bring a product or service from its conception to final markets (Webber and Labaste 2010). Often, value chains consist of input suppliers, producers and buyers (Mac Clay and Feeney 2018). They are supported by a range of technical, financial and business service providers. In terms of activities, value chains encompass diverse activities such as procurement of inputs, physical transformation, processing, distribution and marketing (Webber and Labaste 2010).

Value chain analysis (VCA) is a diagnostic tool to examine all actors involved in the chain, their network structures and the core functions involved in bringing a product from its conception to its final consumers (Gereffi, Humphrey and Sturgeon 2005). It is used to assess the performance of value chains, including the analysis of product flows, information flows and overall chain management. The central aim of a VCA is to identify effective ways for improving the performance of the chain as a whole and of the individual actors involved. The value chain framework has become an increasingly useful analytical approach for understanding the relationships among chain actors and its implications on chains competitiveness and performance especially in developing countries.

Value chain analysis has three elements (Trienekens 2011): (a) the core processes or value chain functions such as input supply, production, trading, processing, wholesaling, retailing and consumption; (b) actors and relationships: describing key value chain actors, their network structures and activities within the value chain; and (c) external environment: the political and socio-economic arena in which the value chain operates. The value chain framework was used in this study to analyse the physical flow of feed products as well as the actors involved in the production, processing, trading and utilization of the feed products.

2.2 Stakeholder analysis and net mapping

The other important framework that was used in this study is the Process Net-Map approach. The approach helps to characterize stakeholders and understand their influence in the folder value chain. A stakeholder can be defined as an agency, institution, group or individual with direct or indirect interest in the feed value chain. Identifying relevant stakeholders for collaborative initiative is challenging. Stakeholders are often selected by their roles and functions. The initial step to identifying stakeholders in a given value chain is by defining the aspects (or issues) of the value chain

under study (Prell et al. 2009). According to Prell et al. (2009), without defining the issue, it is difficult to know which stakeholders to involve and engage in the identification of relevant issues.

Stakeholder analysis can be used to onderstand a system (or a value chain) by defining the aspects of the value chain, identifying the key actors in the chain and assessing their respective interest (and involvement) in that value chain (Prell et al. 2009). More generally, stakeholder analysis refers to a range of approaches for the identification and description of stakeholders on the basis of their attributes, interrelationships and interests related to a given initiative or project.

In the literature, two important tools are identified to undertake stakeholder analysis namely, the ***Participation Analysis Matrix (PAM)*** and ***Process Net-Map (PNM)***. Both approaches measure different aspects of stakeholders' interaction in the feed value chain under study. For better results, stakeholder analysis is conducted at different tiers/ stages (i.e. at producers, traders, processors and end users) of the feed value chain.

A participatory analysis matrix can be used when one wants to explore important features of the stakeholders who are involved in the feed value chain. It helps to understand stakeholders' functions, interests and contribution for the overall performance of the feed value chain. In addition, it is used to solicit key challenges and actions required to improve the competitiveness of the value chain. For better results, it is often applied on experts and actors in the downstream part of the feed value chain. On the other hand, net-mapping is an innovative tool to identify important linkages among actors (Schiffer 2008). It looks at the networks, influence and power of stakeholders. The Process Net-Map considers all activities and processes along the feed value chain, from input supply to end users. The tool enables researchers to identify the visible and invisible ties in a multi-layered network of stakeholders (Schiffer 2008). In the context of this study, the Process Net-Map provided a framework within which to explore the roles of, and relationships between, stakeholders in the feed value chain. It also helped to obtain insights on the effect of stakeholders' power on the improvement of green and dry fodder produced and traded in the study regions.

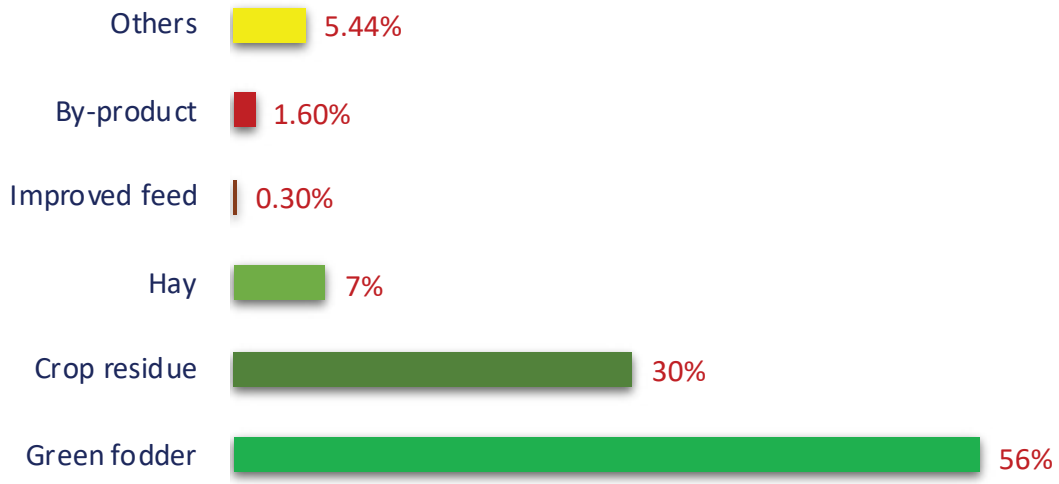
3. Feed value chain in Ethiopia: an overview

In this section, we present an overview of the emerging Ethiopian feed value chain. Specifically, we focus on the following aspects: (i) types of feed resources, (ii) improved fodder production, (iii) feed processing and marketing, and (iv) stakeholder attributes within the chain. The description is entirely based on literature review and secondary data analyses from the Ethiopia Central Statistical Agency (CSA) database.

For the sake of this review, animal feeds were understood as: fodder, agro-industrial by-products (AIBP), and compound/formulated feeds. Fodder can be defined as all kinds of roughage feeds encompassing green forages (cultivated or naturally growing), hay, crop residues, and leaves of fodder trees and shrubs (Gebremedihen et al. 2009; Mengistu 2014; Duguma et al. 2016; Jimma et al. 2016). AIBP are agro-industry processed and prepared feed such as wheat bran, wheat middling, molasses and oilseed cakes. Compound rations are formulated using mainly AIBP and some cereal grains. Thus, the feed value chain encompasses both the fodder and AIBP feed.

Based CSA (2018) information collected on feed usage experience of smallholders in the country, green fodder (natural pasture) is the major type of feed. It accounts for approximately 56% of all animal feed in Ethiopia followed by crops residue that is 30% (see Figure 1). Hay and AIBP were also used as animal feed and comprise about 7% and 1.6%, respectively, of the total feeds, respectively. As can be seen Figure 1, the share of improved fodder is almost insignificant. This implies that smallholder livestock farmers are largely practicing traditional production systems.

Figure 1. Feed resources and use experience in Ethiopia



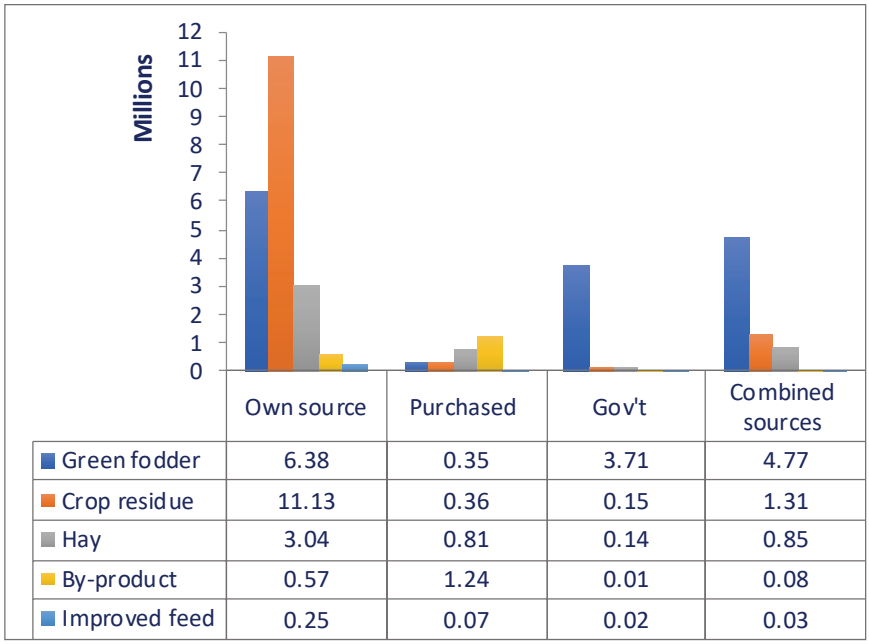
Source: CSA 2018

In the lowlands, livestock mainly depend on natural pasture (grazing) for their feed needs. While in the highlands crop-livestock mixed farming is dominant and crop residues are the main feed type. In both cases, the feeding practice meets the maintenance needs of the animals with little surplus left for the production of red meat and milk (Jimma et al. 2016). Related to this, the importance of natural pasture is gradually declining due to expansion of crop production, redistribution of communal lands to the landless and land degradation (Gebremedihn et al. 2009).

Improved fodder production is still in its inception stage. This class of feed is crucial to increase the energy requirements of animals for better livestock production and productivity (Bezabih et al. 2016). But several factors lead to the low production of improved forage despite its high potential. These include shortage of seeds and seedlings, high price of seed (e.g. alfalfa), lack of awareness and land allocation problems. Summing up, improved nutrition through adoption of fodder production and better crops residue management could substantially increase livestock productivity in Ethiopia.

Figure 2 presents the sources of livestock feeds by types of feed at the national level. Based on the graph, 'own source' is the major source of all types of feeds for the majority of livestock producers in the country. 'Communal (combined source)' is also observed as the main sources of green fodder for a considerable number of smallholders. It can be also observed from the graph that smallholder livestock producers purchase of different types of feeds to nourish their animals. Substantial numbers of smallholders are engaged in the purchase of AIBP and hay, for example. Also, a growing number of case studies show that feed marketing is becoming increasingly important, particularly in urban and peri-urban areas of the country (Dejene et al. 2014; Gebremedihn et al. 2009).

Figure 2. Feed resources by source and types in Ethiopia



	Own source	Purchased	Gov't	Combined sources
Green fodder	6.38	0.35	3.71	4.77
Crop residue	11.13	0.36	0.15	1.31
Hay	3.04	0.81	0.14	0.85
By-product	0.57	1.24	0.01	0.08
Improved feed	0.25	0.07	0.02	0.03

Source: CSA 2018

According to Dejene et al. (2014), the emerging Ethiopian feed value chain has four main set of actors: input suppliers, feed producers, traders/processors (as facilitators who effectively link producers and end users) and end users (represented by the farmers owning livestock as the end point). Studies also show that a number of factors contribute to the effective operation of the feed value chain — actors roles, infrastructure, regulations/policy and supportive institutions. However, evidence is patchy and limited on the details of key stakeholders involved, their interrelationships and the core functions they perform within the feed value chain. This type of analysis is crucial to support evidence-based decision and policymaking to promote the inclusive development of the livestock subsector in the country.

4. Methodology

This section describes the research design and methods employed to collect and analyse the necessary data and information. The section is organized as follows: Description of the study context, the research design used for the study, delineation of the data collection sites, the data collection process and sampling strategies used. Finally, the section describes how the data and information collected was organized and analysed.

4.1 Description of study site

The study was conducted in the two regions: Amhara (Bahir Dar Zuria woreda) and SNNPR (Lemo and Angacha woredas) (see Figure 3 and Table 1). These three woredas are pilot learning woredas of the Innovation Lab for Small-Scale Irrigation (ILSSI) and the Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) projects which are being led by the International Livestock Research Institute (ILRI) in Ethiopia and financed by the United States Agency for International Development (USAID) Feed the Future initiative. ILSSI mainly focuses on improved fodder development using small-scale irrigation to enhance year-round quality feed access to smallholder producers and the implication of this on smallholder livelihoods.

Figure 3. Location of the research areas

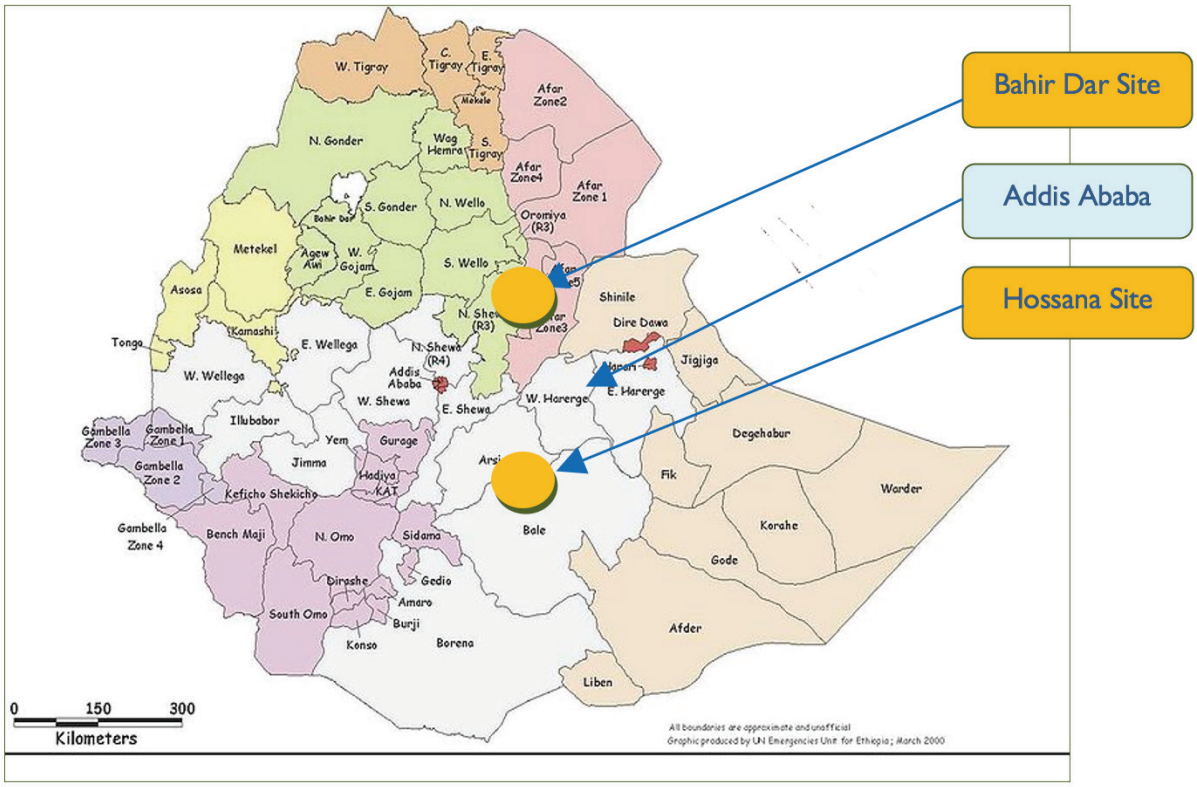


Table 1. Study sites by region, woredas and kebeles

Region	Woreda	Kebele
Amhara	Bahir Dar Zuria	Robit Bata
		Hayse
SNNPR	Lemo	Jawe
		Upper Gana
	Angacha	Kerekicho

The mixed crop-livestock farming system is the common practice among the smallholder farmers in all the selected study areas of the two regions. The common crop enterprises practiced in the study areas include mono-cropping (production of only one type of crop) and intercropping of cereals and pulses. The dominant crops grown in both sites includes cereals, pules, fruits and vegetables.

The livestock species reared in the study sites include: cattle, goats and poultry. Oxen are mainly used for traction by smallholder farmers. Some farmers fatten their oxen for sale after the land preparation for the cropping season passes, while others maintain their oxen until the next cultivation cycle. In both study sites, dairy farming is commonly practiced by smallholder farmers. Moreover, fodder production and marketing is practiced. Fodder is produced under small-scale irrigation and rain-fed conditions. Farmers participate in different types of local institutions including producers' or service cooperatives and microfinance institutions. Farmer training centres (FTCs) are located in both study sites and, among other roles, they demonstrate forage development technologies and train smallholder farmers.

4.2 Research design

In this study, we used a qualitative case study design, which often suits stakeholder characterization and value chain analyses studies. Qualitative research allows good insights and rich description of the case under study. A three-step approach was followed to collect data.

First, using the value chain framework (Trienekens 2011) the feed value chain was mapped out with purposively sampled experts and a review of existing literature. The visualization of the feed value chain consists of identifying core functions, actors involved and their networks, and enabling environment. The feed value chain structure and organization was decomposed into two: the fodder value chain and agro-industrial by-products (AIBP) feed value chain.

Second, the Process Net-Map tool was applied to characterize stakeholders and their roles in the feed value chain. The Process Net-Map is a participatory social network mapping tool based on the visualization of networks within multi-stakeholder systems by respondents (Schiffer 2007, 2008). The tool was used to identify all the actors involved in the value chain and to assess how they are linked. Guided by the mapping manual developed by Schiffer (2007), the Process Net-Map exercise was carried out with purposively selected respondents who had an in-depth understanding of how the entire feed value chain operates in the two study sites.

Finally, in-depth interviews were conducted with selected respondents from all the identified stakeholder categories from the Process Net-Map exercise using purposive sampling. These respondents were selected on the basis of having a high level of experience and expertise in carrying out specific functions in the feed value chain. The respondents included experts from public research institutions, government agencies, feed/milk processors, non-governmental organizations (NGOs), and farmers across the two study regions. A total of 65 respondents were involved in the study (see Table 2). Each interview was semi-structured and open-ended with the aim of best capturing the respondents' expert opinion on the issues under consideration.

Table 2. Number of participating respondents, by region

Region	No. of sampled Woredas	No. of interviews conducted with FGD and KII	No. of participants in FGD and KII
Amhara	1	17	31
SNNPR	2	19	34
Total	3	36	65

4.3 Data collection

To fully address the research questions, qualitative data and information was gathered. Primary data was gathered at two levels: (i) farm/farmers, and (ii) organization/experts. These are the prominent players in the feed value chain of the study areas. Farmers are upstream actors who are involved both as fodder producers and end users. The second groups of actors are those involved in the downstream part of the value chain, which includes woreda government agencies, public research institutes, NGOs, and private actors. Qualitative data was collected from these respondents using focus group discussions (FGDs), key informant interviews (KIIs), and direct observation (Table 3). These tools were developed and customized by the researcher prior to the field work to ensure that the questions were comprehensible, relevant, and appropriate to context and culture. The tools were deployed as semi-structured interview guides comprising questions that the researcher determined in advance, but were supplemented by additional questions asked within the context of the interview to fit its exploratory nature.

Data collection was carried out between December 2019 and January 2020. Two FGDs were conducted at farm level, one at each study site. In these FGDs, an attempt was made to learn how farmers produce fodder, the types of forage produced, feed storage and feeding methods, sources of forage seed, extension services and the providers of those services, feed marketing and feed marketing challenges. Farmers' socio-economic profile and access to rural institutions was also explored. On average, FGDs lasted 90–120 minutes, while KIIs lasted 30–45 minutes per session.

Table 3. Research tools and approaches used for data collection

Category	Research tools and approaches	Types of information and data collected
Farm/farmers	Focus group discussion (FGD) guided by a checklist and key informant interview (KII) using semi-structured questionnaire	Household profile (socio-economic characteristics), household livestock ownership, access to institutions and markets, available feed resources, fodder production methods, types of fodder produced, feeding system, forage seed types and sources, government and NGOs initiatives, feed production constraints.
Organization/experts	FGD guided by a checklist, net mapping tool and participant analysis matrix (PAM)	Feed production and utilization trend in the community, structure and organization of the feed value chain (FVC), stakeholders involved in the FVC, stakeholders roles and relationships, influential actor in the chain, extent of collaboration among stakeholders, feed production and marketing constraints.
Farms and organizations	Direct observation and secondary data extraction from existing databases.	Observation on forage plots (forage cropping systems, management of plots, pulley irrigation), feeding trough, fodder storage, and others. Secondary data on feed resources at national level, livestock population etc.

At organizational level, we held two FGDs, one at each research site. The purpose of these FGDs was to conduct the Process Net-Map exercise and characterize stakeholders. In Bahir Dar Zuria, the Process Net-Map exercise was carried out with nine respondents from different categories of stakeholders in the feed value chain while seven respondents were involved in the net-mapping exercise in Hossana. Table 4 presents the composition of stakeholders involved in the Process Net-Map exercise. The respondents mainly include experts from government agencies, public research institutes, NGOs, and private actors. On average, FGDs lasted 120–180 minutes, while KIIs lasted 30–45 minutes.

Table 4. Stakeholder composition in the study

Stakeholder category	No of sampled participants	
	Bahir Dar Zuria	Hossana
Government agencies	3	4
Public research institutions	3	0
International research institutions (ILRI)	1	2
Agro-processors/cooperative unions	1	0
NGOs/supporting actors	1	1
Traders/agro-dealers	1	0
Dairy cooperatives leaders	2	2
Urban dairy producers	1	1
Farmers	6	10
Total	19	20

Source: Study data, 2020

The Process Net-Map exercise involved four main steps: (a) the respondents were asked to identify all the actors involved in the feed value chain and their respective roles. These identified actors were recorded on a flip chart that was prepared ahead for this purpose. (b) The respondents were asked to identify flows (fund flows, knowledge and technology flows and business linkages) between the different actors. Single-headed arrows were used for linkages that were unidirectional while double-sided arrows were used for two-way linkages between actors. Different colours were used to distinguish the different types of flows. (c) After completion of the map, respondents were asked to review whether all the stakeholders and linkages in the feed value chain had been included. (d) Finally, follow-up questions were asked on the challenges and improvement options in the feed value chain. This included asking respondents to identify any additional actors who had not been considered in the net-mapping exercise that could potentially play an important role in the development and production of fodder.

In addition, stakeholders were asked to review their mapping exercise using participant analysis matrix (PAM). It mainly focused on the roles, resources, challenges and improvement options related to respondents' specific activities in the value chain. The interviews also served as a means of validating the fund flows, knowledge flows and business linkages of the actors established from the Process Net-Map exercise. The net-mapping exercises was performed through group discussions while key informant interviews were conducted on one-on-one basis.

4.4 Data analysis

Data and information collected from respondents was compiled and verified through several steps. The first step involved transcription and organization of the data. This included checking the data and information immediately after the interview to determine if the research questions were answered adequately. Open coding was then performed to categorize certain phenomena and themes such as attributes of the stakeholder mapping, stakeholder roles and functions, actor networks and influence, and challenges and improvement options. Thematic and content analyses then informed final conclusions and recommendations for further examination. Continuous comparisons and triangulations using the multiple perspectives captured during data collection were used to identify emerging themes, ensure validity and, ultimately, provide the rigours necessary to generate plausible results and recommendations.

Moreover, the value chain framework was used to analyse and diagnose the structure and organization of feed value chains in this study. Stakeholders in feed value chains operate in an institutional environment characterized by poor resource availability, infrastructure constraints, and lack of market access. Regarding the network analysis, the networks and institutional linkages identified during the Process Net-Map exercises were analysed qualitatively. The various types of flows were analysed based on the respondents' views and opinions. Influence and power of stakeholders were shown using layers of coins and analysed accordingly. The dynamics of stakeholders' relationships and positions, relative to each other, stem from flows of funds, information, advice and trust within a stakeholder network.

5. Results and discussion

The findings and results from this study are presented below. First, the on-the-ground realities and structure of feed value chains are discussed. Second, an assessment of the various actors participating in the feed value chain and their roles is given. Third, qualitative evidence on the flows and institutional linkages is provided. Fourth, the improved fodder production systems and animal feeding practices are examined. Finally, the results on the constraints in fodder production and marketing are reported.

5.1 Household socio-economic characteristics

The socio-economic characteristics of the households in the study areas are summarized and presented in Table 5. According to the study results, the mean age of the household heads is 50 years and 53 years in Hossana and Bahir Dar Zuria sites, respectively. The average household size in the study areas was 6.5 persons per household. About 50% of the members in the sampled households in Bahir Dar Zuria could read and write while this figure was 60% in Hossana. Thus, households in Hossana site are more literate compared with those in Bahir Dar Zuria. About 28.5% of the sampled households were female headed (range from 17% in Bahir Dar Zuria to 40% in Hossana).

Table 5. Socio-economic characteristics of sample respondents

Characteristics	Bahir Dar Zuria	Lemo-Angacha
Age (years)	53 (25–68)	50(35–73)
Education (read and write %)	50.00	60.00
Family size (No)	6 (3–10)	7 (3–12)
Forage area (ha)	0.2 (0.125–0.25)	0.18 (0.125–0.25)
Female (%)	17.00	40.00

Figures in parenthesis are ranges (based on study data 2020).

Land is an important determinant of household food security in agrarian economies such as Ethiopia. In particular, in crop-livestock mixed farming systems, shortage of land could lead to immense poverty and food insecurity. It was reported in the FGDs that all sampled households own land to run their farming businesses. In the study areas, land is used for production of annual crops (major share), perennial crops and improved forage production (smaller portion). As indicated in Table 5, the mean land size allocated for improved forage production is about 0.2 ha and 0.18 ha in the Bahir Dar Zuria and Hossana sites, respectively.

The livestock industry of Ethiopia comprises a large traditional sector and a small but important commercial sector (in urban and peri-urban areas). Most smallholder farmers rear livestock, using traditional systems, as an important household asset that provides both food and income. The presence of livestock in a household decreases household vulnerability to shocks and helps stabilize access to food for consumption. Livestock also can be used as draught power and as a source of manure for the farm. As shown in Table 6, the predominant types of livestock in the study areas include large ruminants such as oxen and cows and small ruminant such as goats.

The mean number of oxen owned by a household in Bahir Dar Zuria and Hossana is 1.33 and 2.4, respectively. There are more oxen in Hossana compared to Bahir Dar Zuria. The average number of milking cows in Bahir Dar Zuria and Hossana sites is 3.8 and 4.4, respectively. It was revealed in the FGDs that the majority of dairy cows in the study areas are local breeds. It was also mentioned that more cross-bred cows are found in the urban and peri-urban areas of the two sites.

Table 6. Livestock holdings of sample households in the study sites

Species	Bahir Dar Zuria	Lemo-Angacha
Number of oxen	1.33(0-3)	2.4(1-4)
Number of cows	3.83(3-5)	4.4(2-7)
Number of goats	0.66(0-4)	0.8(0-3)

Figures in parenthesis are ranges (based on study data, 2020).

It was reported that about 83% and 40% of farmers are members of dairy cooperatives in the Bahir Dar Zuria and Hossana research sites, respectively (Table 7). Dairy cooperatives in the study areas largely engaged in value chain activities such as dairy products (milk, butter and cheese) marketing. The other formal collective institutions in the areas are rural microfinance institutions, which provides saving and credit services to smallholder farmers. Accordingly, 16% and 20% of sampled farmers had access to credit institutions in Bahir Dar Zuria and Hossana sites, respectively.

Table 7. Farmers' access to rural institutions

Rural institutions	Districts	
	Bahir Dar Zuria	Lemo-Angacha
Cooperative membership (yes %)	83	40
Access to credit (yes %)	16	20
Access to mobile (yes %)	83	90
Extension contact (yes %)	67	60
Access to markets (yes %)	83	80

Source: Study data, 2020

The livelihoods of rural farmers are most often constrained by poor access to markets and market information. Indeed, improving market access for rural farmers enhances their ability to diversify their links with markets. One way of improving access to markets is to improve the proximity of farmers to the markets and facilitate access to market information. Farmer cooperatives can play a role in facilitating market access for the producers/members. Digital technologies have also emerged as a good source of market information. In this respect, it was noted that almost all of the sampled farmers have a mobile phone (Table 7), which helps them to access market information.

Rural farmers obtain technical assistance and extension services from the kebele development agents (DAs) in each site. Based on Table 7, about 67% and 60% of farmers have access to extension service in Bahir Dar Zuria and Hossana sites, respectively. However, in the FGDs, it was explained that extension services obtained from the kebele DAs is too general. Moreover, weak coordination from woreda livestock agency was mentioned as a major issue affecting the development of livestock enterprise in the study sites.

5.2 Organization of the fodder value chain

A value chain structure depicts the different components of the chain, nature of flows and how each actor in the value chain has positioned themselves. It is commonly presented through mapping of the value chain. Understanding the value chain structure is a precondition for value chain analysis. Value chain processes, on the other hand, are the different activities that each value chain actor undertakes within the chain. In this subsection, we present the results on the structure and organization of feed value chains in the study areas.

The various feed resources used in the study areas as summarized in Table 8 include: crop residues, hay, cultivated (improved) forages, agro-industrial by-products (AIBP) and others. Crop residues is the first ranked feed type with 50%, 65%, and 70% utilization proportion in Angacha, Lemo, and Bahir Dar Zuria areas, respectively. The second most ranked feed is hay with a proportion of 10%, 15%, and 20% in Bahir Dar Zuria, Lemo, and Angacha area, respectively (see Table 8). Though small in proportion, farmers in all sites use cultivated forage and AIBP.

Table 8. Feed resources in the study sites, as stated by respondents

Feed category	SNNPR region				Amhara region	
	Lemo		Angacha		Bahir Dar Zuria	
	Percentage	Rank	Percentage	Rank	Percentage	Rank
Crops residue	65%	1	50%	1	70%	1
Hay	15%	2	20%	2	10%	3
Improved forage	10%	3	15%	3	15%	2
AIBP	5%	4	5%	5	4%	4
Enset (leaves, steam and roots)	5%	5	10%	4	-	-
Atela (brew by-product)	-		-		1%	5

Source: Study data, 2020

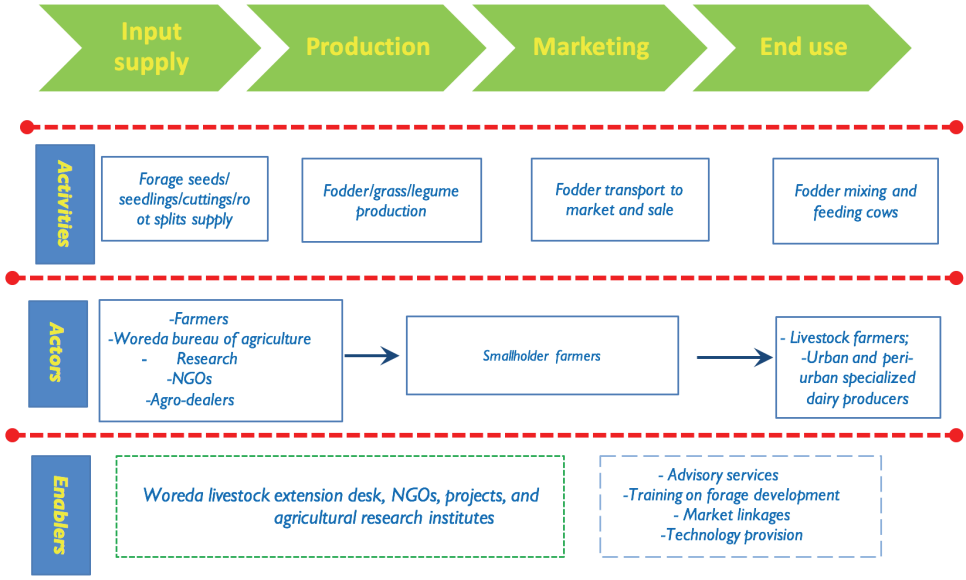
The feed value chains are grouped into two for ease of analysis: the fodder (crop residues, hay and cultivated forage) value chain and AIBP value chain. The difference in the structure of the two feed value chains is in the number and type of actors involved, biomass flows and core processes. Based on expert FGDs results, the value chains for fodder has four main processes: (a) the supply of seeds and planting materials, (b) the production of fodder, (c) marketing of fodder, and (d) end use of fodder. Figure 4 presents the value chain map of fodder in the study areas.

The key activity in the seed supply node of the value chain consists of forage seeds production and dissemination. The main actor involved in seed production and supply are research centres, agro-dealers, woreda bureaus of agriculture (BoA) and NGOs. Farmers sometimes use own-saved seeds. The production node of the value chain focuses on the cultivation and collection of crop residues and improved forage. Smallholders are the dominant actors in this node and are engaged in the traditional fodder production process. During the FGDs, it was explained that smallholder farmers were engaged in the production of fodder using traditional system (i.e. rain-fed) and small scale irrigation systems. Small-scale irrigation is often used for the production of improved forage such as Rhodes, Napier, Desho, and Elephant grasses and legumes (pigeon pea, ***Desmodium***) intercropped with Elephant grass.

The next node in the fodder value chain is marketing, in which fodder transport and sale is undertaken. Smallholder farmers commonly sell dry fodder such as hay and cereal straw in the Bahir Dar town market to urban dairy producers and other farmers. This is also the case in Hossana. In addition, smallholder farmers in Hossana are engaged in the marketing of green fodder. For example, one bale of hay is sold for about ETB40 in the Angacha area (source: KII with experts). Urban dairy producers and smallholder farmers are the major end users of purchased fodder (Figure 4).

The institutional environment of the fodder value chain encompasses the regulations and social environments within and around the chain that can influence actors' interactions and relationships. These services are crucial for the effective operations and development of the fodder value chain. Institutions provide various value chain support functions including advisory services, training, credit services and technology services. In the study sites, woreda livestock extension desk, farmers training centres (FTCs), DAs, and agricultural research institutes were mentioned.

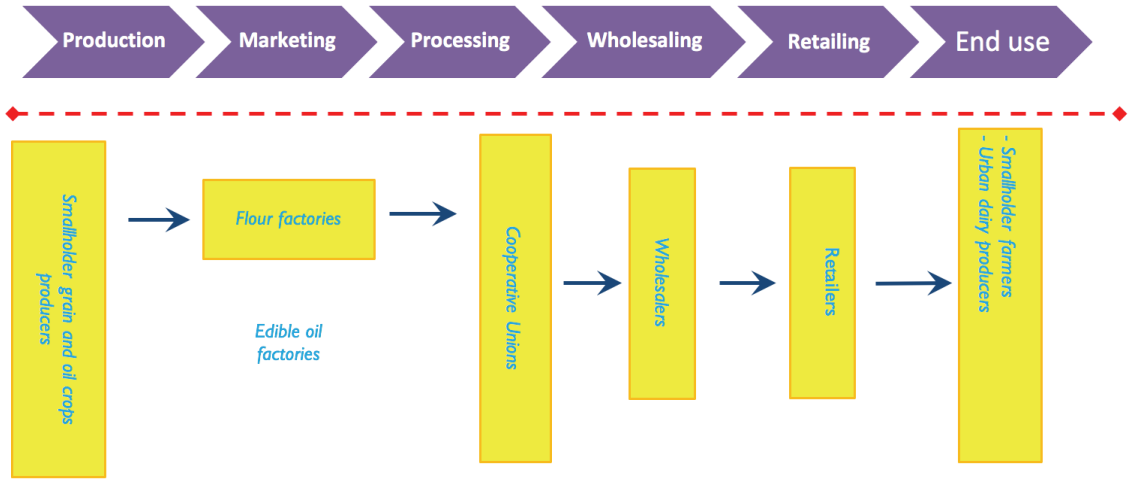
Figure 4. Fodder value chain in the two research sites



The other feed category used in the study sites is AIBPs such as wheat bran, wheat middling, cakes and formulated/ balanced ration. The value chain of AIBPs includes: (i) production of cereal grains, (ii) marketing, (iii) processing, (iv) wholesaling, (v) retailing and (vi) end use. The value chain map of AIBPs is presented in Figure 5. The main grains used as input in the production of concentrate feed are wheat and maize, while the inputs for oilcake are noug seed, linseed and other oilseed crops depending on availability in the woreda (source: Expert FGDs). Thus, the key stakeholders in the production node are smallholder grain producers. Flour factories/millers and oil factories are responsible for the production and processing of the by-products, which include wheat bran and oilseed cakes. These factories sell the by-products in a spot market basis. There is no contractual marketing of the by-products, which is a more stable and sustainable trade arrangement.

Cooperative unions are the dominant buyers of by-products from the millers and edible oil factories in both study sites. Licha and Ambericho unions in the Hossana site and Merkeb union in Bahir Dar Zuria site are engaged in the processing and marketing of formulated feed (Figure 5). Wholesalers and retailers are involved in the distribution of by-products to end users. As end users, urban dairy producers and farmers also directly buy formulated feed from the union.

Figure 5. Agro-industrial by-products (AIBPs) feed supply chain in the two research sites



5.3 Stakeholders and their roles in feed value chain

This subsection includes the results on the types of stakeholders and their roles in the feed value chain of the study areas. A diverse group of stakeholders are involved in the feed value chains in Bahir Dar Zuria and Hossana (Table 9). The results from Process Net-Map exercise and Participation Analysis Matrix revealed that government agencies (woreda experts and DAs), cooperative unions (agro-processors), private sector actors (agro-dealers), public research institutions (Areka Agriculture Research Center and Andasa Livestock Research Center), public universities (Bahir Dar University and Wachamo University), ILRI, NGOs (civil society stakeholders), and end users (farmers, urban dairy producers and youth entrepreneurs) are the main stakeholders in the feed value chain. The 20 stakeholders/ institutions identified in the feed value chain are grouped into seven clusters as shown in Table 9.

Smallholder farmers serve as the main source of fodder feed in the study area. However, they mostly use traditional systems to produce the fodder. Farmers are also involved in the end user (consumption) node of the fodder value chain in both research sites. In addition, they participate in the supply of improved forage seeds. Agro-processors are the main source of concentrate feed (formulated ration) in both study sites. While agro-dealers/traders are the major sale outlets for concentrate feed and agro-industrial by-products (cereal bran and oilseed cakes). Traders also play a crucial role in connecting end users and agro-processors.

The woreda livestock agency is the primary government agency responsible for the upgrading and inclusive development of the feed value chains. It is involved in the preparation of manuals, implementation of forage development strategies and provision of extension services. This stakeholder works in collaboration with zonal agriculture bureaus, particularly in the development of forage production strategies and polices. Together, these stakeholders facilitate the institutional environment and regulatory services of the feed value chain in the study areas.

Public research institutions are the driving force for innovation and technology in the fodder value chain. The Andasa Livestock Research Institute (ALRI) is the main livestock research institute under the umbrella of the Amhara Agriculture Research Institute, while the Areka Agriculture Research Centre is responsible for livestock research in southern Ethiopia under the Southern Agriculture Research Institute (SARI). ALRI and the Areka Agricultural Research Center are mandated to breed improved forage varieties suitable for the different agro-ecologies in these regions. They also undertake applied research and generate evidence for policymaking to promote inclusive fodder development. Bahir Dar University is responsible for scientific and technological research on the feed value chain development. Wachamo University is a new university in Southern Ethiopia and it is carrying out research on forage development in the Hossana area. These public universities collaborate and complement the outputs of other public research institutions.

ILRI (through the ILSSI and Africa RISING projects) works closely with national partners to implement research for development projects and build local capacity in the evaluation and promotion of feed and fodder technologies. It gives emphasis to participatory on-farm research as a means to evaluate, demonstrate and promote context-specific feed and forage technologies that can be scaled widely and produce impact in the livelihoods of livestock producers. Finally, there are several end-users that are increasingly using fodder and concentrate feeds in the chain. These include rural farmers, urban dairy producers and youth entrepreneurs.

Table 9: The roles and responsibility of key stakeholders in the feed value chain

Stakeholders	Cluster	Major roles/functions
Zone and woreda livestock agencies and farmer training centres	Government agencies	Coordinating feed development activities
		Supervising and follow up of small and medium enterprises
		Training and supervision of DAs
		Implementing forage development strategies
		Preparing of manuals
		Providing extension services to farmers

Stakeholders	Cluster	Major roles/functions
Areka Agricultural Research Center, ALRI, Wachamo University, and Bahir Dar University	Public research institutes and universities	Conducting adaptation trial (research), Demonstrating and scale-up of best practices Providing training to small and medium enterprises, DAs and farmers Preparing manuals on forage development Providing technologies
ILRI	International research institutes	Demonstrating and supply of technology Providing training to small and medium enterprises, DAs and farmers Conducting research on feed system development
Licha union, Ambericho union, and Merkeb union	Agro-processors	Mixing/processing concentrate feed Distributing and selling formulated feed Training farmers on feed utilization
Traders, wholesalers and retailers	Agro-dealers	Distributing concentrate/balanced feed, Retailing concentrated feed to farmers
Africa Rising, ILSSI, USAID, Food for the Hungry, Agri-service Ethiopia	NGOs	Developing capacity (soft skills) Suppling seeds Developing water wells Establishing seed multiplying centres
Farmers, dairy producers, youth entrepreneurs	Producers	Fodder cultivation and production Marketing of fodder feed Selling forage seeds and seedlings End users of fodder and concentrate feeds

Source: Study data, 2020

5.4 Flows and institutional linkages

The approach suggested by Schiffer (2007) was used to analyse stakeholders influence and their network strength. The analysis is based on interviews and FGDs with woreda livestock agencies, agro-processors, agro-dealers, researchers, NGOs staff and farmers. Two expert FGDs, one at each site, were held using the Process Net-Map exercise to identify key types of flows and institutional linkages associated with the stakeholders in the feed value chain.

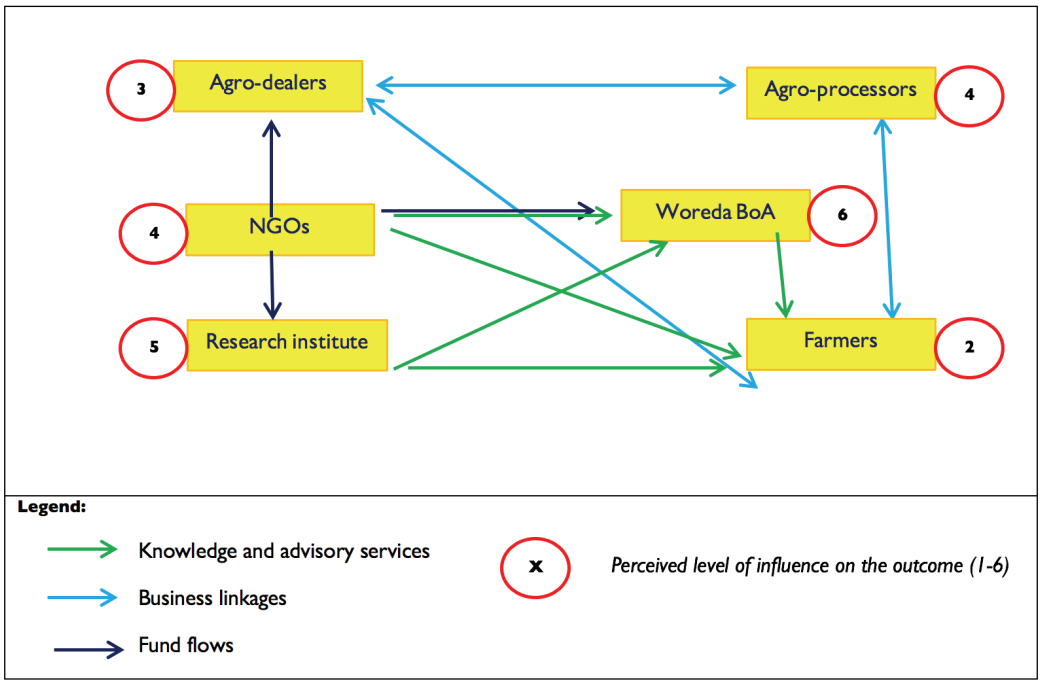
In the Process Net-Map exercise, three main types of linkages/flows were identified in the feed value chain: knowledge flows, fund flows, business/trade linkages. Fund flows were defined as money or financing allotted for a particular value chain activities; knowledge flows were considered as linkages in information exchange, technical know-how, training and capacity development; and business linkages were defined as transactions involving the exchange of quality feed. The results of the net-mapping for these institutional linkages are presented in Figure 6 and 7. The results vary by location and are discussed for each of the sites as follows.

Stakeholders influence and networks in Hossana feed value chain

The Process Net-Map findings revealed that stakeholders varied in the levels of power they exert and influence they have over the outcome variable. In Hossana, six key actors were identified in the net-mapping exercise: agro-dealers,

agro-processors, NGOs, woreda livestock agency, research institutes and smallholder farmers (Figure 6). FGD participants were asked to rank the influence of these actors (with score value 1 through 6 with 1 the least influential) in the feed value chain. The woreda livestock agency was the most influential stakeholder with score of 6 followed by research institutes. These institutions were found to be the most powerful in influencing other stakeholders to change or improve the feed value chain in the study areas.

Figure 6. Stakeholder influence and networks in the feed value chain in Hossana area.



It is evident in Figure 6 that the network for fund flows is highly dependent on donor funds, which is represented by the NGOs. The figure also shows that the woreda livestock agency and research institutes are the focal institutions that receive most of the funds from NGOs. In this network, farmers (most important actor) do not receive any direct funding from NGOs; rather they obtain funds from rural microfinance institutions in area. Figure 6 also shows that knowledge flows are significantly dispersed among research institutions, the woreda livestock agency and farmers in the value chain. Most of these actors in the network both transfer and receive knowledge. In this regard, farmers are the most connected actors in the network and received knowledge from different sources. Research institutions, NGOs and woreda livestock agency are the main sources of knowledge and technology. The main actors in business linkage are agro-processors such as unions.

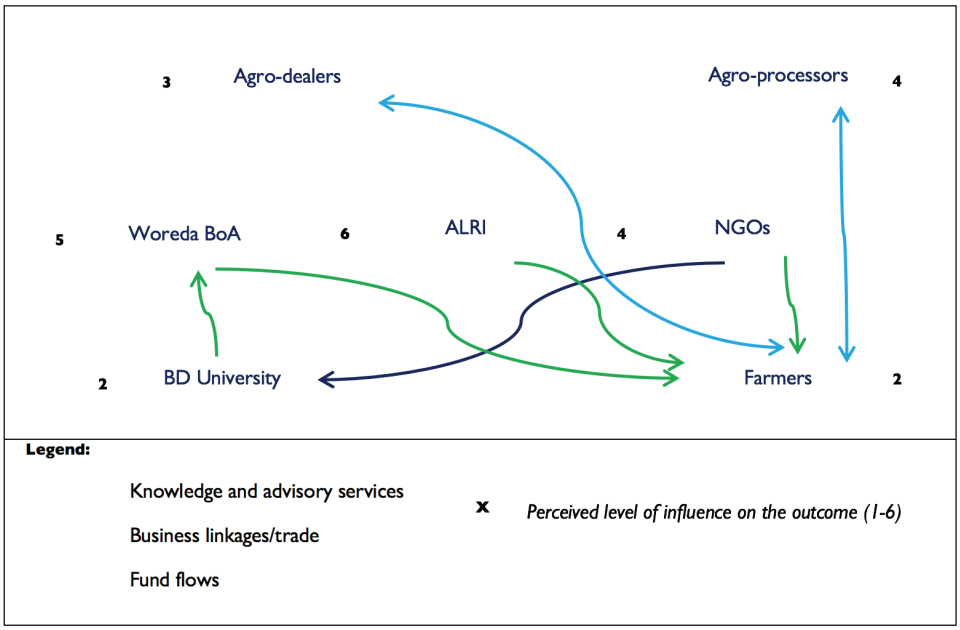
Stakeholders influence and networks in the Bahir Dar feed value chain

In Bahir Dar Zuria, seven dominant actors were identified from the Process Net-Map exercise: agro-dealers, agro-processors, NGOs, woreda livestock agency, public university, research institute and smallholder farmers (Figure 7). Based on respondents ranking, ALRI is the most influential actor, with a score of 6, followed by the woreda livestock agency (score 5); in effecting change to improve the feed value chain in the area.

In terms of fund flows, ALRI and Bahir Dar University are the two public institutions that primarily received donor funds. NGOs are the main source of funds in this network. However, results showed that farmers hardly received any direct donor funding. They obtained money from rural microfinance institutions in area. The network for knowledge flows is dominated by public institutions such as the university, research institute, and woreda livestock agency (Figure 7). The research institute and woreda livestock agency are the most influential stakeholders in the provision of technology and capacity development services. Farmers are the most important actors in receiving knowledge and technologies in this network.

As expected, the network for business linkages is dominated by private sector actors such as agro-dealers and agro-processors (see Figure 7). Multipurpose unions and AIBPs processors are the most influential actors in controlling the flow of business/processed feed in the feed value chain in the area.

Figure 7. Stakeholder influence and networks in the feed value chain in Bahir Dar area



5.5 Improved fodder production systems and feeding practices

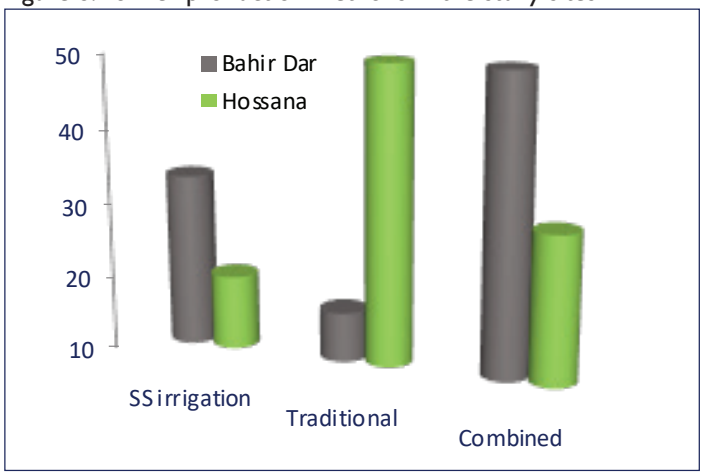
This subsection presents the results on the fodder production systems and how farmers feed their animals (feeding systems) in the two study sites. A summary of findings on the institutions that support smallholder farmers in the production of improved fodder is also given.

Fodder production systems

The results on the main fodder production systems are presented in Figure 8. Findings showed that farmers have three types of fodder production systems: small-scale irrigation system, rain-fed system and the combined system. In the irrigation system, smallholder livestock producers use shallow well water (pulley irrigation) to produce improved fodder for their dairy animals. This is practiced more in Bahir Dar than in Hossana. About 33% of the sampled households used small-scale irrigation system in the Bahir Dar site. In addition, farmers in Hossana mentioned that traditional canal irrigation is used to produce forage. They also explained that in Lemo and Angacha, ground water shortage is the major problem that affects the use of the pulley irrigation system.

The traditional system involves production of fodder using rainwater. This is practiced in both sites. However, it is largely used in Hossana compared with Bahir Dar. As can be seen in Figure 8, most of the sampled farmers in Hossana produced fodder using this system. In the farmers' FGDs, households in Hossana mentioned that three crops commonly produced as fodder for their animals using rainwater: maize (with dense planting rate), oats and vetch. Hay is also produced using rain-fed farming mostly in marginal areas of farmers' main plots. Farmers also use a combined approach to produce fodder for their livestock. This is a system in which farmers grow improved forages using irrigation usually around their residences and use rain-fed production in the farms. On average, about 50% of sampled households used this approach in Bahir Dar site while in Hossana (about 30% of sampled households used this system to produce fodder.

Figure 8. Fodder production methods in the study sites

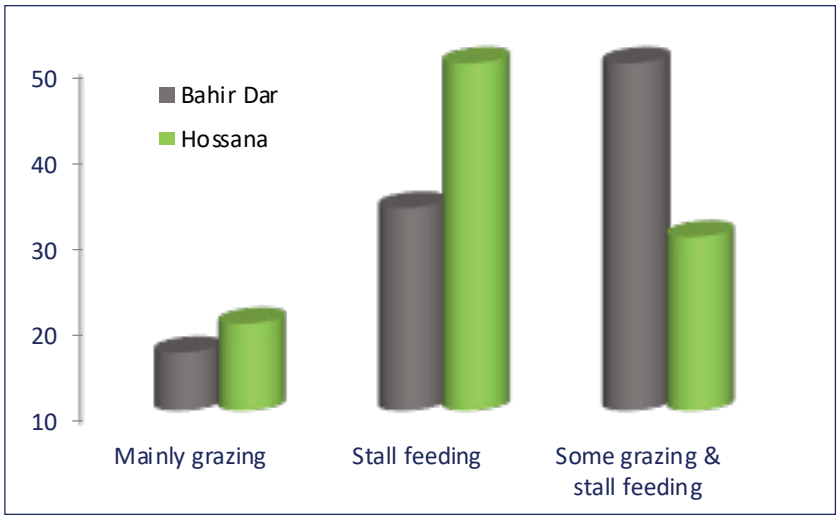


Source: Study data, 2020

Feeding practices

Results showed that three types of feeding systems are practiced in the study sites: zero-grazing/stall feeding, grazing, and a mix of some grazing and stall feeding. Figure 9 presents a summary of the results in the two sites. In stall feeding, the dairy animals are managed indoors and farmers used a cut and carry feeding method while with grazing, animals are allowed to freely browse in the field, roadsides and around farm plots. As can be seen in Figure 9, more farmers in Hossana use the stall feeding system while in Bahir Dar most farmers use a combination of grazing and stall feeding.

Figure 9. Feeding systems in the study sites



Source: Study data, 2020

In the FGDs, farmers explained that the trend in the use of free grazing has declined due to a shortage of land and lack of communal grazing areas. Most participants in the farmers' FGDs emphasize the merits and importance of the stall feeding system. FGDs participants said the advantages of cut and carry /stall feeding system include:

- Facilitating good animal follow-up and supervision.
- Enabling animals to get good rest, which has a positive effect on their health and productivity.
- Improving water consumption by the animals.
- Minimizing animal health risks.
- Increasing feed use efficiency (feed management).

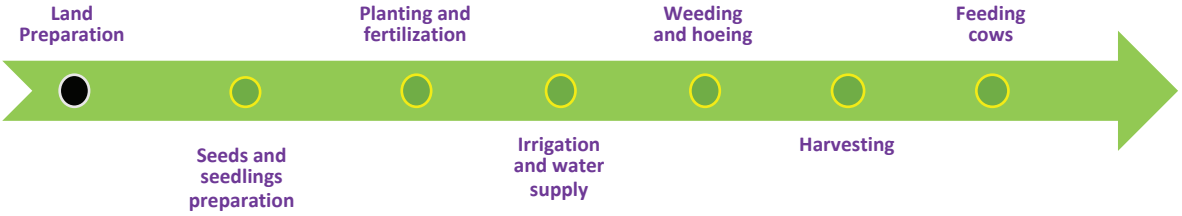
- Increasing milk production.
- Improving milk quality.

In the study sites, farmers usually mix green fodder with hay and other crop residues when feeding dairy animals. To this end, when asked whether they use feeding troughs, most of the FGD participants in Hossana said they did not use them and had no experience with feeding troughs. In Bahir Dar farmers had started using feeding troughs made of wood. A male farmer respondent said that a feeding trough had helped him reduce feed wastage that previously occurred when feed was placed on the ground and trampled on or soiled by the animals.

Steps in adoption and production of improved forages

In the FGDs, farmers were asked about the key steps needed for the adoption and/or production of improved forage using small-scale irrigation. Results of the findings are summarized in Figure 10. The first step is preparation of the plot allocated for the production of improved forage. In this case, the main activities are cleaning the plot and frequent ploughing (often more than twice).

Figure 10. Steps in adoption and production of improved forages



Source: Authors, based on study data, 2020

The second step is preparation of forage seeds and seedlings. Planting and fertilization are the next steps after obtaining quality forage seed. Farmers mentioned in the FGDs that they use mixed planting of grasses with legumes. They mostly plant tree legumes around the hedge of the forage plot. The fourth step is water supply and irrigation. Especially during the dry season, some farmers said they irrigate their fodder plots using pulley irrigation (source: Farmer in Bahir Dar). The fifth step is hoeing and weeding. Finally harvesting and feeding the green fodder to the dairy animals. Farmers also mentioned that fencing their plot is critical for fodder production.

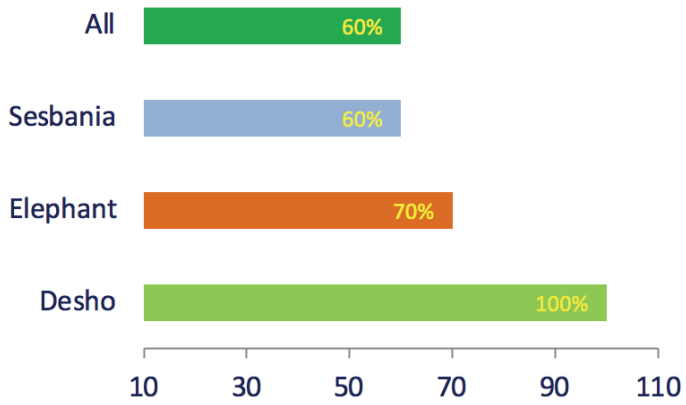
5.6 Type of improved fodder produced

Farmers produced various types of fodder using small-scale irrigation. This subsection shares the results of an assessment of the type of improved fodder farmers grow in the study sites. Accordingly, we reported the results of our analysis in Figure 11a and 11b. The most common types of improved fodder produced in the Hossana sites include Desho grass, Napier grass, and Sesbania sesban (Figure 11). Almost all sampled farmers (100%) who have irrigation access produced Desho grass at the Hossana sites. On average, 70% of the sampled farmers grew Elephant grass. The graph also shows that 60% of the sampled farmers grew all types of grasses and legumes in the Lemo and Angacha areas. Farmers reported in the FGDs that these improved forages determine milk yield significantly and are usually harvested while still green and fed to cows. Farmers also mentioned that they sell green fodder in woreda markets for income, which positively impacts their family livelihoods.

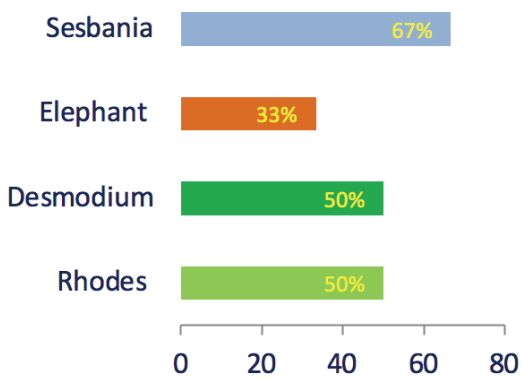
The most common types of fodder produced using small-scale irrigation in the Bahir Dar site are Rhodes grass, Elephant grass, ***Desmodium***, pigeon pea, and ***Sesbania sesban*** (Figure 11b). On average, 67% of the sampled households said that they have grown ***Sesbania sesban*** using small-scale irrigation. Farmers in the FGDs said that they grow improved fodder using mixed planting of legumes and grasses. They also reported that improved fodder is crucial during the dry season for feeding lactating cows and maintaining milk yields and quality. Unlike in Hossana, sale of green fodder is rare in the Bahir Dar site.

Figure 11. Types of improved forages cultivated in the study sites

(a) Types of fodder grown in Hossana



(b) Types of fodder grown in Bahir Dar



Source: Authors, based on study data, 2020

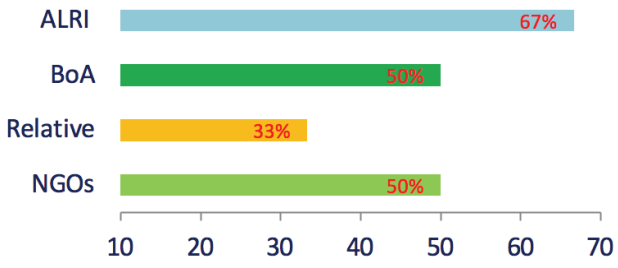
5.7 Access to fodder seeds and other services

One of the major problems often reported in the existing literature in improved forage production is lack of access to quality forage seeds. The extent of this problem was assessed in the study sites and a summary of the results is presented in Figure 12a and 12b. The main source of forage seeds in the Bahir Dar sites includes the woreda bureau of agriculture, ALRI, relatives and NGOs. However, the main source is ALRI, from which 67% of sampled farmers obtained forage seeds. Next to ALRI, NGOs and the bureau of agriculture are the major sources of forage seeds as revealed by 50% of the sampled farmers (Figure 12a).

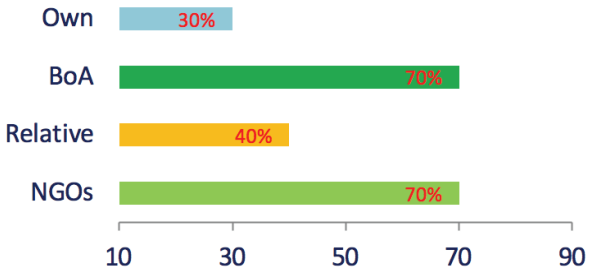
In Hossana, the major sources of forage seeds are woreda bureau of agriculture, relatives, NGOs and own saved seeds (Figure 12b). On average, about 70% of the sampled farmers reported that they source their improved forage seeds from NGOs (e.g. the Africa RISING project, which is led by ILRI). Unlike in Bahir Dar, the woreda bureau of agriculture in Hossana is the major source of forage seeds for 70% of sampled farmers. The Areka Agricultural Research Center and Wachamo University participate in different research activities and provision of some technologies. Moreover, in the Hossana area smallholder farmers use their own saved seeds. This is not the case in Bahir Dar site.

Figure 12. Seeds and seedlings sources in the study sites

(a) Seed sources in Bahir Dar



(b) Seed sources in Hossana



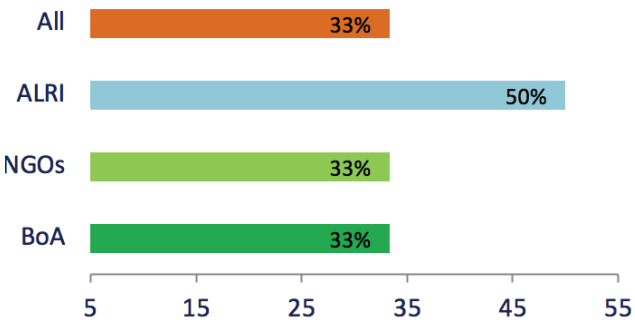
Source: Authors, based on study data, 2020

The other key element discussed in the farmers' FGDs was their source of support in improved forage production. Farmers perception on this issue were explored and the results are summarized in Figure 13a and 13b. The key institutions involved in supporting farmers in the development of improved forages are woreda bureaus of agriculture and NGOs. The woreda bureau of agriculture often provides technical and extension services on improved forage development through DAs. A forage development package is prepared by woreda livestock experts and implemented

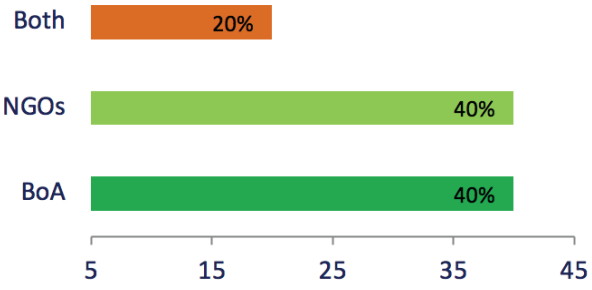
by DAs at farm/household level. NGOs on the other hand organize training for experts and DAs, supply forage technologies, and facilitate market linkages. However, in the case of the Bahir Dar site, ALRI plays an important role in the provision of extension services, seeds, and other technologies (e.g. providing cross-breed heifers). On average, 50% of the sampled farmers said that they obtained seeds and other support from ALRI.

Figure 13. Farmer support institutions in improved fodder production

(a) Support for institutions in Bahir Dar



(b) Support for institutions in Hossana



Source: Authors, based on study data, 2020

5.8 Perceptions on the adoption and effects of improved fodder production

Respondents in both study areas reported that improved forage production is practiced by livestock farmers. The level of adoption, however, varies between the two sites. It was reported that 15% of farmers have adopted improved forage production in the Robit Bata Kebele. However, the results from Hossana sites showed that, about 7%, 5%, 3%, 10% of farmers adopt and produced improved fodder in Upper Gana, Jawe, Hayse, and Kerekicho kebeles, respectively. Respondents in the experts FGDs reported that the low level of adoption of improved fodder production in the Hossana kebeles was because of factors such as low extension services, limited access to improved forage seeds, shortage of ground water and land. Furthermore, respondents in Bahir Dar reported that low market access for milk and dairy products contributes to the low adoption of improved fodder cultivation.

Respondents in both study areas reported that improved fodder production has benefits for smallholder farmers who adopt the technology. It was reported both in the farmers FGDs and the experts FGDs that improved fodder production and utilization has positive animal yield and income effects. The use of improved fodder increases volume and quality of milk, increases butter and cheese quality, improves the health condition of cows, and improves their reproductive performance (mainly oestrus cycle). In addition to these, respondents said improved forages are a source of income through direct sale of harvested green grass (e.g. Desho grass – 100kg is sold for ETB100–130 Birr), and sale of forage seeds. Furthermore, improved fodder production improves degraded lands, helps in soil conservation and environmental protection (source: Experts FGD in Hossana).

Milk yield improvements vary by location and breeds of cows, as reported by the respondents. In Hossana sites it was reported that feeding animals on improved fodder increases milk yield of local cows by about 15%, and by up to 70% for cross-bred cows. A male farmer in Hayse Kebele shared the experience of how his cross-bred cow that used to give 10 litres of milk, now gives about 15 litres after being fed on improved fodder and concentrate feed. Farmers in Robit Bata Kebele also reported that their milk yields had increased by 10% for local cows and 50% for cross-bred cows due to using improved forages.

5.9 Constraints in feed production and marketing

Generally, the constraints in fodder production vary by location. The most common constraints of fodder production in the Hossana sites are shortage of seeds, shortage of water, and poor utilization and management of fodder (Table 10). Shortage of land was another key constraint mentioned by the respondents. Others were lack of extension services and seasonal availability of fodder.

Table 10. Constraints in fodder production and utilization – Hossana sites

Constraints	Rank (1–6)
Poor access to improved forage seeds and seedlings	1
Shortage of water	2
Poor feed storage and management	3
Shortage of land for forage cultivation	4
Weak extension services	5
Seasonal availability of fodder	6

Source: Study data, 2020

In the Bahir Dar sites, the three most common constraints in fodder production and management are poor storage and management of feed, unattractiveness of dairy markets, and bulkiness of hay and straw (Table 11). The others are shortage of land, lack of proper extension services and seasonality of fodder feed. A unique constraint that was found in Robit Bata Kebele is the high price of hay and crop residues, which faces stiff competition from house construction demand.

Table 11. Constraints in fodder production and utilization – Bahir Dar sites

Constraints	Rank (1–6)
Poor feed storage and management	1
Unattractiveness of milk markets	2
Bulkiness (difficulty in feeding) of hay and straw	3
Shortage of land for forage cultivation	4
Weak extension services	5
Seasonal availability of fodder	6

Source: Study data, 2020

AIBPs feed is used as a supplement feed in Bahir Dar and Hossana sites and often fed to milking cows and calves. The main source of this type of feeds is the respective cooperative unions in each site as indicated in section 5.2. The key problem with the marketing of concentrate feed is an underdeveloped marketing system and informal actors involved in the transaction of AIBPs feed. Results of the assessment of constraints in marketing of AIBPs feed are presented in Table 12 and 13. Some of the constraints vary with location. Overall, the two major constraints of AIBPs marketing in Hossana as reported by farmer respondents, are high price of by-products and supply shortage of AIBPs.

Table 12. Constraints of AIBP feed marketing – Hossana sites

Constraints	Rank (1–4)
High price of wheat bran and oilcake	1
Low supply of agro-industrial by-products	2
High price of formulated ration	3
Shortage of formulated ration by animals category	4

Source: Study data, 2020

In the Bahir Dar site, the main constraints reported in the marketing of AIBPs were high price of formulated rations, low quality of concentrate feeds supplied by traders and retailers and high price of wheat bran and oilcake (Table 13). Farmers also mentioned in the FGD that although their cooperative is allowed to purchase from the Merkeb Union (the only AIBPs feed processor in the area), they often could not access concentrate feed from the union and bought it from traders. On the other hand, respondents in the expert FGD were unaware of the difficulty of sourcing concentrate feed from the Merkeb Union, and they believe the union gives priority for the delivery of quality services to its member cooperatives and farmers.

Table 13. Constraints of AIBP feed marketing – Bahir Dar sites

Constraints	Rank (1–4)
High price of formulated rations	1
Low quality of AIBPs	2
High price of wheat bran and oilcake	3
Shortage of AIBPs	4

Source: Study data, 2020

6. Conclusions and recommendations

The livestock subsector plays a crucial role in the political economy of Ethiopia. It serves as source of food, services (transport and traction), cash income, manure (soil fertility and fuel), store of wealth, and employment for the majority of smallholder farmers. The country has a large untapped livestock resource with a huge comparative advantage. However, despite the large livestock head count, the sector's contribution to the economy at the micro and macro level is well below its potential. Three critical factors are identified from literature for the low performance of the sector: (i) low production and productivity, (ii) poor market-orientation and value addition, and (iii) weak private and public institutions.

Lack of access to quality feed is the main factor responsible for the poor livestock productivity. Though several studies have sought to address feed-related issues in livestock production most of them have focused on the biological aspects of feed and animal feeding and not on the performance of feed value chains. This study analysed stakeholder roles and relationships, actors' integration, feed production and marketing practices within the feed value chains in the study areas. A qualitative research design was used in the study.

Results on socio-economic characteristics showed that the mixed crop-livestock farming system is the dominant type of agricultural practices in the study areas. Livestock in the study areas include large ruminant such as oxen and cows, goats, and poultry. Smallholder farmers in the study areas generally use traditional subsistence-oriented livestock production systems. Rural collective action institutions such as dairy cooperatives play important roles in linking farmers to the emerging urban food markets. Two primary dairy cooperatives, one at each site, are engaged in milk marketing and dairy processing. The Habebo Primary Cooperative in Lemo is engaged in dairy processing and producing skim milk, butter and cheese for the local market. In Bahir Dar Zuria, the Genet Le Robit Dairy Cooperative is engaged in the collection and marketing of milk.

The study identified two types of feed value chains: the fodder value chain and AIBPs value chain. The fodder value consists of four core processes namely, seed supply, fodder production, marketing and end use. Smallholder farmers are the dominant actor in the production and marketing of fodder. The main types of fodder produced and used in the study areas are crop residues, hay, and improved fodder. Crop residues is the primary feed source (62%) identified by farmers in the study areas followed by hay (15%). The AIBPs value chain includes six core processes: production (crops), marketing, processing, wholesaling, retailing and end use. The dominant stakeholder in the production and processing of AIBPs is cooperative unions (agro-processors). Millers and edible oil factories are also involved in the production of by-products. This class of feed is expensive and mostly used by dairy producers in the urban and peri urban area.

Results on the Process Net-Map exercise revealed three types of flows in the characterization and mapping of stakeholders: fund flows, knowledge and technology flows, and business linkages. The key constraints in the contemporary feed value chains identified in the study include shortage of improved forage seeds, poor fodder storage and management, shortage of water, and lack of awareness in improved forage production. In addition, shortage of AIBPs and high prices of formulated feed were identified as the main feed marketing problems.

These findings suggest that there is great scope for improving the sustainable production of animal feed in Ethiopia if constraints, such as lack of forage seeds, lack of awareness, and poor storage and management are addressed. One way to upgrade and enhance the performance of the country's fodder value chain is by establishing woreda-level forage development platforms. The stakeholders with higher influence such as research institutions and woreda bureaus of agriculture could help to establish and manage these platforms. Moreover, the following recommendations are suggested to improve feed production in the country:

- Overall, farmers awareness on proper feeding, storage, and management of crops residue is low, resulting in poor quality of this feed and feeding practices. Hence, interventions are needed to remedy this problem and promote proper feeding, improve quality and storage mechanisms. One way to do this could be provision of training (soft skills) to farmers on roughage feed treatment and better storage methods.
- Feed wastage and bulkiness during use of crops residue as feed are serious problems in both sites particularly in the stall feeding system. Interventions and closer attention are required to reduce feed waste and improve the palatability of roughage feeds. Promotion of the use of feeding troughs and other feed management technologies could be used to address the issue.
- Generally, the awareness of farmers on the importance and use of improved fodder is low. This category of feed is rich in nutrients and important for dairy production. Hence, interventions to improve farmer awareness and the use of improved fodder feed are required. One option could be to promote smallholder fodder cultivation using small-scale irrigation technologies.
- Although woreda stakeholders such as livestock experts and extension workers have general training on livestock production, they lack awareness and tacit knowledge on feed and forage development. Targeted training on the following feed and forage development issues should be given to strengthen the capacity of stakeholders:
    - forage seed business models
    - improved fodder production modality
    - irrigation technologies
    - forage packages, and
    - modern extension systems.
- Lack of access to improved forage seeds is the key problem in the input supply segment of the feed value chain. Interventions are needed to alleviate this problem and enhance supply of quality forage seeds to farmers. One option could be organizing farmers into forage seed producer groups and supporting the groups in seed production and marketing. This would help to improve farmer livelihoods through the establishment of seed businesses (sell of forage seeds), which would include:
    - women collective action groups (e.g. women forage seed business association) to support producer groups to engage in improved fodder seeds production and marketing.
    - Supply of improved forage seeds (direct supply) and provision of forage seeds and planting materials to farmers.
- The AIBPs and formulated feed value chains is low and most AIBPs supplied by retailers are of low because most of them have insufficient knowledge on the use and benefits of this feed option. As a result, the AIBPs value chain has high transaction costs which increases the unit price. Interventions to address this problem should include removing the middlemen and increasing supply of AIBP. One way could be by supporting and facilitating the engagement of youth entrepreneurs in the distribution and marketing of AIBPs. This would also create job opportunities for the youth and reduce the rapidly growing youth unemployment in the regions.
- Dairy cooperatives play a pivotal role in linking farmers to remunerative urban dairy markets in both sites. However, they are face internal governance (low member participation, commitment problems, weak leadership, lack of awareness on cooperative business model) and management problems. The service delivery performance and organizational capacity of dairy cooperatives could be improved by:
    - Providing training to leaders/managers on management of cooperatives, cooperative business models and cooperative leadership.

- Creating awareness and training of members on cooperative functions, by-laws and governance.
- Facilitating capacity development and providing milk processing equipment, storage, and office facilities.
- A resilient feed value chain is likely to be more important in the future with the emergence of market-oriented livestock production. Connected to this, further studies are needed on the following issues:
- Diversity of forage seed business models, their functions, and impacts.
- Adoption drivers for irrigated fodder production.
- Dairy cooperatives performance and management.
- Feed marketing and market organizations.
- The role of women in feed production and marketing.

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ISBN: 92–9146–626–8

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