Ethiopia National Dairy Development Strategy 2022–2031

ግብርና ሚኒስቴር

MINISTRY OF AGRICULTURE

Ethiopia National Dairy Development Strategy 2022–2031

Getachew Legese[1], Ulfina Gelmesa[2], Temesgen Jembere[2], Tamrat Degefa[2], Seyoum Bediye[2], Tariku Teka[3], Daniel Temesgen[4], Yohannis Tesfu[5], Asmelash Berhe[6], Lema Gemeda[6], Dejene Takele[6], Gashaw Beyene[6], Gebeyew Belachew[6], Girma Hailu[6] and Segni Chemeda[6]

1. International Livestock Research Institute (ILRI)
2. Ethiopian Institute of Agricultural Research (EIAR)
3. Ethiopian Livestock Development Institute (LDI)
4. Ethiopian Society of Animal Production (ESAP)
5. Global Alliance for Improved Nutrition (GAIN)
6. Ministry of Agriculture (MOA)

December 2023

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

Cover photos—ILRI/Apollo Habtamu, Zerihun Sewunet, Stevie Mann and Paul Karaimu

Citation: Legese, G., Gelmesa, U., Jembere, J., Degefa, T., Bediye, S., Teka, T., Temesgen, D., Tesfu, Y., Berhe, A., Gemeda, L., Takele, D., Beyene, G., Belachew, G. Hailu, G. and Chemeda, S. 2023. *Ethiopia National Dairy Development Strategy 2022–2031*. Ministry of Agriculture, Federal Democratic Republic of Ethiopia. Addis Ababa, Ethiopia.

Contents

Tables

Figure

Acknowledgments

This National Dairy Sector Development strategy of the Ministry of Agriculture (MOA) of the Federal Democratic Republic of Ethiopia has been realized with collaboration of different institutions and professionals. The Ministry of Agriculture's livestock led the strategy development process by providing guidance on the government's development agenda and key focus areas. The government, therefore, guided the technical task force that were part of this collaborative effort.

We appreciate the Global Alliance for Improved Nutrition (GAIN) for financially supporting efforts of the technical task force.

The MOA is grateful to the International Livestock Research Institute (ILRI) for committing a resource person who contributed to leading the strategy development process closely working with experts from MOA, Livestock Development Institute (LDI), and Ethiopian Institute of Agricultural Research (EIAR). ILRI has provided financial and technical support on publication of the strategy document in both English and Amharic.

We owe special thanks and appreciation to a task force composed of experts from MOA, EIAR, LDI, ILRI, Ethiopian Society of Animal Production (ESAP), and GAIN for their professional inputs and commitment towards realizing this national dairy sector development strategy. The commitment shown by this professional team of experts was impressive and exemplary.

We appreciate all actors who committed their time in reviewing the strategy document and providing professional inputs to improve the quality, at different stages of the strategy development process. We further express special gratitude to all stakeholders from regional states, universities, non-government Organizations (NGOs) and other partners who travelled long distances to attend the validation meeting at Adama and provided inputs that contributed to the realization of a comprehensive strategy document relevant to different parts of Ethiopia's complex agriculture landscape.

Special appreciation goes to Ato Segni Chemeda of MOA and Dr Getachew Legese of ILRI for their leadership and coordination of the strategy development process.

Tsigereda Fekadu
Lead Executive of Livestock and Fisheries Development
Ministry of Agriculture

Foreword

Ethiopia is endowed with huge livestock genetic diversity and immense potential for dairy development. Dairy in Ethiopia forms the basis of livelihoods of several millions of smallholder farmers in the rural and urban settings, as well as, pastoralists and agro pastoralists settings. Because of increasing demand for dairy products, the dairy sector has continued providing income, nutrition and employment for many youths, women and all actors working along the dairy value chain.

However, the current contribution of the Ethiopian dairy sector to the national economy and livelihoods of Ethiopians is not congruent with the value of this resource base and its potential for development. Important constraints hampering the development of the dairy sector include production system-specific constraints related to genetics, feeds and feeding systems, limited access to health services and inputs, low adoption of improved technologies, an inefficient marketing system, absence of clear policy support, poor access to finance, poor rural infrastructure, high post-harvest losses, weak value addition, poor product quality and safety, and a weak regulatory system to enforce government rules and regulations to improve the performance of the dairy sub-sector.

To address the above multitude of challenges, the Ministry of Agriculture (MOA) has declared bold development, and policy interventions targeting transformation of the dairy sector in the Ten-Year Development Plan and associated programs including the Ten-in-Ten development initiative and '*Yelemat Tirufat*'. This Dairy Sector Development Strategy will provide clear implementation pathways for different government intervention measures that are indicated in the different strategic development plans.

The strategy document considers the conceptual, technical, socioeconomic, organizational, policy and capacity challenges that should be addressed for the transformation of the Ethiopian dairy sector. The strategy document has also recognized the roles and responsibilities of different stakeholders in implementation of specific interventions.

The strategy was developed in a collaborative process involving a taskforce of experts from MOA, LDI, EIAR, representatives from regional states, universities, non-government Organizations (NGOs) and other partners, GAIN and ILRI. The strategy development process was financially supported by ILRI and GAIN.

On behalf of the Ministry of Agriculture, we would like to extend our appreciation to Ato Segni Chemeda of MOA and Dr. Getachew Legese (Research Project Coordinator, ILRI) for leading the development of the different aspects of the strategy. Our special gratitude goes to members of the technical task force: Drs. Ulfina Gelmessa, Temesgen Jenbere, Tamrat Degefa, and Mr. Seyoum Bediye from EIAR; Prof. Daniel Temesgen from ESAP; Ato Tariku Teka from LDI; Ato Yohannis Tesfu from GAIN; and Ato Dejene Takele, Ato Asmelash Berhie, Ato Lemma Gemeda, Dr. Geshaw Beyene, Ato Gebeyew Belachew and Ato Girma Hailu from MOA. We thank all for their active involvement in the process of developing Ethiopia's National Dairy Sector Development Strategy.

HE Dr. Fikru Regassa
State Minister, Livestock and Fisheries Resources Development Sector
Ministry of Agriculture of the Federal Democratic Republic of Ethiopia

Prof. Appolinaire Djikeng
Director General
ILRI

Acronyms and abbreviations

ADPLAC	Agricultural Development Partners Liaison Advisory Council
AEMFI	The Association of Ethiopian Microfinance Institutions
AFC	Age at First Calving
AHI	Animal Health Institute
AI	Artificial Insemination
AIT	Artificial Insemination Technician
AOSS	Agricultural One Stop Service
ART	Assisted Reproductive Technology
ATI	Agricultural Transformation Institute
ATVET	Agricultural Technical and Vocational Education and Training
AU-PANVAC	African Union – Pan African Veterinary Vaccine Centre
CADU	Chilalo Agricultural Development Unit
CBPP	Contagious Bovine Pleuropneumonia
CCPP	Contagious Caprine Pleuropneumonia
CI	Calving Interval
CRA	Customs and Revenue Authority
CRGE	Climate Resilient Green Economy
CSA	Central Statistical Agency
DA	Development Agent
DBDS	Dairy Business Development Service
DBE	Dairy Business Enterprise
DDE	Dairy Development Enterprise

DOVAR	Disease Outbreak and Vaccination Reporting
EAFIA	Ethiopian Animal Feed Industry Association
EARO	Ethiopian Agricultural Research Organization
EBI	Ethiopian Biodiversity Institute
ECA	Ethiopian Conformity Assessment
EDPPA	Ethiopian Dairy Producers and Processors Association
EFS-TP	Ethiopian Food Systems – Transformation Pathway
EIAR	Ethiopian Institute of Agricultural Research
EPRDF	Ethiopian People's Revolutionary Democratic Front
ES	Estrus Synchronization
ESAP	Ethiopian Society of Animal Production
ET	Embryo Transfer
EVA	Ethiopian Veterinary Association
FAO	Food and Agriculture Organization of the United Nations
FMD	Foot and Mouth Disease
FTC	Farmer Training Centre
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GTP	Growth and Transformation Plan
HF	Holstein Friesian
HLI	Higher Learning Institution
IAIP	Integrated Agro-industry Park
IAR	Institute of Agricultural Research
ICARDA	International Center for Agricultural Research in Dry Areas
ICT	Information and Communication Technology
ILRI	International Livestock Research Institute
IVP	In Vitro Embryo Production
LDI	Livestock Development Institute
LITS	Livestock Information and Traceability System

LN	Liquid Nitrogen
LSA	Livestock Sector Analysis
LSD	Lumpy Skin Disease
M&E	Monitoring and Evaluation
MAS	Marker Assisted Selection
MCC	Milk Collection Centre
MFI	Microfinance Institution
MOA	Ministry of Agriculture
MOET	Multiple Ovulation and Embryo Transfer
MOOC	Massive Open Online Courses
MOT	Ministry of Trade
NAHDIC	National Animal Health Diagnostic and Investigation Centre
NAHRC	National Animal Health Research Centre
NAIC	National Animal Genetic Improvement Centre
NARS	National Agricultural Research Systems
NDB	National Dairy Board
NGO	Non-Governmental Organization
NVI	National Veterinary Institute
PAD	Pilot Advisory Services
PPP	Public-Private Partnership
PPR	Peste des petits ruminants
PTC	Pastoralist Training Centre
RARI	Regional Agricultural Research Institute
RBME	Results-based Monitoring and Evaluation
SDG	Sustainable Development Goal
SFE	Sub-Regional Office for Eastern Africa
SLM	Sustainable Land Management
SME	Small and Medium Enterprise
SNNP	Southern Nations, Nationalities and Peoples

SNV	Netherlands Development Organization
SWOC	Strengths, Weaknesses, Opportunities and Challenges
TAD	Transboundary Animal Diseases
TB	Tuberculosis
TMR	Total Mixed Ration
TOT	Trainer of Trainers
TV	Television
TVET	Technical and Vocational Education and Training
UHT	Ultra Heat Treated
UN	United Nations
USD	United States Dollar
VAT	Value Added Tax
VDFACA	Veterinary Drugs and Animal Feed Administration and Control Authority
VRRM	Veterinary Rationalization Road Map
WADU	Wolaita Agricultural Development Unit
WHO	World Health Organization
YSM	Young Stock Mortality

Executive summary

Ethiopia has the largest livestock population in Africa. According to a CSA (2021) livestock sample survey, the country possesses 70.3 million cattle, 42.9 million sheep, 52.5 million goats and 8.1 million camels. The livestock sector contributes about 45% of the agricultural GDP, 18.7% of the total national GDP, and 16–19% of the total foreign exchange earnings of the country (Behnke and Metaferia 2011). In Ethiopia, dairy production depends mainly on indigenous livestock genetic resources of cattle, camels and goats. Cattle are the largest contributors to the total national annual milk output, followed by camels (CSA 2021).

Ethiopia has a huge potential for dairy development. The large and diverse livestock genetic resources, existence of diverse agro-ecologies suitable for dairy production, increasing domestic demand for milk and milk products, developing market opportunities, and proximity to international markets all contribute to the potential and opportunities for dairy development in the country. However, dairy development has been hampered by multi-faceted, production system-specific constraints related to genotype, feed resources and feeding systems, access to services and inputs, and low adoption of improved technologies. An inefficient marketing system and absence of clear policy support, poor access to finance, weak regulatory system to enforce government rules and regulations are also among the systemic constraints to the development of the Ethiopian dairy sector. Moreover, the sector is constrained by poor rural infrastructure, high post-harvest losses, weak value addition and poor product quality and safety.

The government of Ethiopia plans to increase milk production four-fold by 2031 through targeted interventions aimed at improving the productivity of dairy cows, camels and goats. Investment in the dairy sector has been prioritized in the ten-year perspective plan of the government. It is anticipated that the plan will contribute to unlocking major bottlenecks in genetics, improved technologies, feeding, health, input and output marketing, value addition, product quality and consumer safety. It is also envisaged to reduce post-harvest loss of milk and milk products and enhance use of improved technologies in the dairy sector. This strategy document aims to guide implementation of the ten-year perspective plan and associated initiatives such as the dairy project in the Ten-in-Ten and *Yelemat Tirufat* initiatives developed to transform the dairy sub-sector. It highlights key interventions to be implemented in the short-, medium- and long-term plan periods from 2022 to 2031.

The document identifies strategic issues and priority interventions in the short-, medium- and long-term in dairy breed improvement, feeds and nutrition, biosecurity and dairy health management, milk quality and safety, dairy business management and market development, investment in commercial farming and processing industry, extension linkage, capacity development and some cross-cutting issues. It also highlights various roles and responsibilities of different actors.

1 Introduction

1.1 Background

Ethiopia has the largest livestock population in Africa. According to a CSA (2021) livestock sample survey, the country possesses 70.3 million cattle, 42.9 million sheep, 52.5 million goats and 8.1 million camels. Livestock are an integral part of agriculture and the daily life of the Ethiopian people. The livestock sector contributes about 45% of the agricultural GDP, 18.7% of the total national GDP, and 16–19% of the total foreign exchange earnings of the country (Behnke and Metaferia 2011). In Ethiopia, dairy production depends mainly on indigenous livestock genetic resources of cattle, camels and goats. Cattle are the key contributors to the total national annual milk output, followed by camels and goats (CSA 2021). Besides milk and milk products, enhanced dairy production and productivity can make a significant contribution to household incomes and improve access to animal source foods which will also influence the physical and mental development of children, youth and women. Moreover, increased access to consumption of camel and goat milk has an added advantage due to the better nutritional and medicinal value of milk from these animals.

Ethiopia has a huge potential for dairy development. The large and diverse livestock genetic resources, existence of diverse agro-ecologies suitable for dairy production, increasing domestic demand for milk and milk products, improved market opportunities and proximity to international markets all contribute to the growing potential and opportunities for dairy development in the country. However, the development of the sector has been hampered by multi-faceted, production system-specific constraints related to genotype, feed resources and feeding systems, access to services and inputs, and low adoption of improved technologies. An inefficient marketing system and absence of clear policy support, poor access to finance, a weak regulatory system that could ensure enforcement of government rules and regulations are also among the systemic constraints to the growth of the Ethiopian dairy sector. Moreover, the sector is constrained by poor rural infrastructure, high post-harvest losses, weak value addition and poor product quality and safety. The livestock masterplan (Shapiro et al. 2015) projected increasing national cow milk production during the GTP II period (2015–2020) by 93%, a surplus of 2501 million litres over projected domestic consumption requirements on condition that proposed interventions are implemented. However, the proposed interventions were not implemented, the challenges mentioned earlier remain unsolved. and the projected increase in milk production was not realized. As a result, the daily average milk yield is estimated at 1.48 litres/cow, and 2.79 litres/camel (CSA 2021). The total annual milk production in Ethiopia from cows and camels is estimated at 7.1 billion litres; this could be translated into a per capita milk consumption of about 60 litres/year, which is only about a third of the World Health Organization (WHO) recommended per capita annual milk consumption of 200 litres. The annual growth rate in milk production of 1.2% from 1998 to 2020 is less than the annual human population growth estimated at 3% (GRM International BV 2007). Due to the huge gap between demand and supply, the country spends significant amount of resources to import dairy products and fill the supply gap. For instance, Ethiopia imported more than 19.43 million liters gross weight of milk and cream in different forms from 51 countries for between 2009 and 2018 and spent over 2.23 billion Ethiopian birr to import these products (Tesfaye et al, 2019).

The government of Ethiopia has a plan to increase milk production four-fold by 2031 through targeted interventions aimed at improving the productivity of dairy cows, camels and goats. Investment in development of the dairy sector has been given top priority in the ten-year perspective plan. The government plans to unlock major bottlenecks in genetics, feeding, health, input and output marketing, value addition, product quality and consumer safety. It is also envisaged to reduce post-harvest loss of milk and milk products and enhance use of improved technologies in the dairy sector. This strategy document provides guidance on implementation of the ten-year perspective plan and associated initiatives such as the dairy project in the Ten-in-Ten and *Yelemat Tirufat* initiatives developed to transform the sub-sector. The strategy proposes key interventions to be implemented in the short-, medium- and long-term plan periods from 2022 to 2031.

1.2 Rationale for developing the strategy

The livestock sector analysis (Shapiro et al. 2017) and the dairy sector component of the Ten-in-Ten agricultural development program revealed that dairy farming supports the livelihoods of over 3 million farmers in Ethiopia. However, due to limited intervention, the productivities of indigenous cattle (97.3% of cattle population), indigenous camels (100% of camel population), and indigenous goats (99.9% of the total goat population) have remained very low. For instance, the dairy cattle population is characterized by slow growth rate, late age at first calving (57 months), low milk yield (270–350 kg per lactation, and 1.48 kg per day), short lactation length (180–240 days), and about 570 days of calving interval (Yilma et al. 2011).

The dairy component of the Ten-in-Ten development program targets improvement in production, reproductive efficiency and productivity of dairy cattle, camels and goats through different interventions. The plan anticipates increasing milk production from 7.1 billion liters in 2020 to 28.4 billion liters in ten years (2031) and thus attain the WHO recommended per capita annual consumption of 200 liters. The plan also anticipates improving value addition, marketing and consumer safety, and reducing post-harvest losses. The strategy targets improvement in the productivity of indigenous dairy cows, camels and goats through genetic improvement, improved feed and nutrition, and promoting health and better management practices. This document has therefore been developed to guide strategic interventions to realize the targets anticipated in the ten-year perspective plan and other government initiatives which aim to transform the Ethiopian dairy sector.

1.3 Vision, mission, goal and objectives

Vision: To be self-sufficient in milk and milk products with a per capita milk consumption reaching the WHO recommended level by 2031.

Mission: To transform milk production and productivity from dairy cattle, camel and goat for food to ensure nutrition security, poverty reduction, social equity, import substitution, export promotion and environmental sustainability.

Goal: To contribute to enhanced livelihoods, food and nutrition security, access to healthy and nutritious diets, economic growth and environmental sustainability through improved dairy production, value addition and marketing.

Objectives: The general objective of this strategy is to guide the Ethiopian dairy sub-sector's future development, move and transform existing fragmented development initiatives into organized, rationalized, scientific and sustainable development programs through facilitating knowledge and technology transfer while improving the efficiency and effectiveness of institutional service delivery.

The specific objectives of the strategy are to:

- Establish a sustainable system of providing improved inputs, services and suitable technologies to improve production and productivity, and ensure the quality and safety of dairy products.
- Strengthen existing milk and feed processing industries and support the establishment of new ones.
- Enhance institutional efficiency and effectiveness in implementation and service delivery in different dairy production systems.
- Establish systems to build domestic and export market linkages that are critical to stimulate increasing productivity and commercialization of dairy enterprises.
- Enhance linkages between development and research institutions and create enabling environments for building strong public-private partnerships (PPPs).
- Enable development of climate smart dairy technologies and innovations to mitigate and adapt to climate change/variability.
- Guide the development and capacity enhancement of the dairy sub-sector.

1.4 Scope of the strategy

This strategy aims to address dairy development at the national level. A timeline of ten years has been set to revamp existing programs, identify priorities for new ones and develop a framework for development initiatives. This document will promote future development interventions aimed at improving and promoting efficient utilization of dairy resource potentials in Ethiopia. It addresses all value chains of dairy cattle, camels and goats in the ten-year perspective plan, the dairy component of the Ten-in-Ten program and the *Yelemat Tirufat* initiatives of the Ministry of Agriculture (MOA).

1.5 Guiding principles

The Dairy Development Strategy is guided by the following principles:

- Aligning with the development policy and plans of the country.
- Facilitating the capacity for information exchange and competitiveness of the dairy sector through application of advanced science and technology.
- Strengthening linkages among national and international institutions working in the dairy sector.
- Capitalizing on globally available fundamental knowledge and best practices, and making good use of experiences and practices from other countries.
- Establishing and sustaining collaborative development and research relationships among national and international organizations.
- Accountability to clients and users, plus promotion of a vibrant private-public-partnership (PPP) in dairy resource development and utilization.
- Availing information and technology to users.
- Considering cross-cutting issues such as socio-economic factors and nutrition sensitivity.
- Participatory planning, implementation, monitoring and effective technology transfer.

- Ensuring job creation, inclusiveness (youth, gender) and social equity.
- Ensuring regenerative production practices and environmental sustainability in dairy production, processing, distribution and marketing.
- Ensuring sustainable consumption practices.
- Creating a favorable environment for stakeholders for long-term engagement and shared responsibility.

2 Situation analysis

This section presents an assessment of the overall situation of the Ethiopian dairy sector. The major issues covered include development goals of the dairy sector formulated in the country's ten-year perspective plan and associated documents, trends in the production and marketing of dairy products, the institutional capacity of the dairy sector and research focusing on breeding and genetics, feeds and feeding, plus animal health. It provides a comprehensive background for a SWOC analysis and identification of strategic issues and interventions.

2.1 Development goals in the dairy sector

The Ministry of Agriculture's ten-year perspective plan and the dairy sector initiative in the Ten-in-Ten programs have set targets for increasing milk production and productivity of dairy cattle, camels and goats. This plan targets to increase total milk production from the three species from 4.3 billion litres in 2020 to 28.4 billion litres in 2031 (Table 1). The plan envisages to increase total milk production from indigenous cows, camels, crossbred cows, goats and exotic cows to 13.5 billion, 8.7 billion, 5.8 billion, 326 million and 314 million liters, respectively. The plan intends to achieve 17% annual growth in milk production through the right genetics and application of biotechnological tools and proper management interventions. Project implementation areas have been identified in all national regional states of the country. It is expected that about 85% of the milk production will be from four major regions (Oromia, Ethiopia Somali, Amhara and SNNP), while the remaining 15% will come from the other regional states.

Table 1: Livestock sector development goals

Production type/sub-sector	Unit of measure	Baseline year target (2019/20)	MOA 10-year perspective plan and Ten-in-Ten initiative target for 2030
Milk from cows, goats and camels	Billion litres	4.3	28.4
Meat from cattle, goats, sheep and camels	Thousand tons	294.0	1,759.0
Skins and hide	Million pieces	13.5	72.5
Chicken meat	Thousand tons	48.0	106.0
Eggs	Millions	2,854.2	5,546.3
Honey	Thousand tons	59.0	152.0
Wax production	Thousand tons	6.0	10.0
Silk production (cocoon)	Tons	29.96	77.7
Fish	Thousand tons	57.4	260
Number of milk-producing indigenous cows	Million heads	15	10.8
Number of milk-producing crossbreed cows	Million heads	0.313	1.03
Number of milk-producing exotic cows	Thousand heads	37	260

The Ministry of Agriculture identified three intervention options to realize its targets for improving milk production and productivity. The three options are designed to match the different agro-ecologies and associated dairy development potentials in these systems. Option 1 aims to enhance interventions based on the classical approach for the production, processing and marketing of milk and milk products. Option 2 will involve making use of high-yielding pure exotic breeds from abroad. However, this is a type of technology shopping from abroad, and adopting the same is usually more costly. It will also be difficult to get best bet technologies adapted to different production systems. Option 3 entails implementing interventions with crossbreeds of different blood levels and desirable performances, along with production (feed, health and management), processing and marketing packages with acceptable yield of quality and quantity which is also appropriate for youth and women members of the community. Since 70% of the population in Ethiopia comprises the youth, involvement of this group will be crucial to the achievement of project objectives. Option 1 might be appropriate for marginal areas that may not be suitable for crossbreeding programs and where the other options cannot be implemented. Option 2 may be feasible for peri-urban and urban production systems with high-level marketing infrastructure, as well as resource-rich farmers who can afford exotic breeds. Option 3 is perceived to be the most feasible since there are tremendous proven technologies and best bet practices generated by EIAR/RARI breed improvement programs which are in line with the objectives of this project.

The other important source of milk in Ethiopia is camel production that contributes about 15% of the total production in the country. The ten-year perspective plan envisages improvement in camel milk production through selection among pastoral camel herds. In this process, the target is to increase the daily milk yield per camel from 2.9 liters in 2020 to 3.4 liters in 2031. There are also plans to reduce post-harvest loss of camel milk from 10% to 5%, and increase the marketable quality of camel milk from 47% to 78% during the planned period.

Regarding goat milk production, the ten-year perspective plan aims to increase daily milk yield per goat from 0.46 litres in 2020 to 0.5 litres in 2031 through breed improvement using selection and crossbreeding with exotic breeds. Post-harvest loss of goat milk will also be reduced from 10% to 5%. In addition, the quality of goat milk will be improved to ensure that the amount sold to markets increases from 44% to 64% during the same period.

2.2 Trends in dairy production and marketing

Total milk production in Ethiopia increased during the 1961–2000 period at an average annual rate of 1.55%, though per capita production declined as a result of the high population growth rate. However, during the last decade, production grew at the rate of 3%. The increased coverage of extension services (such as better management skills) and increased use of improved inputs (improved breeds and feed) plus policy changes aimed at promoting dairy production have contributed to faster growth of the sub-sector. Dairy product imports during this period were relatively less compared to the previous three decades. Most of the growth during the 1990s was concentrated in peri-urban and rural production systems. The emergence of private processing industries and marketing units has stimulated producers in peri-urban areas and rural production systems as a result of improved market access for dairy products. Overall, dairy processing and marketing functions were performed at various levels; the parastatal Dairy Development Enterprise (DDE), dominated the dairy industry from the late 1990s when the private and cooperative sectors appeared to play significant roles in the collection and processing of milk. Under the current market-oriented economic system, private sector involvement in milk marketing has emerged alongside co-operative marketing organizations. The privatization of DDE in 2007 marked the end of the parastatal dairy production system in Ethiopia. As indicated above, dairy is one of the priority intervention areas in the country's ten-year perspective plan and associated programs including the Ten-in-Ten government initiatives scheduled to be implemented in ten years (up to 2031). The government intends to increase milk production from cattle, camels and goats from the current level of about 7.1 billion to 28.4 billion litres in 2031.

2.3 Institutional capacity and policy framework

Different institutions have made tremendous efforts to improve the performance of Ethiopia's dairy sector and build capacities that can support initiatives to transform the sector. Efforts have been made to improve the genetics, feeds and feeding, health care and marketing of dairy products. This section describes the institutional capacity of the country and efforts that have been made to improve these capacities over time with respect to thematic areas.

2.3.1 Genetics

The dairy sector enhancement activities date back to the early 1950s with the initiation of modern dairying with the first batch of dairy cows received from the United Nations Relief and Rehabilitation Administration. Since then, efforts have been made to crossbreed indigenous breeds with exotic breeds. In line with this, the then National Animal Genetic Improvement Centre (NAIC) engaged in production and importation of semen for use in the crossbreeding program. Additionally, research and higher learning institutions have been undertaking technology development and demonstration activities. In terms of conservation, Abernosa, Dida Tiyura, Gobe, Metekel and Mayweini ranches were engaged in improvement of indigenous cattle breeds in their respective localities. However, the Abernosa and Gobe ranches were sold to private investors in response to EPRDF's market-led economic policy and privatization.

Currently, a number of institutions are engaged in dairy cattle genetic improvement, conservation and multiplication. At federal level, the Ministry of Agriculture has the national responsibility of overseeing the policy, regulation and technical domains. Additionally, the EIAR and NARs have overall responsibility for national coordination of dairy cattle genetic improvement and research activities, while the Livestock Development Institute (LDI) serves as an umbrella institution for improvement and continual supply of improved dairy genetic resources. Moreover, LDI is in charge of preparing the national breeding policy, strategies and programs, plus implementation, upon approval by the government. Technical institutions such as EIAR, the Biotechnology Institute and Biodiversity Institute engage in their respective technical domains at the national level. They aim to deliver improved genetics, promote conservation and ensure sustainable utilization of resources. Regional Bureaus of agriculture, livestock and fisheries, regional research institutions and tertiary institutions also engage in implementation of projects on genetic improvement, conservation and sustainable utilization of dairy cattle genetic resources in their region and production systems. In addition, there are non-government institutions and professional societies involved as a major development partner in dairy genetic improvement at different levels in different areas of the country. These comprise the International Livestock Research Institute (ILRI), SNV, Land O'Lakes, FAO, Heifer International, the Ethiopian Society of Animal Production (ESAP) and other non-governmental development organizations (NGOs).

The long-awaited National Livestock Breeding Policy of Ethiopia was approved and issued in 2016. With respect to dairy animals, the policy recognizes key tasks of identification, systematic characterization, conservation, genetic enhancement through selection or crossbreeding, multiplication, and sustainable utilization of dairy animal genetic resources.

2.3.2 Animal reproductive biotechnology

Dairy cattle genetic improvement and availability of replacement heifers has great potential to boost national milk production, improve reproductive efficiency and productivity per cow, and increase household incomes. Nevertheless, despite the great effort made in dairy cattle genetic improvement in Ethiopia since its inception in 1947 through application of assisted reproductive technologies, there has been little impact, resulting only in a 2.6% exotic gene inheritance, including crosses, hybrids and exotics, from the total cattle population in the country. This is due to the inconsistent use of artificial insemination (AI) as a result of factors such as infrastructural

problems, high turnover of AI technicians (AITs), lack of incentives on non-working hours and public holidays, inefficiency of AI service due to inferior quality semen, poor handling and management, skill gap among AITs and inconsistent or unreliable supplies, particularly liquid nitrogen.

Furthermore, unlocking the reproductive efficiency of the indigenous cattle and unveiling their innate potential such as heat and disease tolerance remains untapped. Nucleus herd multiplication for domestic semen production had an insignificant impact on fulfilling the demand for improved dairy animals despite very high demand for improved dairy cows and replacement heifers in the dairy industry.

2.3.3 Animal health

Maintaining dairy cattle health goes beyond the safety and the well-being of the animal. It also includes producing safe and surplus food and securing the well-being of the consumer, thus reflecting the effective interface of veterinary public health. This requires provision of quality veterinary service and biosecurity measures by availing an adequately trained workforce, laboratory and field logistics, veterinary drugs, plus biological and diagnostic kits. Furthermore, with the wide distribution of dairy cattle in almost all agro-ecologies, the country needs to ensure accessible and competent veterinary service coverage for dairy producers, with a set minimum standard (one health post for three *kebeles*). Although the current 15 regional laboratories provide diagnostic, surveillance and investigation services, and the national referral laboratory, Animal Health Institute (AHI) and National Institute for the Control of Tsetse fly and Trypanosomiasis are currently rendering veterinary services, strengthening capacity and ensuring accessibility to cutting-edge technologies is important.

In Ethiopia, there is only one quality control laboratory (VDFACA Quality Control Lab) working on quality assurance and residue testing, and a national vaccines production institute (NVI) with some capacity of anti-helminthics production. This production capacity needs to be upgraded particularly to address the limitation in production of vaccines for the prevention and control of some transboundary animal diseases (TADs). Currently, there is a shortage of veterinary drugs due to scarce foreign currency. In general, despite improving coverage of service delivery, the quality has been hampered by several factors: dependence on government structure, plus limited availability of equipment, consumables and logistics. The regulatory and inspection service is not strong enough to control movement of animals and set stringent requirements that minimize the risk of disease introduction and spread. Hence, recent strengthening and reformation need serious attention and support to advance the regulatory and monitoring service by the government.

2.3.4 Feeds and nutrition

The institutional landscape of animal feeds and nutrition pertaining to dairy animals began with establishment of the feeds and nutrition department/various projects of the MOA, higher learning institutions, research institutions and various NGOs. Within the ministry, a series of feed development projects (the first, second, third and fourth livestock development projects) pertaining to forage/pasture, range and crop residues were carried out. A number of public (research, higher learning), NGOs (international, national) and private organizations were also involved in dairy feed development and utilization. National/regional research institutions, higher learning institutions and NGOs have also carried out a series of interventions aimed at removing key barriers and enhancing feed supply and nutrition of dairy animals. Besides public institutions and NGOs, private institutions were engaged in dairy feed development particularly in improving the supply of feed ingredients, specialty feeds (minerals, premix and vitamins) and compound feed production. The Ethiopian Animal Feed Industry Association (EAFIA) and the forage seed producers' association are the key private institutions engaged in compound dairy feed production and supply of improved forages, respectively. With respect to dairy feed quality analytical services, there is a national laboratory at Holetta Research Centre of EIAR and satellite laboratories in regional research/higher learning institutions. Additionally, private laboratories are also coming on board to cater for dairy feed quality and safety analytical services. The VDFACA quality control laboratory is also engaged in the analysis of feed safety and quality assurance.

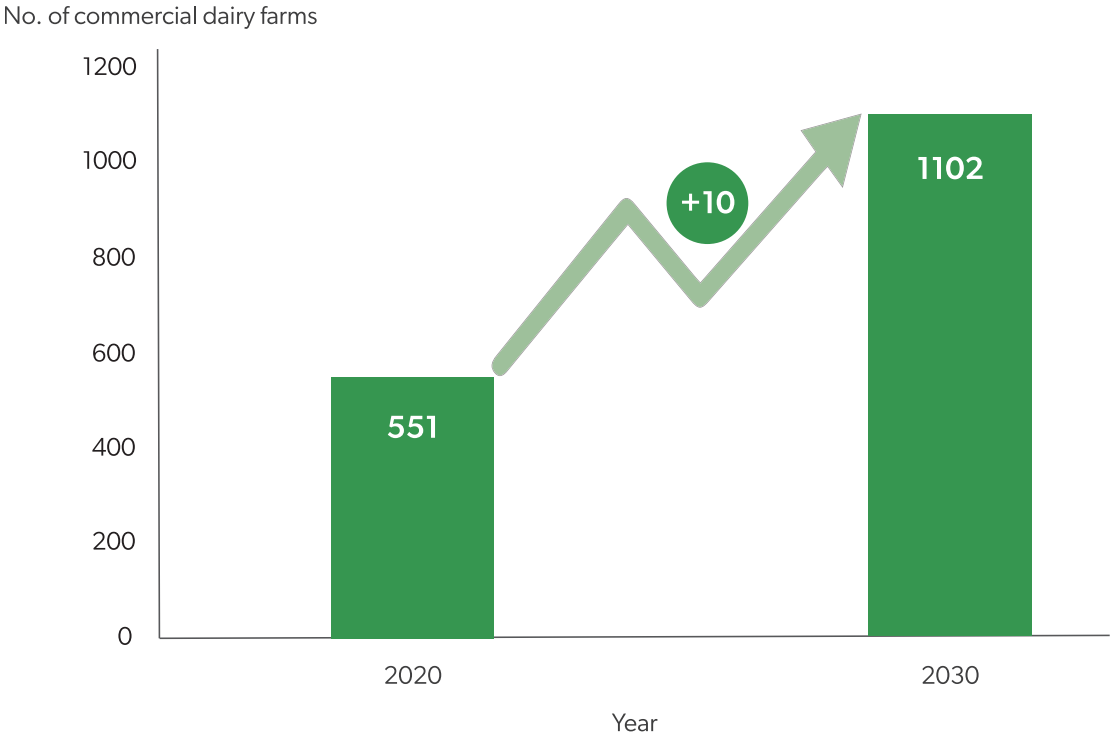
2.3.5 Dairy commercialization in Ethiopia

The dairy sector has great potential for growth in Ethiopia. The transformation of smallholder subsistence dairying into market-oriented commercial dairy production requires engagement of smallholder farmers in commercial dairy farming plus massive private investment, input supply, service delivery and milk value addition to overcome fluctuations in raw milk demand and supply due to seasonal consumption of animal products associated with fasting seasons in the country.

Development and promotion of policies that support private sector participation and investment in the dairy sector is one of the priority areas of the Ethiopian government. The private sector has invested and continues to invest in commercial dairy farms, milk processing plants, feed processing, and supply of dairy inputs and services. Meeting the increasing demand for milk and dairy products cannot be realized without rapidly increasing the number of high-producing tropically-adapted cows, the number of commercial dairy herds, plus the number of cows per herd and productivity per cow. However, in Ethiopia, the sector is yet to fully realize its potential to produce enough milk and dairy products to meet the domestic demand. As a result, the country is forced to import powdered milk and other milk products.

Current efforts by different actors in the dairy value chain are worth acknowledging but are not adequate. They are usually fragmented, project-driven, and lack continuity in area and type of intervention. Thus, both government-led platforms of actors and private sector investment are necessary to address the current dairy development challenges. Private sector investment must be encouraged to lead the transformation of the sector. The sustainability of commercial dairy development will only happen if the private sector fully participates and takes a lead in the overall development of the dairy sector.

Figure 1: Commercial dairy farm growth plan of Ethiopia



Source (Ten-in-Ten program)

Different developing countries have pursued a range of business models. Ethiopia adopted a government-dependent system to address improved breed supply through semen supply and AI services. The emerging practice and current focus of the government is, however, commercialization of breed improvement services. It could be realized by establishing and/or strengthening public or private sector-based improved heifer multiplication centers/ranches. Community-based multiplication helps to widen the base for improved heifer supply.

2.3.6 Dairy marketing

Dairy products in Ethiopia are channeled to consumers through both formal and informal dairy marketing systems. The informal milk market involves direct delivery of fresh milk by producers to consumers within the neighborhood and sale to itinerant traders or individuals in nearby towns. The term 'informal' is often used to describe marketing systems with minimal government involvement. Producers sell the surplus milk to their neighbors and/or in the local markets, either as liquid milk or in the form of butter and/or homemade fresh cheese (*Ayib)*. The characteristics of this system include the following: no license to operate, low cost of operation, high producer prices when compared to the formal market and no regulation of operation. The hygienic conditions of milk and milk products channeled through this system is also poor. This is mainly due to the prevailing situation where producers have limited knowledge on how to handle dairy products, coupled with the inadequacy of infrastructure such as cooling facilities and unavailability of clean water in production areas.

In the formal milk marketing system, milk is collected at the cooperative or private milk collection centers and transported to processing plants. In this system, milk quality tests are performed on delivery, thereby assuring the quality of milk. This has encouraged producers to improve the hygiene conditions, storage and transportation of milk in order to avoid rejection of the product upon delivery to collection centers. The formal milk market has been expanding in the last two decades with the private sector leading the dairy processing industry in Addis Ababa and other major regional towns. The vast majority of milk produced outside urban centers in Ethiopia is processed into products by the farm household and sold to traders or other households in local markets. Although the cost of different inputs into the dairy production varies and is constantly increasing, milk producers continue to earn minimal returns for their products. Formal milk markets are particularly limited to peri-urban areas and Addis Ababa. Over 85% of the milk produced by rural households is consumed within the producer households, with the proportion marketed being less than 7%.

2.3.7 Value addition

There are over 40 dairy processing companies in Ethiopia, with a total processing capacity of 1.2 million liters per day (TRAIDE Ethiopia 2021). From 2010, the number of processors increased from 18 to 40, and the volume of processed milk increased from 150,000 liters to 350,000 liters a day. These processors are currently operating at only 28% of their maximum production capacity. They process a mere 2.6% of the annual milk production of the country. This small proportion can mainly be attributed to the poor quality of the supplied milk, caused by poor handling, absence of cooling facilities, unstable power supply (Gebreselassie 2020), adulteration, as well as low supply of milk within the formal system. Shortage of supply is also linked to the limitation in the collection domain of processors around main roads, while producers located far from main roads are struggling with lack of access to markets, as milk collectors do not reach remote areas. Processors collect milk from milk collection centers (MCCs), cooperatives and unions, private milk collectors and/or individual farmers. They produce fresh milk, pasteurized ultra-heat-treated (UHT) milk, fermented milk, fruit flavored (UHT) milk, cream, butter (used to make bread, cosmetics, table and cooking butter), cheese (e.g. gouda, mozzarella, cottage cheese, provolone, smoked, ricotta, fontina, feta and cream cheese), and yoghurt (natural and fruit flavored).

2.3.8 Dairy products quality and safety

Milk is the most popular food for human consumption and is considered a complete and nutritious food. However, it serves as an excellent growth medium for a wide range of microorganisms. In Ethiopia, the major source of milk is smallholder farmers where milk hygiene and safety standards have failed to meet the requirements due to improper handling practices, poor quality and safety of the feed, poor pre-milking and post-harvest handling practices like improper storage, transportation and retailing (Tsedey and Asrat 2015; Fufa et al.

2019). Milk quality and safety is also affected by the health and hygiene of the dairy stock, environment, available storage facilities and management (FAO 2013). Lack of enforcement of milk quality and safety standards, which include the use of poor quality livestock feed and non-food grade containers for milking and transportation, inconsistent testing and rejection at collection points, is an entrenched problem. This is further exacerbated by limited consumer awareness, processor competition for milk volumes at the expense of quality, lack of quality-based payment for farmers, and poor milk handling practices along the value chain. Consumption of poor quality and unsafe milk can pose several hazards to human health. Unsafe milk may contain food-borne pathogens and toxic chemicals from fungi (aflatoxin) that cause diseases. Moreover, antibiotic residues in milk may cause antibiotic resistance, which makes treatment of illnesses more difficult. A milk quality control system will test milk and milk products for quality and safety, and ensure that producers, collectors, processors and marketing agencies follow the proper procedures.

2.4 Dairy cattle improvement in Ethiopia

2.4.1 Research in dairy cattle genetic improvement

Existing sources indicate that modern dairying started in Ethiopia in the 1950s. The first attempt to improve dairy production involved receiving of 300 Friesian and Brown Swiss dairy cattle in 1947 from the United Nations Relief and Rehabilitation Administration. In addition, 109 in-calf Holstein heifers were imported from Kenya in 1959 (Amsalu 2012). The modern dairy development efforts were thereafter adopted by various institutions. Agricultural teaching institutions, namely Jimma Teaching School, Ambo Agricultural School and College of Agriculture at Alemaya (now Haramaya University) are pioneers in dairy research for development in Ethiopia. The adaptation of purebred Friesian as well as their crosses with native Zebu in terms of milk production was studied by Haramaya University at the university center since 1963.

The centralized livestock research was launched in 1966 in four livestock research stations, namely, Holeta, Bako, Adamitulu and Melka-Werer. Data were pooled from these stations for overall evaluation. The program began by assessing the different characteristics and milk production potential of four indigenous Zebu cattle, namely Borana, Horro, Barka and Fogera, which are considered distinct and relatively uniform, and represent different agro-ecologies of the country. The assessment conducted by then indicated that the average lactation milk yield from 4–6 lactation records of each of these indigenous breeds did not exceed 700 liters under relatively improved management conditions.

Several projects were later launched, all aimed at improving these indigenous cattle for milk production. The contribution made by the Chilalo Agricultural Development Unit (CADU) is worth mentioning as the first step in introducing crossbreeding at farm level. After recognizing the possibilities of genetic improvement through crossbreeding, similar development units like Wolaita Agricultural Development Unit (WADU), funded by the World Bank, was established and made an immense contribution.

Results of the series crossbreeding program from different projects revealed a dramatic milk improvement of 300–500% over the performance of the indigenous breed. As a result, a long-term crossbreeding research program was proposed in 1972. The exotic breeds used were Friesian, Jersey and Simmental. The study involved contemporary comparisons among the first generation (F1), second generation (F2) and ¾ exotic breeds. The performance of 50% and higher grade crossbred dairy cows were evaluated and recommendations made for different production systems. However, the genetic progress made so far was not commensurate either with the genetic resources available or with the efforts made to improve them due to several impediments. A major reason could be that projects were limited to specific areas and failed to address issues affecting other parts of the country. Therefore, formulating an operational strategy that could evaluate applicability of technologies and capacity building in the use of modern technology was a challenge.

2.4.2 Research in assisted reproductive biotechnologies

Reproductive biotechnologies are a set of methods, procedures or operations whose main purpose is to maximize genetic potential and to obtain more offspring under optimal conditions beyond the characteristic limit of the species. Thus, acceleration of reproduction management, optimization of biological and economic output at farm level and genetic improvement are some of the advantages that this technology could provide for the livestock industry. AI, recognized as the best biotechnological technique for increasing reproductive capacity, has received widespread application in large farm animals, and is the first and only technology applied in Ethiopia with some success recorded. However, the conception rate in field AI programs, as in other developing countries, is very low, and therefore the desired effect in terms of animal genetic improvement and increase in the number of breeding stock has not been achieved. AI with sexed semen brings about great advantages in terms of reduction of cost of acquiring breeding stock by a preferential use of female sexed semen and herd expansions. Hence, altering the sex ratio could increase the effectiveness of AI progeny testing programs, effective use of multiple ovulation and embryo transfer (MOET) and in vitro embryo production (IVP) programs, thus offering additional opportunities for the breeders.

Estrus synchronization is a manipulation of the reproductive process and reduces or eliminates the need to detect estrus and allows the herd manager to schedule breeding activities and create a more uniform calf crop. In the context of smallholders, hormonal estrus synchronization could be used to produce a large number of crossbred dairy animals within a short period of time, match calving with feed availability and improve the effectiveness and efficiency of AI services. Although there has been immense effort in research capacity building on application of assisted animal reproductive technology in EIAR with physical and human capacity building, further targeted training and expansion would enable the effective use of internal and external genetics in dairy animal development. Furthermore, mitigation of identified technical and non-technical constraints affecting the AI service efficiency (infrastructure, input supplies and skills gap) and effectiveness of estrus synchronization has to be the core points of intervention to utilize the potential of these technologies in improving genetics and the reproductive performance of dairy animals.

2.4.3 Research in animal feed and nutrition

Research on dairy animal feed and nutrition in Ethiopia in the last 50 years has covered aspects of feed resource development and utilization with a special focus on improved forage, natural pasture, crop residues, agro-industrial by-products and rangelands. To date, more than 70 improved forage varieties have been released for the different agro-ecological zones of Ethiopia. Beyond feed resources development, interventions in enhancing nutritional efficiency of dairy animals (cattle, goats and camels) and development of feed packages have been among the key areas of research. In terms of availing technological alternatives, development of multi-nutrient blocks, urea treatment, use of total mixed ration, application of effective microbes, use of strategic supplementation and application of early warning systems were the key thematic areas addressed to enhance nutritional efficiency of dairy animals.

Despite availability of information and technological alternatives, past research in dairy animal feed and nutrition were constrained by the piecemeal approach in technology/information generation, transfer, and extension. Possible reasons for low adoption of dairy animal feed and nutrition technologies include lack of adequate demonstration on comparative advantages of the technologies, lack of specialization in livestock production and underdeveloped market-oriented livestock enterprises, lack of inputs such as forage seeds, the overall low attention paid to feed development by the extension service, absence of private sector engagement and actor convergence in feed technology development, plus transfer/extension. Historically, most development efforts in Ethiopia in terms of feed resources have been associated with different short-term projects run by external sources, which lacked strategic and sustainable development approaches. Therefore, strong coordination and institutional linkages should be established among various actors (research, higher education, extension, seed enterprises, private sector, investment commission, etc.) for advancement and optimal utilization of feed and nutrition technologies for dairy animals.

2.4.4 Research in animal health

Rampant animal diseases have a negative impact on the economy in the form of production loss or loss of animals, the cost of health care, and imposition of trade bans on livestock products. It is also a public health threat due to zoonosis. Hence, investment in animal health research is important if livestock farmers are to benefit from the resource wealth and productivity potential. Moreover, competent animal health research is critical for the development of evidence-based policies and introduction of legislative measures to govern disease surveillance, prevention, control and eradication strategies.

Animal health research in Ethiopia was launched in the 1980s under the Department of Animal Science. Its main aim was to complement research in the improvement of dairy animals and offer veterinary services. However, in the early 1990s, the research was restructured at division level following decentralization of the political system. This led to the division of the national agricultural research system (NARS) into federal and regional agricultural research institutions (RARIs) and higher learning institutions (HLIs). With the establishment of EARO in 1997, animal health research was centralized and the National Animal Health Research Centre (NAHRC) from the regional animal health diagnostic laboratory based in Sebeta. Following the restructuring of NAHRC to form the National Animal Health Diagnostic and Investigation Centre (NAHDIC), animal health research in EIAR underwent a further restructuring process: Department, Program, and Division cross-cutting discipline (from 2007–2012), Case team (2013–2014), Commodity (2015–2016) and National program (from 2016 to present).

Despite the rigorous restructuring process, today, the animal health program is coordinating research in Holeta, Bishoftu, Werer, Asosa, Pawe, Kulumsa, Welkitie, Tepi, Jima, Ambo, Abobo, Debremarkos and Mehoni research centers. The EIAR animal health research program is working with different institutions and NGOs with the aim of improving livestock production efficiency, animal welfare and public health safety by developing improved animal health technologies and systems for disease control, containment, and prevention. An example is the identification of circulating local strains of some pathogens used for vaccine production (strains of FMD viruses, respiratory disease complexes, lumpy skin disease viruses). Currently, a number of research activities with respect to the dairy sector are focusing on mastitis, young animal mortality, abortion, respiratory diseases, tick and tick-borne diseases, internal and external parasites, vector-borne diseases, herbal medicines, public health and food safety. The diverse indigenous livestock resources and their production potential have not yet been adequately exploited. The incidences of endemic, emerging, re-emerging and zoonotic diseases, plus resistant pathogens are increasing over the years and remain major threats to the dairy operation at large. Thus, the realization of the dairy development strategy demands the existence of a strong animal health research wing.

2.5 Strengths, Weaknesses, Opportunities and Challenges (SWOC) analysis

Developing a country-specific dairy strategy that transforms the sector requires critical assessment of the opportunities and challenges, plus possible interventions.

Table 2: SWOC analysis for dairy development in Ethiopia

Strengths	Weaknesses	Opportunities	Challenges
2.5.1 Dairy genetic improvement			
2.5.1.1 Dairy genetics and breeding			
• Low external input requirement for milk and milk production • Most indigenous cattle, goat and camel populations characterized at phenotypic level and some at molecular level • Presence of a research program for dairy cattle, camels and goats • Presence of community-based breeding program initiatives for goats • Availability of some established dairy cattle breeding herds in different research centers, plus ranches and stations • Presence of institutional structure including MOA, LDI, EIAR, RARIs and universities • Availability of FTCs and livestock development agents at *Kebele* level and presence of dairy extension packages	• Low productivity of milk-producing animals • Inadequate supply of improved dairy breed of cattle, camels and goats • Limited breed choice of dairy cattle, camels and goats • Lack of strong animal records and traceability system • Poor logistics support and incentive mechanisms for dairy extension service • Inefficiency of dairy farms (synchronization, AI, MOET, etc.) • Inability to meet international sanitary and zoo/phyto-sanitary standards • Poor utilization of milk products • Absence of well-established and sustainable breeding program and schemes for different milk-producing animals • Uncontrolled animal movement and marketing • Low level of community involvement on genetic improvement of dairy animals • Poor and inefficient extension system (e.g. limited advisory and technical support for genetic improvement)	• Huge potential in terms of population, production and diversity of milk-producing animals (cow, camels and goats) • Conducive climate that supports high yielding dairy breeds • Availability of national dairy cattle, camels and small ruminant breeding policy and research strategy • Availability of research centers, HLI, LDI and other organizations working on the dairy value chain • Presence of professional associations (ESAP and EVA) • Growing demand for milk and milk products • Attention given to the dairy sub-sector by government bodies, donors and other funding organizations • Capacity building at various levels (HLI, EIAR, RARI, ATVET and others) • Presence of international research centers (ILRI, ICARDA) providing backstopping for the NARS	• Low productivity of indigenous dairy animals • Poor reproductive performance of indigenous animals • Climate change/recurrent drought • Small herd and flock size in highland areas • Mobility in pastoral areas • High prevalence of animal diseases

Strengths	Weaknesses	Opportunities	Challenges
	• Genetic erosion and dilution among indigenous cattle • Negative selection (selling and castrating fast-growing young bulls (cattle, camels and bucks) • Critical shortage and inefficiency of multiplication centers for breeding animals and conservation of indigenous animals • Absence of animal breeders' society • Lack of well-organized and consistent breeding program (with defined breeding goals) designed particularly for dairy camel improvement • The indigenous cattle, camel and goat population are not adequately characterized, especially at molecular level • Poor intra- and inter-institutional collaboration and partnerships • Underutilization of technologies to promote production and productivity of dairy animals • Lack of strong quality standard (certification) and regulatory mechanism for dairy breeds		
2.5.1.2 Assisted reproductive technology in dairy cattle, camel and goat breeding			
• Widely adapted use of cattle AI and ES in cattle breeding in the country • Existence of regional AI centers and LDI • Existence of substantial number of cattle AI technicians in different agro-ecologies throughout the country	• Poor expertise and lack of infrastructure for the wider application of ART in wider dairy production potential areas • Poor efficiency of AI service and delivery system • Absence of regulatory service on the quality assurance of semen and AI service	• Availability of policy and government support in utilization of modern reproductive biotechnologies for dairy cattle breeding • Tax exemption on all reproductive biotechnology tools and technologies, plus ease of transportation	• Low level of trust on reproductive technologies of dairy cattle breeding • Poor/No recording system on reproductive performance

Strengths	Weaknesses	Opportunities	Challenges
• Initiation of private cattle AI services • Initiation of cattle ART research and teaching in NARS & HLI in the country • Availability of ART-related facilities, supplies, technologies and germplasms in the global market • Existence of livestock breeding policy, LSA, agricultural biotechnology research strategy, livestock research strategy etc., • Identified dairy development corridors in the country	• Lack of baseline information on reproductive potential and characteristics of indigenous breeds • Low adoption of reproductive technologies other than conventional AI • Low availability/absence of technology tools for camel and dairy goat breeding in the country • Lack of hands-on practical training in the HLI on artificial breeding of dairy animals	• Initiation of teaching and trainings of biotechnologists in universities and TVETs	• Dependence on imported inputs and some technologies for dairy animal breeding, • Weak capability of private sector investment on technological input supplies • Lack of involvement of private sector in semen and other inputs production • Critical shortage of ranches and multiplication centers for dairy cattle, camel and goat breeds
2.5.2 Dairy feeds and nutrition			
2.5.2.1 Institutional dimension of dairy feeds and nutrition			
• Presence of key public institutions (MOA, higher learning institutions, and federal and regional agricultural research) • Presence of NGOs and the private sector • Presence of Ethiopian Animal Feed Industry Association (EAFIA) • Professional societies (ESAP, EVA)	• Absence of strong linkage and complementarity among public institutions (teaching, extension, research, regulatory, and standards) • Poor linkages among public, private companies, farmers' organizations, and NGOs • No national platform for the private sector	• The move toward pluralistic extension • Presence of ILRI gene bank and biodiversity institute	• Absence of feed processing sub-sector representation in the agricultural research and extension linkage at various levels
2.5.2.2 Supply and quality of basal dairy feeds			

• Presence of packages of:
  • Improved forage production
  • Pasture/range management &
  • Forage crops
• Presence of government initiatives for sustainable forage intensification
	• Absence of national policy and strategy for sustainable use of grazing land
	• Limited attention and awareness by community and public institutions about best practices and packages
		• Presence of grazing lands and rangeland resources
		• Existence of traditional institutions for management of community grazing land resources.
			• Population pressure, conversion of grazing lands to crop lands, and environmental change both in the highlands and lowlands

Strengths	Weaknesses	Opportunities	Challenges
	• Limited forage seed and planting material supply • Lack of incentives for forage seed production investment • Absence of modern database on grazing resources (location, coverage, status)	• Availability of suitable agro-ecologies for forage production under irrigation and rain-fed conditions • High demand for livestock and livestock products • Increasing demand for quality livestock feeds in the local and export market	• Limited land allocation for dairy • High investment requirement for improved forage production and range resources
• Government commitment towards irrigation-based agricultural development	• Limited awareness in economic benefit of forage production under irrigation • Lack of compelling evidence on economic benefit of irrigation-based forage production	• Availability of water for implementing irrigation-based feed development. • Availability of irrigation potential for forage development in high livestock production potential areas • Opportunity for job creation to women and youth	• High investment cost for irrigation schemes
• Presence of farmers' experience in use of crop residues as livestock feed	• Little attention given to improve, conserve and utilize crop residues • Limited knowledge on the potential of crop residues as livestock feed in some areas	• The presence of proven and emerging technologies to conserve crop residues (densified block and TMR) • Increasing price of milk attracting investment in feed production	• Wastage of crop residues and lack of proper storage • Low nutrient density and bulkiness
2.5.2.3 Supply and quality of feed ingredients and compound feeds			
• Increasing trend in the number of food processing industries producing by-products for livestock feed	• Absence of regulations to control marking of industrial byproducts created a gray area for ever increasing prices of animal feed	• Development of agro-industrial parks	• Unregulated price and high interference of middlemen in marketing
• Presence of feed processing companies, and farmers' unions engaged in compound feed production	• Lack of proper marketing channel for feed ingredients and compound feeds • Low production level of compound feeds	• Emerging trend on value addition of agricultural commodities • Macro-economic policy supporting investment and commercialization	• Lack of sustainable and adequate supply of feed ingredients • High cost of ingredients and compound feed

Strengths	Weaknesses	Opportunities	Challenges
• High potential for increased domestic production of compound feed and ingredients	• Underutilization of some potential feed resources (sugarcane by-products). • Limited knowledge of ration formulation for different animal species • Inadequate policy support • Limited financial support for investment in the area	• Emerging trend in intensification of livestock production demanding quality feeds • Possibility of attracting domestic and foreign direct investment in specialty feed ingredients	• Limited direct and efficient market linkage of ingredient producers and compound feed producers • Limited technical capability to support production of formula feeds, and utilization of agro-industrial by-products • Absence of domestic production and reliance on importation and high cost of premixes and feed additives
• The move towards exporting agricultural products after value addition	• Exporting agricultural products without value addition • Limited investment in processing of agricultural products	• Emerging trend on value addition of agricultural commodities • Macro-economic policy supporting investment and commercialization	• Agro-industries are running below their capacity due to shortage of raw materials, which affect compound feed processing • Feed companies operating below installed capacity • Continued export of whole grain of oil seeds
2.5.2.4 Rangeland rehabilitation, restoration and conservation			
• Presence of formal (government) and informal (community) pastoral institutions	• Fragile rangeland demanding proper management • Lack of proper understanding of rangeland and pastoral livelihood by policy makers • Land degradation (e.g. vegetation, soil)	• Availability of research centers/research strategies • Availability of undergraduate and graduate programs on rangeland management	• Climate change/variability and drought • Lack of clear policy on rangel and land tenure system • Restriction of mobility

Strengths	Weaknesses	Opportunities	Challenges
	• Lack of appropriate pastoral training centers with a focus on rangelands • Knowledge gap on the status of rangelands	• Availability of different rangeland management projects	• Expansion of alien herbaceous and woody species • Inter- and intra-clan conflicts
• Policy focus to pastoral areas	• Weakening of pastoral customary institutions	• Presence of early warning system and implementation manual	• Frequent drought and poor preparedness • Poor drought response mechanism
2.5.2.5 Feeding system/nutrition of different categories of dairy animals			
• Long years of research experience and strategic supplementation, plus feeding packages for various categories of dairy animals	• Limited on-farm demonstration and technology transfer initiatives • Limited efforts in digitalizing promising technologies • Mismatch between nutrient requirement and supply for various categories of dairy animals	• High demand for improved feed technologies and information • High potential for compound feed/ ingredient, forage crops and range development • Strategic supplementation based on the quality of basal diet and productivity level • Expert advice and use of home- made mixture	• Land allocation for forage development • Limited supply and ever-increasing feed price • Limited supply of feed ingredients and compound feed
2.5.2.6 Supply of feed inputs (forage seed, fertilizer) and machinery (feed processing equipment, mower, baler, tractor, chopper)			
• Huge demand for inputs in domestic and regional markets	• Lack of experience in responding to market signals	• Policy supports for investment	• Lack of working experience and competence
2.5.2.7 Dairy feed safety and quality regulation			
• Presence of national institutions (Ethiopian Agricultural Authority and Ethiopian Standard Institute)	• Limited public awareness on feed quality and safety standards	• Use of public media and electronic means for public awareness creation	• Traditional society and institutions that are not product quality and safety conscious
• Emerging private institutions in feed safety and quality analytical service	• Limited analytical capacity in service delivery	• Possibility for domestic/foreign direct investment	• Expensive analytical service charge

Strengths	Weaknesses	Opportunities	Challenges
2.5.3 Climate smart dairy development			
2.5.3.1 Climate change/variability and greenhouse gas emissions			
• Government commitment to build green economy	• Lack of attention in targeting climate change and mitigation • Lack of tailor-made livestock extension	• Global and national focus on climate change and green economy • Donors and development partners interested in sustainable production systems	• Limited human, physical and financial capacity
2.5.4 Biosecurity and dairy health management			
• Presence of a number of regional laboratories and national animal health institutes (AHIs) engaged in disease investigation and diagnostic services • Existence of animal health and animal biotechnology research programs in EIAR • Presence of domestic institute producing vet. vaccines • Functional quality control laboratory to ensure quality and safety of animal products • Availability of animal health clinics and health posts at the village and PA levels • Existence of established surveillance system and risk analysis • Availability of control strategy with implementation guidelines for some priority diseases of dairy animals (CBPP, LSD, FMD, tryps, brucellosis, TB, etc.)	• Weak regulatory service on dairy biosecurity, food safety, drug use, movement control • Unavailability of strong unit accountable for rapid response in epidemics and disasters • Lack of institute specifically dealing with diseases affecting dairy sector and veterinary public health • Weakness in regulation of dairy professional competency • Limited share of private sector in veterinary service, pharmaceutical and diagnostic kits • Shortage of veterinary inputs (vaccines, equipment and drugs, quality laboratory consumables) • Lack of national dairy herd/flock health management guidelines and biosecurity guidelines and standards • Poor infrastructure development (electric power, transportation, cold-chain facility) needed for competent veterinary services • Unavailability of post entry quarantine for imported animals	• Availability of policy and strategy documents on livestock development (dairy cattle breeding policy and strategy, LMP, feed strategy, disease control strategy, CRGE, etc.) • Establishment of the Ethiopia Agricultural Authority that plays a regulatory role • Expansion of colleges and universities creating skilled human resources in veterinary and dairy/animal biotechnologies • High demand for food of animal origin • Availability of advanced dairy technologies in the global market • Presence of rich indigenous knowledge and herbs (ethno-veterinary practice) • Implementation of control and eradication program for PPR (goat disease	• Uncontrolled animal movement within and along borders • Occurrence of emerging and re-emerging diseases due to climate change, natural and manmade hazards • Existence of rampant diseases and disease vectors • Market inflation and scarcity of foreign currency for importation of veterinary inputs • Drug resistance

Strengths	Weaknesses	Opportunities	Challenges
	• Lack of evidence on economic impact of animal diseases on dairy industry • Limited access to wide range of drugs and vaccines, plus technologies used for dairy animal disease control • Lack of implementation of the identification and traceability system		
2.5.5 Dairy product quality and safety			
• Government focus on dairy sector development with special attention on quality and safety improvement • Development and approval of 10-year perspective plan to improve dairy product quality and safety • Government commitment to develop milk marketing channel to link with IAIPs (Integrated Agro-industry Parks)	• High post-harvest losses and safety problem due to lack of market, lack of cooling facilities, inefficient transportation, lack of appropriate technology, underdeveloped milk processing and marketing system • Weak coordination of value chain actors in maintaining quality and safety • Poor quality and inadequate hygienic practices at farms, milk collection centers, transportation and storage/bulking, plus marketing dairy products • Limited access to food grade milking utensils, storage, transportation and chilling equipment; and facilities at collection centers and different segments • Limited and unreliable supply of utilities (electricity, clean water, etc.) mainly in rural areas • Limited access to credit and financial services to improve milk quality and safety • Lack of quality-based payment system • Weak law enforcement of hygiene and safety regulations to prevent adulteration of milk	• High demand for safe, high-quality milk and milk products with a long shelf-life • Presence of development partners and stakeholders supporting the government on the issue of dairy product quality and safety • Presence of standards for safety and quality of milk/milk products sourced from cattle, camels and goats • Increasing camel milk demand in neighbouring and Middle East countries • Presence of dairy processing, collection, IAIP, dairy unions and cooperatives	• Unavailability of food grade milk handling materials • No system for control of antibiotics residue • Illegal importation of sub-standard dairy products (implications to human health)

Strengths	Weaknesses	Opportunities	Challenges
	• Limited capacity of personnel on milk cold chain maintenance and laboratory testing equipment		
2.5.6 Dairy business management, market development and support for commercialization			
2.5.6.1 Dairy business development services			
• High government priority and development of initiatives to promote the dairy sector • Existing institutional arrangement/ government structures • Existing institutional capacity	• Limited understanding of dairy as a business • Poor development of dairy business services • Limited business models to access inputs and marketing of outputs • Poor business enabling environment • Poor focus on dairy entrepreneurial skill development	• Expansion of business incubation centers • Emerging experiences in Agricultural One Stop Service (AOSS) centers • Increasing demand for milk and milk products • Diverse agro-ecology for dairy production • Improved awareness of consumption of dairy products • Trainable human resources (youth, graduates) • Emergence of integrated agro-processing industry parks in the country	• Limited understanding of the dairy business and poor business development capacity • Inadequate infrastructure to support the development and expansion of dairy business services • Limited incentives to encourage business service provision • High initial investment for dairy farming and dairy processing • Shortage of foreign currency allocated for importation of capital goods
2.5.6.2 Dairy market development			
• Attempts to distribute cold chain facilities for milk collection and transportation • Emergence of integrated agro-processing industry parks in the country • Development of dairy marketing legal framework • Initiatives to develop milk collection centers	• Poor regulatory system • Poor transportation facilities, market infrastructure • Limited access to market information • Poor promotion of the nutritional value of dairy products • Weak implementation of collection centers • Unorganized marketing system • Lack of quality-based milk marketing system	• Promotion of dairy as priority development interventions in the food system transformation process • Rapid increase in demand for milk and milk products • Increasing demand for camel and goat milk • High dairy product import demand in neighbouring countries (Somalia, Kenya, Sudan, Djibouti, Eritrea and South Sudan)	• Poor infrastructure for dairy marketing • Lack of protection for local producers • Lack of legal framework on out-growers scheme • Absence of strong regulatory body and weak enforcement of dairy marketing legal framework

Strengths	Weaknesses	Opportunities	Challenges
	• Inadequate bulking and transportation systems • Lack of trained technicians to install and maintain cooling facilities	• Continental free trade partnership and duty free/quota free privilege • Development of integrated agro-processing industries • Increasing supermarkets and international hotels and restaurants • Presence of vibrant airline and development of railways • Emerging school feeding initiatives • Presence of Milk Day Event for promotion of milk consumption	• Weakness in sustaining collective action • Limited concern for consumer safety • Seasonality of demand for dairy products • Lack of business ethics • Lack of clear dairy input marketing business models

2.5.7 Investment in dairy farming and processing industry

• Government commitment to developing the dairy sector (Homegrown economic reform like Ten-in-Ten initiative) • Presence of system to develop/amend incentive packages • Presence of relevant government structures to support dairy investment • Experience in commercial dairy • Emergence of integrated agro-processing industry parks in the country • Existing institutional capacity	• Poor ease of doing business in the dairy sector • Exclusion of the dairy sector from provision of essential incentive packages (tractors, trailers and their spare parts) • Lack of organized dairy information system • Shortage of experienced personnel in dairy management	• Diverse and suitable agro-ecologies for dairy investment • Diverse species and breeds of dairy animals for crossbreeding and setting up ranches • Positive economic outlook (population growth and increasing demand for dairy products, improved awareness of dairy products consumption) • In vestment protection against nationalization /expropriation	• Limited access to land and longer land transferring procedures • Limited incentives to encourage private sector • Lack of commitment in enforcement of land use plans (replacement of dairy farms by other enterprises) • Poor access to finance • Limited foreign exchange allocated for import of dairy goods and equipment • Considering dairy investment as urban organic waste • VAT on dairy products discourages value addition

Strengths	Weaknesses	Opportunities	Challenges
		• Supportive policy (nutrition-sensitive agriculture, job creation, food security, import substitution, industrial parks development) • Easily deployable human resource • Availability of diverse financial institutions	
2.5.8 Dairy extension/coordination and linkages			
• Dairy is a government priority sector • Presence of reform institutional structure (MOA-LDI, TVET, research, and others) and agro-industry park • Presence of different dairy projects led by development partners • Existing FTCs, and PTC services for farmers and pastoralists • Experience of the farmer in dairy farming in the cluster (like Bure, etc.) • Availability of pilot dairy digital extension service (PAD)	• Weak linkages among dairy value chain actors • Weak institutional coordination • Lack of inclusive dairy extension advisory service • lack of extension specific to the dairy sector • Lack of competency among extension agents (DAs) • Weak promotion and practical demonstration of dairy technologies • Lack of platform for dairy value chain actors • Weak PTCs extension service in most pastoral and agro-pastoral areas • Low technology application in FTCs and PTCs for dairy demonstration practice	• Presence of research centers, universities, ATVET • Development of 10-year perspective plan and Ten-in-Ten initiative for dairy sub-sector • Involvement of development partners in the dairy value chain • High demand for milk and milk products • Availability of information channels (TV, radio, and print media) to promote dairy and dairy products • Expansion of urbanization and emerging middle-income society	• Weak link between research and extension • Unattractive incentives for extension agents • Poor access to ICT infrastructure and services • Seasonal movement of pastoral community • Recurrent drought in pastoral areas • Conflict among pastoral communities due to limited resources (pasture and water) • High turnover rate of extension agents
2.5.9 Capacity building			
• Availability of researchers, experts, and AI technicians • Availability of structure for implementing on-farm dairy breeding activities	• Continuous turnover of experienced breeders, experts and AI technicians • Low level of breeding knowledge among experts, AI technicians and farmers	• The government's attention for human resource development • Availability of HLIs	• Inadequate budgeting for genetic improvement and capacity building • Limited focus on long-term training

Strengths	Weaknesses	Opportunities	Challenges
• Availability of AI centers and liquid nitrogen production plants in different parts of the country • Establishment of modern biotechnology laboratory at Holeta	• Shortage of sufficient number of trained AI technicians, experts and breeders • Limited coordination, complementarity and integration among MOA, research institutions, HLIs and other development institutions related to the dairy industry • Inadequate and un-sustained financial support for the promotion of the dairy sub-sector		• Inefficient procurement system for utilizing the available resources

2.6 Benchmarking

Benchmarking is a process of improving performance by constantly identifying, understanding and adapting best practices and processes followed inside and outside the industry and implementing the results (Dragolea and Cotîrlea 2009). The main emphasis of benchmarking is on improving a given business operation or a process by exploiting best practices. There are two types of benchmarking, namely, internal and external. Internal benchmarking involves benchmarking against its own units or branches, for instance, business units of the company situated in different locations. External benchmarking is used by companies to seek the help of organizations that have succeeded on account of their practices. This kind of benchmarking provides one with an opportunity to learn from high-end performers.

Targets to transform the Ethiopian dairy sub-sector into a regionally and globally competent entity by 2030 was benchmarked against Brazil and India (Table 3). These countries have well developed dairy research and development platforms, and have made significant progress in dairy development and research. Therefore, Brazil and India are used as reference points in the preparation of Ethiopia's 10-year Dairy Sector Development Strategy.

2.6.1 The Indian dairy sector

India is the world's largest producer of dairy products by volume, accounting for more than 13% of the world's total milk production. It also has the world's largest dairy herd. As the country consumes almost all of its own milk production, India was neither an active importer nor an exporter of dairy products prior to the year 2000. However, since implementation of the Operation Flood Program, the situation has changed significantly; domestic production increased, and importation of dairy products reduced to very small quantities. Since 2003, India has become a net exporter of dairy products. Yet, the country's share in global dairy trade remains minor, at 0.3% and 0.4% for exports and imports, respectively.

India's dairy sector has a unique smallholder milk production system, wherein more than 70% of dairy farmers own one to two animals. Dairying in India is more about livelihoods for about 80 million rural households than simply a business. It provides a stable cash flow compared to crop cultivation. There is a large network of dairy institutions, all providing market access to the dairy farmers. Around 60–70% of consumer money flows back to producers, which is the highest in the world. Milk is India's single largest agricultural commodity in terms of value, amounting to about USD 118 billion.

Having achieved the status of the largest milk-producing nation in the world, India offers a number of important lessons for dairy development, and the associated policies including the regulatory framework in food quality and safety, genetic improvement, milk processing and responding to demand for traditional products by the formal sector, market linkage and continuous support to the sector. The government of India issued and implemented a number of acts to regulate the food quality and safety issues. Prevention of Food Adulteration Act is the main food safety act that focuses on establishment of regulatory standards for food safety. The standard applies equally to domestic and imported foods including livestock products.

The Indian dairy sector has also benefited from the multiplier effects of the Green Revolution which brought dramatic change in the crop sector and related infrastructure development. The livestock sector benefited from improved irrigation infrastructure which enabled year-round availability of fodder and feed. Genetic improvement of dairy animals through selection and crossbreeding also played a key role in India's dairy development. The success of cattle crossed with exotic dairy genes offers important lessons for similar approaches in tropical settings.

India has more than 120 million goats and about 70% are nondescript and meat type (Pal et al. 2011). In 2017–2018, the country produced 6.16 million tons of goat milk which is expected to increase to 8.2 million tons in

2022–2023. Available information indicates that goat milk contributes about 3% of the total milk consumed in India. Each milking goat provides about 0.5 to 2 litres/day and is milked for about six months. A good quality dairy goat can produce up to 2.7 litres of milk per day.

Globally, the population of goats is showing an increasing trend. A similar trend has been observed in Ethiopia where the goat population has increased by about 214% between 1995 (about 16.7 million) and 2020 (52.5 million). According to CSA (2021), there are close to 3 million goats used for milking in Ethiopia. On average, these animals are milked for about 75 days with an average yield of approximately 0.5 litres per day. There are various options of increasing the milk production from goats in Ethiopia including increasing the population of goats to be used for milking, increasing the productivity of individual goats beyond 0.5 litres per day and increasing the lactation length of goats, among others. Hence, exploiting these genetic resources is important using the experiences of India as a benchmark.

2.6.2 The Brazilian dairy sector

The Brazilian dairy sector is the fourth largest dairy industry in the world. The number of milk cows in Brazil reached 19.7 million in 2016, according to the Municipal Livestock Research (IBGE 2018). This value is equivalent to 9% of the entire national cattle herd. Brazilian milk production grew even when cow numbers were falling because of impressive increases in milk yield per cow. The milk yield has been consistently increasing by 4.3% since 1993. Current average lactation milk yield per cow is about 2,849 litres for 50% crosses and 1,490 litres for indigenous breeds (Table 3). Because most dairy farms use grazing as the primary source of feed, milk production in Brazil exhibits a seasonal pattern. Monthly production in the fall months of April, May and June, when cool, dry weather slows grass growth, is 20–25% less than during the warmer, wetter spring and summer months. Brazil's milk production is much more stable than in countries such as Ireland that rely even more heavily on rotational grazing and seasonal calving. Hence, seasonality does not appear to present a significant problem for the processing sector or serve as a constraint to expanding exports.

Brazil's dairy processors are part of a rapidly evolving, multi-faceted industry. Fluid milk constitutes about one-third of total dairy products processed and marketed in Brazil. UHT milk represents 70–75% of fluid milk sold in the country. The informal market constitutes about 35% of the milk consumed in the country. Milk powder—a major export item for Brazil's dairy industry—represents a growing segment in the dairy processing business.

Brazil has a good supply of dairy service providers in the primary producing regions. Veterinarians are especially in ample supply. Many DVMs are employed in other segments of the dairy sector besides animal health. Concentrates, by-product feeds and dairy supplies appear to be readily available. Of particular note, the large frozen concentrated orange juice industry of Brazil is located in close proximity to the major dairy region, thus making citrus pulp readily available to most dairy farms.

Table 3: Proportion of cattle population, milk production and reproduction performances in Brazilian, Indian and Ethiopian dairy cows

Country	Proportion (%) of crossbred/ pure exotic	Lactation milk yield (kg/cow)		Lactation length (days)		Age at first calving (month)	
		50% cross	Indigenous	50% cross	Indigenous	Cross	Indigenous
Brazil	80	2,849	1,490	281	312	34.5	36.0
India	20	3,594	2,300	322	313	34.6	38.9
Ethiopia	2.7	2,200	550	340	230	36.3	45.0

3 Strategic issues and interventions

Based on the analysis of strengths, weaknesses, opportunities and challenges in the dairy sector, this section identifies the major strategic issues and interventions for development of the Ethiopian dairy industry. It begins with a brief description of the issues followed by a detailed Table that clearly outlines the short-, medium- and long-term interventions.

3.1 Description of strategic issues and interventions

3.1.1 Dairy breed improvement

In Ethiopia, despite the huge number of cattle, camels and goats for milk production, productivity remains disproportionately low when compared to other sub-Sahara African countries including Kenya and Sudan. The breeds available in the country are evolved for adaptive traits with multi-purpose uses and not specialized for a particular type of production. Low productivity of indigenous milk-producing animals, genetic dilution of indigenous animals through uncontrolled breeding, inefficient use of animal biotechnology, lack of national level animal recoding and traceability system, lack of emphasis on establishing different breeders' societies, lack of an agro-ecology-based dairy development strategy for milk-producing animals, and lack of improved heifer multiplication centers are the major strategic issues/challenges that should be addressed in order to transform the Ethiopian dairy sector.

With respect to assisted reproductive technology, various techniques have been developed and refined globally to obtain a large number of offspring from genetically superior animals or obtain offspring from infertile (or sub-fertile) animals. Among these techniques, artificial insemination, estrus induction and control, embryo transfer, in vitro fertilization, and sexed semen technologies have impacted the dairy sector and were promoted to the commercial dairy industry due to the double and more advantage they render to the producers. Artificial insemination, the most commonly used and valuable biotechnology, has provided dairy producers an opportunity to transform the herd structure through proper use of proven semen. It has been in operation in Ethiopia for over 30 years, but with minimal efficiency and impact in productivity and genetic improvement. A successful artificial insemination operation requires acquisition of quality semen, proper estrus detection, and ability to properly place the semen at the right place in the reproductive tract of the fully fertile and conditioned female animal. Estrus synchronization is the second most widely implemented technology with lower success in all regions in Ethiopia that participated in the campaign-based implementation. Nevertheless, in comparison with other AI, its impact has remained low due to a number of technical, system-related, financial and managerial problems. For instance, if proper levels of nutrition, the right body condition and health, plus heat management situations are not optimal, the program is likely to fail.

3.1.2 Dairy feeds and nutrition

Dairy is among the key and high value livestock commodities offering multiplier effects for boosting economic and social growth through vertical and horizontal linkages. Despite the presence of a huge resource base, dairy production in Ethiopia is constrained by limited supply/poor feed quality, traditional feeding practices and skyrocketing feed prices. Animal feed is a key determinant of biological/economic feasibility and environmental sustainability of dairy production since it accounts for about 60–70% of the total cost of production. The 10-year Ethiopian feed perspective plan and Ten-in-Ten initiative envisages increasing dairy feed production from 23 million tons in 2022 to 39 million tons in 2030. To realize this goal, it is worth identifying strategic issues and interventions on aspects of dairy animal feeds and nutrition. The major strategic issues limiting growth in the Ethiopian dairy feed and nutrition sector include poor institutional development, poor quality and insufficient quantity of feeds, poor rangeland rehabilitation, restoration and conservation, traditional feeding practices, limited private sector engagement, low participation of youth groups in production, processing and marketing of dairy feeds.

3.1.3 Biosecurity and dairy health management

The dairy sector in Ethiopia is highly influenced by widespread trans-boundary and production diseases that are prevalent in the country. According to data from the national animal disease surveillance system (DOVAR-II), anthrax, contagious bovine pleuropneumonia (CBPP), contagious caprine pleuropneumonia (CCPP), foot and mouth disease (FMD), lumpy skin disease (LSD), brucellosis, peste des petits ruminants (PPR), and trypanosomiasis are the most commonly reported diseases. These are also among the 15 prioritized national list of animal diseases in the country which are cited as important diseases in the livestock sector analysis report (Shapiro et al. 2017). Other diseases include mastitis, ecto- and endo-parasites. Young stock mortality, plus pre parturition loss due to abortion and stillbirth are the other factors that are hindering development in the dairy sector. Thus, a production system and species-specific young stock mortality reduction package should be implemented to reduce the mortality rate. This will help to increase the number of replacement stock in the herd/flock from 15% to over 35%, and will allow producers to increase their herd sizes. As informed by the SWOC analysis, the major biosecurity and dairy health issues to be addressed in this strategic plan are dairy biosecurity standards and guidelines, disease surveillance and traceability system, veterinary service delivery and accessibility of inputs, mortality of young stock, and regulatory service on standardization of inputs and dairy products. Addressing these strategic issues will play a key role in improving productivity and enhance the benefits from the dairy sub-sector.

3.1.4 Milk quality and safety

Despite its strategic importance, Ethiopia's dairy sector remains largely unregulated, with the bulk of milk sold in its raw (unprocessed) form in informal markets. Suppliers are paid based on the quantity of milk produced rather than on its quality. Since most consumers prefer to purchase low-cost raw milk, a major challenge for the dairy value chain production has been to make formal dairy marketing more attractive. Lack of adherence to milk quality and safety standards, which includes the use of poor-quality feed, non-food grade plastic containers for milking and transportation, and minimal testing and rejection at collection points, are among the entrenched problems. This is further exacerbated by limited consumer awareness, processor competition for milk volumes at the expense of quality, poor milk handling practices along the chain, and minimal enforcement of milk quality and safety standards. The major challenges that need to be addressed to improve the quality and safety of milk along the dairy value chain include:

- Poor dairy husbandry practices and dairy extension services to support quality and safety of milk production at farm level.
- Inadequate milk handling facilities and milk quality laboratory and required quality testing equipment at milk collection centers.

- Lack of technical, managerial and marketing skills in the dairy value chain to maintain the quality and safety of dairy products.
- Inadequate infrastructure, inappropriate transportation of raw milk and inconsistent testing of the product at delivery, bulking points and milk collection centers.
- Lack of milk quality-based payment system.
- Weak regulatory system.

3.1.5 Business management and market development

Marketing is the pooling factor in stimulating production and productivity improvement. It is effective in the creation of new and activation of the current demands if supported with effective promotion. Marketing facilitates the development of technical innovations and provides employment opportunities for all actors engaged in the dairy value chain. However, dairy and dairy products marketing is very complex and constrained by several factors related to product quality, lack of a strong regulatory system, poor infrastructure and lack of a well-coordinated system to lead the input and output marketing.

3.1.6 Investment in commercial farming and processing industry

The ten-year perspective plan of the Ethiopian government clearly promotes commercialization of the dairy sector. The government fully recognizes the potential for commercialization of dairy farming to increase production and create employment opportunities in rural, urban and peri-urban areas. The government program promotes the development of the sector through close engagement with smallholder and commercial farms. Government support for investment in dairy farming in Ethiopia aims to achieve multiple targets including increased production and productivity, plus job creation and improved livelihood for youth, women and other actors involved in the dairy value chain. Enhanced food and nutrition security, and achievement of targets set in the Ethiopian Food Systems Transformation Pathway are also among the targets of dairy commercialization in the country. Various regulatory and investment-oriented policy measures in the form of both fiscal (tax holidays, tax exemption, etc.) and non-fiscal (land allocation, one-stop-shop services, etc.) provisions will be put in place to bolster the government's capacity to support medium and large commercial farms.

3.1.6.1 Access to land

Access to land is typically one of the significant constraints that dairy entrepreneurs face when investing in new operations. Obtaining land for initial investment and expansion is extremely difficult. Land in Ethiopia is considered a public property. It can be leased by those who want to use the commodity. There are two broad classifications of land for rent or lease purposes: rural land is mainly used for agricultural purposes, while urban land is mainly used for industrial purposes or other activities. Land lease or rental rates differ depending on location. The lease price of rural land is set by authorities and may depend on factors such as the development level of the area, distance from all-weather roads, quality or grade of the soil, irrigation possibilities, and agricultural activity. The duration of the lease contract can also vary depending on the same factors. Land prices in urban areas can be set by auction. Companies that contribute to regional welfare can occasionally lease land without any payments.

3.1.6.2 Access to financial institutions and services

Though the financial sector in Ethiopia is liberalized, it is not adequately serving the dairy industry. Despite the availability of over 12 new private commercial banks and one cooperative bank, their involvement in provision of services is limited to large investors who are not usually interested in investing in the dairy sector. This is mainly

due to long reproduction cycles of the species that result in long gestation period for the investment in dairy cattle and camel farming, plus the overall high level of risk involved in livestock farming. These commercial banks have been involved in credit services through government incentives for special programs and NGO support.

The other major source of credit is from microfinance institutions (MFIs) that flourished after the issuance of Proclamation 40/1996, which provides for the establishment, licensing and supervision of microfinance institutions. Up to 2005, there were 23 licensed MFIs reaching about 905,000 clients in the country (Gobeze, 2005). Though most of the MFIs support the dairy sector, smallholder farmers are constrained by unfavorable loan sizes, repayment periods and the long application procedures. The maximum loan amount is Birr 5000, which is not enough to start a single dairy cow farm. According to the latest Directive No MFI/13/2002 (Ibid), the interest rates are high (up to 20%) when compared to the bank interest rate (7.5%). In addition, the ceiling interest rate can still be decided by the board of directors. The MFIs are also loosely linked to other actors in the service delivery system, including government personnel. This is because these institutions work independently once they obtain a certificate from the National Bank. Wolday (2002) pointed out that the National Bank of Ethiopia has limited capacity to supervise MFIs and there was no government department or other institution tasked to supervise or support these institutions.

3.1.7 Extension, coordination and linkages

Extension, coordination, and linkages are systems that facilitate access of farmers, their organizations, and other market actors to knowledge, information and technologies. It also facilitate farmer's interaction with partners in research, education, agribusiness, and other relevant institutions; and assist them to develop their own technical, organizational and management skills and practices. The Ethiopian dairy extension system is dependent on farmer training centers (FTCs), pastoralist training centers (PTCs) and trained DAs that provide extension services to farmers and pastoralists. FTCs/PTCs serve as entry points for providing effective and efficient extension services. They also serve as hubs for knowledge and information sharing and centers for promoting best practices. Proper documentation ensures that smallholder farmers can access crucial information in a timely manner, which consequently increases dairy production and productivity, thus addressing food insecurity. Successful dairy production knowledge and information management requires strong institutions, infrastructure, facilities and skilled human resources to generate, capture, store and disseminate tailor-made services to all farming communities.

3.1.8 Capacity development

Human and institutional capacity development in the Ethiopian dairy sector needs to be emphasized. The infrastructure development that plays a pivotal role in the production, processing and marketing, is inadequate. Labour, while affordable and abundant, lacks the necessary skills and therefore requires continuous training and education. Enhancing the capacities of institutions in both the public and private sectors (including research and development institutions) to support the breeding and multiplication of appropriate dairy animals, feeds, and animal health is essential. It is crucial that financial institutions enhance their marketing systems, and that conventional financial institutions provide working and investment capital to sustain the activities of dairy industry actors. They must come up with feasible and practicable development, research, extension and policy intervention options to help address the challenges and enhance dairy farming and processing efficiency.

3.1.9 Cross-cutting issues

Mainstreaming cross-cutting issues in any development intervention is critically important. The national cross-cutting issues in agricultural development comprise gender sensitivity, nutritional sensitivity and CRGE development initiatives. Besides the issue of human rights, there are strong economic reasons why gender

equality needs to be promoted across the agriculture sector. If equal access to agricultural inputs and support is not guaranteed, women will be less productive and will not share the benefits with their male counterparts. Similarly, failure to mainstream nutrition sensitivity and climate change issues in agricultural development, particularly dairy farming, limits the relative gains from the dairy sector. Therefore, this strategy document will significantly contribute to mainstreaming the cross-cutting issues. It will ensure that due consideration is given to the issues of gender and youth, human nutrition and climate change in the overall dairy value chain.

3.1.10 Monitoring and evaluation

Monitoring and evaluation (M&E) should be an integral part of all the interventions, generating reliable and timely data, and providing information to stakeholders and the ministry on progress of activities, results and outputs achieved, plus the challenges faced during implementation. The absence of a well-established M&E system in dairy development activities remains a key weakness. Hence, establishing context-specific and tailored M&E systems will have multiple benefits. Having a proper M&E framework enables the Ministry of Agriculture and other stakeholders to monitor and evaluate planned interventions and take appropriate corrective actions at different levels. This will help the ministry and its partners to fine-tune the strategic interventions and establish accountability during implementation. The M&E activities will be carried out by a group of experts in the ministry and partners at different levels.

3.1.11 Enabling policy and regulatory frameworks

An appropriate policy and legal framework that supports the private sector's active engagement will ensure transformation of the sub-sector. Hence, formulating and implementing comprehensive policy and legal frameworks is crucial for success in improving the production and productivity of the sector. Over the last six years, various policies and strategies have been developed and implemented in the Ethiopian dairy sector. The most important document that benefited the dairy sector was the livestock masterplan that was designed for implementation from 2016 to 2020. Even though the masterplan was phased out in 2021, the livestock sector analysis which contains scenario analyses for the dairy sector is still providing useful information for development of important policies, strategies, and emergence of important institutions like LDI, AHI and important systems like LITS, the national livestock breeding database and feedback system. The sector analysis was a foundational document that helped development of the livestock masterplan, livestock breeding strategy, feed development strategy, dairy cattle breeding strategy, camel breeding strategy, and small ruminant breeding strategy. Moreover, sample breeding programs for dairy cattle have also been developed based on this document.

As a result of recent moves by the United Nations Food Systems Summit that intended to realize the UN sustainable development goals (SDGs), the government of Ethiopia has developed its food systems transformation pathway (EFS_TP). This document is promoting a diet-centred approach in which dairy development has been highly emphasized. In line with this, MOA has developed and started implementing nutrition-sensitive agricultural development. Dairy sector transformation is at the heart of the nutrition-sensitive agricultural development policy. Today, dairy sector transformation initiatives, Ten-in-Ten and *Yelemat Tirufat* are active implementation tools at hand for the transformation of the sector.

A review of the Ethiopian dairy industry reveals that existing policy frameworks are characterized by multiple and complex laws and regulations touching on access to land and finance, supply of inputs, plus import and export of products. Access to land and finance for small- and medium-scale commercial production remains a key challenge, even in rural areas. Despite recent policy reforms to support the agricultural sector in general, inadequate incentives and subsidies, double taxation and issues related to import duty on dairy inputs, especially feed, are vital challenges which still require due attention. The role of the public and private sectors in providing inputs and services should also be clearly streamlined at different levels of the value chain. As indicated earlier, the current initiatives that aim to transform the dairy sector, Ten-in-Ten and *Yelemat Tirufat,* are designed to overcome these policy challenges and could result in a profound transformation in the sector.

3.2 Detailed strategic issues and interventions

Table 4 presents details of strategic issues and interventions for the Ethiopian dairy sector development in the short-, medium- and long-term, from 2022 to 2031.

Table 4: Strategic issues and interventions

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
3.2.1 Dairy animal breed improvement			
• Limited evidence on genetic characteristics of indigenous dairy cattle, camel and goat breeds	• Undertake phenotypic and genetic characterization • Undertake diversity and similarity studies of dairy animals genetic resource • Undertake performance evaluation of milk-producing animals • Identification and development of breeding objectives under different production systems for different milk-producing animals	• Undertake phenotypic and genetic characterization • Undertake diversity and similarity studies of dairy animals genetic resource • Undertake performance evaluation of milk-producing animals	• Genetic characterization of different dairy animals under different dynamic production systems

• Low productivity of indigenous milk-producing animals
  • Shortage of milk and milk products
  • Poor reproductive performance (long AFC, open days and CI)
	• Promote good dairy farming practices to enhance dairy productivity and reproductive performance
	• Improve performance of indigenous animals through selection
	• Strengthen the existing crossbreeding activities using ART (AI, ET, sexed semen) or improved bulls
		• Enhance dairy productivity and reproductive performance through good dairy farming practices
		• Improve performance of indigenous animals through selection
		• Strengthen the existing crossbreeding activities using ART (AI, ET, sexed semen) or improved bulls
			• Enhance dairy productivity and reproductive performance through good dairy farming practices
			• Improve performance of indigenous animals through selection
			• Strengthen the existing crossbreeding activities using ART (AI, ET, sexed semen) or improved bulls

• Shortage of improved breeding bulls/quality semen	• Strengthen the existing effort for improved bull/quality semen production for better efficiency and full capacity operation	• Establish new nucleus herd/new bull stations • Import improved bulls/quality semen	• Produce quality semen • Import improved bulls/quality semen

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Inadequate systems for conserving endangered breeds	• Implement the breed conservation strategy jointly developed by MOA and Ethiopian Biodiversity Institute (EBI) • Enforce rules and regulations, and capacitate institutions to conserve endangered breeds and take care of animal genetic diversity	• Enforce rules and regulations, and capacitate institutions to conserve endangered breeds and take care of animal genetic diversity	• Enforce rules and regulations, and capacitate institutions to conserve endangered breeds and take care of animal genetic diversity
• Absence of well-established dairy cattle, camel and goat breeds genetic improvement programs	• Identification and development of breeding objectives under different production systems for different milk-producing animals.	• Optimize the genetic improvement efforts using modern genetic improvement technologies • Establish nucleus breeding programs • Implement well organized breed improvement tools – Genomic testing, Marker assisted Selection/MAS, ART (AI, ET, MOET)	• Implement well organized breed improvement tools – Genomic testing, Marker assisted Selection/MAS, ART (AI, ET, MOET)
• Lack of focus on developing different breeders' societies	• Awareness creation on the need for dairy animal breeder societies	• Establish breeder societies on the identified breeds	• Operationalize and strengthen the established breeders' societies
• Genetic dilution of indigenous animals through uncontrolled breeding	• Awareness creation on dangers of genetic dilution	• Determine the level of genetic dilution • Adhere to breeding policy and strategies • Develop and implement mechanisms to control genetic dilution and incorporate into the existing breeding strategy	• Implement mechanisms to control genetic dilution and the breeding policy

• Insufficient use of dairy animal biotechnology
  • Inefficiency of estrus detection
  • Inefficiency of AI services
  • Limited/no use of ET technology
	• Evaluation of breed response, testing & standardizing synchronization protocols for dairy animals (cattle, camel, goat) breeding
	• Exercising estrus characterization in dairy cattle for indigenous breeds
	• Develop necessary facilities for embryo production, preservation and transfer and adapt protocols for quality evaluation and implementation
	• Develop standards for animal handling facilities compatible to different breeds and species of animals
		• Timely optimization of synchronization protocols
		• Construction/maintenance of animal handling facilities for different species of dairy AI service
		• Import quality semen (sexed and unsexed), embryo, and live animals
		• On-the-job training of experts on anatomy and reproductive physiology of dairy animals
			• Timely optimization of synchronization protocols
			• Maintenance/construction of animal handling facilities for different species of dairy AI service
			• On-the-job training of experts on anatomy and reproductive physiology of dairy animals

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
	• Construction of animal handling facilities for different species of dairy AI service • On-the-job training of experts on anatomy and reproductive physiology of dairy animals • Encourage and promote innovative research to develop alternative technologies for AI and heat detection in dairy animals • Set standard regulatory modality to control AI kits, quality of produced/imported semen and devising monitoring schemes • Develop standards for AI technicians to service ration and implementation modalities (guidelines) • Develop human capacity for ART	• Encourage and promote innovative research to develop alternative technologies for AI and heat detection in dairy animals • Monitoring and evaluation to ensure proper implementation of standards on AI facilities and service delivery guidelines	• Encourage and promote innovative research to develop alternative technologies for AI and heat detection in dairy animals • Monitoring and evaluation to ensure proper implementation of standards on AI facilities and service delivery guidelines
• Gap in the competence and effectiveness of the AI training system	• Implement occupational standards developed for AI technicians at some agricultural colleges • Review and standardize curriculum for training of AI technicians • Develop strong monitoring and evaluation system to ensure production of the required quality of human resources	• Regular training of AI technicians • M&E of the training system • Review of the curriculum	• Regular training of AI technicians • M&E of the training system • Review of the curriculum
3.2.2 Dairy feeds and nutrition			

• Limited supply and quality of dairy animal feeds	• Inventory of feed resources available for dairy animals
	• Training of trainers document/module, preparation and training for capacity building of experts, DAs, dairy farmers and pastoralists on feed production and utilization
		• Implementation of feed development for dairy cattle:
		  • Improved forage (ago-ecology based)
		  • Natural grazing and rangeland
		  • Crop residue management, improvement, and utilization
		  • Agro-industrial by-products and compound feed
		  • Specialty feed ingredients (premix, vitamins and mineral supplements)
			• Continue implementation of feed production for dairy animals

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Unavailability of special feed ingredients (premix, vitamins and mineral supplements) in domestic markets	• Explore potential for domestic production (demand and resources for production) • Encourage foreign and domestic investment in the sector	• Encourage foreign and domestic investment in the sector • Follow-up and support to investors	• Encourage foreign and domestic investment in the sector • Follow-up and support to investors
• Degraded rangelands	• Assessment, delineation, and mapping of rangelands based on extent of degradation (light, medium and heavy) • Implement available rehabilitation technologies for bush encroachment and invasive plants • Implement animal impact tool for range management and rehabilitation • Implement feed conservation practices • Implement appropriate soil and water conservation structures and biological interventions suitable for rangeland rehabilitation	• Scaling up of available and additional rehabilitation technologies for bush encroachment and invasive plants • Scaling up of animal impact tool • Scaling up of appropriate soil and water conservation structures and biological interventions suitable for rangeland rehabilitation • Implementing feed conservation practices, continued • Review of progress, challenges and lessons learned	• Scaling up of rehabilitation technologies for bush encroachment and invasive plants, continued • Scaling up of animal impact tool, continued • Scaling up of appropriate soil and water conservation structures and biological interventions suitable for rangeland rehabilitation, continued • Implementing feed conservation practices, continued • Review of progress, challenges and lessons learned

• Reliance of the rangelands on highland areas for feed during drought seasons	• Initiate schemes for feed production and feed reserve under lowlands (in good years where possible) through:
	  • Identification of forage production potential of rangelands during good rainy seasons
	  • Build on experiences of sustainable land management (SLM) projects in pastoral areas to close some areas for rehabilitation.
		• Awareness creation and skill training for youth in pastoral areas in forage conservation
		• Encourage inclusive engagement of highland forage producers in the pastoral areas
		• Proper business enabling actions (finance, facilities, etc.)
		• Forage harvesting and conservation
		• Implement schemes for feed production and feed reserve under lowlands (in good years where possible)
			• Awareness creation and skill training for youth in pastoral areas in forage conservation
			• Encourage inclusive engagement of highland forage producers in the pastoral areas
			• Forage harvesting and conservation

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
	• Create ways of experience sharing and business models to enable pastoral youth learn from highland forage producers • Encourage highland forage producers to join pastoral areas through formal business models identified and agreed upon • Harvesting and storage of forage during good years to use them as buffer for drought seasons		• Continue implementation and review of progress
• Traditional feeding practices for different categories of dairy animals	• Preparation of guidelines for improved feeding package for various categories of dairy animals	• Implementation of best-bet feeding practices for different categories of dairy animals and intended production level: • Calf, kids, lamb • Heifer, doe • Pregnant cows, goats, camels • Lactating cows, goats, camels • Dairy bulls, bucks	• Continue implementation of best-bet feeding practices for different categories of dairy animals and intended production level • Review of progress, challenges and lessons learned
• Limited private sector engagement in commercial dairy feed development	• Develop business plan and financial feasibility of commercial scale production of cultivated forages in selected agro-ecologies • Identify and put in place the required incentives for commercial scale production of animal feed • Establish platform for private sector engagement • Develop and implement incentive mechanisms to access land, credit and other inputs for forage and forage seed production • Scoping study on demand and supply of forage seed/planting material in Ethiopia • Mapping actors engaged in multiplication of forage seeds/planting material	• Implementation of special incentives in dairy feed, forage herbage/seed production and feed ingredients: • Availing land, credit, and other incentives • Encouraging contract farming among feed ingredient suppliers and processors • Market development for forage seeds and forage planting materials	• Implementation continues • Monitoring and evaluation of private sector engagement in forage and feed development

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Limited private sector engagement in improved feed technology multiplication	• Map specific areas of feed technology worth considering for private sector involvement • Promote PPP and delivery models for enhanced access to multiplication and utilization of existing feed technologies	• Continue implementation of PPP • Support full scale engagement of private sector in improved feed technology multiplication • Results-based monitoring and evaluation and make refinements	• Continue implementation • Undertake final evaluation and draw lessons for subsequent action

• Limited participation of youth groups in dairy animal feed production, processing, and marketing	• Review of higher education and TVET curriculum on animal production to include practical, hands-on training on feed production, processing/technologies including ration formulation and marketing
	• Inclusion of business orientation in higher learning education curriculum
	• Preparation of training document on feed micro-business for capacity building of youth groups in feed production, processing, and marketing
		• Implementation of trained youth groups engagement in feed micro-business:
		  • Provision of service in animal feeding, ration formulation and feed processing
		  • Collecting and marketing of feeds/forage and forage planting materials from surplus areas
		  • Marketing of feed ingredients and compound feeds
		  • Engaging trained youth in forage production (herbage or seed)
			• Continue implementation of engaging youth groups in feed micro business
			• Review of progress, challenges and lessons learned

• Low level of cultivated forage production at household and commercial scale	• Assess comparative advantage of feed production relative to other crops and availing evidence for decision-making • Awareness creation among different actors • Technical capacity building, linking with finance • Demonstration of feasible production practices • Making seeds and other planting materials accessible • Promoting household and commercial level forage production	• Awareness creation among different actors • Technical capacity building, linking with finance • Demonstration of feasible production practices • Making seeds and other planting materials accessible • Promoting household and commercial level forage production • Results-based monitoring and evaluation	• Continue implementation • Review progress, technology components, challenges and lessons learned
• Limited supply of feed inputs (Land, forage seed, fertilizer) and machinery (feed processing equipment, mower, baler, tractor, chopper)	• Creating an incentive mechanism for the private sector and public enterprises to invest in input supply • Design modalities for use of input machineries • Demand creation through promotion, capacity building and incentives	• Implement supply of feed inputs and machinery at affordable prices	• Continue supply of feed inputs and machinery/feed processing equipment

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
	• Develop policy framework to provide land and other inputs including finance for enhanced participation of private sector • Develop business models for service provision in operation and maintenance of technologies/ machinery		• Monitoring and evaluation of progress made by private sector engagement in improving supply of feed inputs
• Absence of the national regulatory and standard framework to support commercial scale production of cultivated forages	• Undertake background assessment and identify the standards to be developed • Prepare the draft standards and get it approved	• Prepare a manual for implementation of the standards • Prepare a manual on Good Agricultural Practices in Forage Production • Create awareness • Build capacity of key actors in implementing good agricultural practices and the standards	• Review the progress made • Identify key challenges and develop interventions
• Absence of modern database on grazing resources (location, coverage, status)	• Identify the location, coverage and status of key grazing resources nation wide	• Digitalize and develop national database of grazing resources • Translate into various languages • Pilot test and refine the application • Institutionalize and put the application to wider use	• Wider use of the application • Review and update
3.2.3 Biosecurity and health management of dairy animals			
• Lack of dairy herd/flock health management standards and guidelines at national level	• Develop contextualized, mandatory dairy herd/flock health management and biosecurity standard and guidelines (sanitation, facility, animal, manure) • Awareness creation for pertinent stakeholders in the biosecurity guidelines • Capacity building for dairy farmers and extension agents • Streamline the standard and guidelines in the extension service	• Regular monitoring on implementation of the standards • Periodic awareness creation for pertinent stakeholders • Capacity building for dairy farmers and extension agents • Streamline the standard and guidelines in the extension service	• Review and update the standard • Regular monitoring on implementation of the standards • Awareness creation for pertinent stakeholders • Capacity building for dairy farmers and extension agents

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Weak disease surveillance and traceability system	• Strengthen diagnostic capacity of regional laboratories and AHI • Strengthen monitoring, surveillance, and data recording at farm level • Apply national LITS in the dairy sector • Strengthen risk analysis	• Capacity building on dairy health data management and analysis • Strengthen diagnostic capacity of regional laboratories and AHI • Strengthen monitoring, surveillance and data recording at farm and household level • Apply national LITS in the dairy sector • Review risk analysis and response mechanisms • Implement control strategy for priority dairy diseases	• Capacity building on dairy health data management and analysis • Strengthen diagnostic capacity of regional laboratories and AHI • Strengthen monitoring, surveillance and data recording at farm and household level • Apply national LITS in the dairy sector • Review risk analysis and response mechanisms • Implement control strategy for priority dairy diseases
• Weak veterinary service delivery and limited accessibility of inputs	• Improve coverage and quality of veterinary service through equipping clinics and health posts • Review and endorse the veterinary rationalization road map (VRRM) that encourage private service, PPP approach, and universities community service • Design a modality for sustainable supply and access of laboratory consumables, quality drugs and vaccines • Enhance application of solar energy generator for the maintenance of vaccine cold chain • Design a mechanism for use of mobile veterinary clinics • Identify and institutionalize promising indigenous knowledge and ethnoveterinary practices	• Empower private vet services and other modalities of operation • Capacity building for private sector and other actors through training and access to finance • Review and endorse the VRRM • Sustainable supply and access of laboratory consumables, quality drugs and vaccines • Enhance application of solar energy generator for the maintenance of vaccine cold chain • Implement mobile veterinary clinic services with proper monitoring mechanisms • Operationalize indigenous knowledge and ethnoveterinary practices	• Empower private vet services and other modalities of operation • Capacity building for private and other actors through training and access to finance • Monitor implementation of VRRM • Sustainable supply and access of laboratory consumables, quality drugs and vaccines • Build new inland drug and vaccine production facilities and strengthen the existing one

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
			• Enhance application of solar energy generator for the maintenance of vaccine cold chain • Implement mobile veterinary clinic services with proper monitoring mechanisms • Capacitate ethnoveterinary practitioners
• High mortality rate of young and adult stocks due to poor husbandry and disease management	• Train farmers on young stock mortality reduction packages (management, health) • Make inputs required for implementation of YSM reduction packages accessible to farmers	• Train farmers on young stock mortality reduction package (management, health) • Provide inputs required for implementation of YSM reduction package • Regular monitoring of YSM reduction package implementation	• Train farmers on young stock mortality reduction package (management, health) • Provide inputs required for implementation of YSM reduction package • Regular monitoring of YSM reduction package implementation
3.2.4 Dairy product quality and safety			
• Milk quality deterioration at farm level due to faulty milking procedures	• Dissemination of guidelines, working procedures, and demonstration of materials for dairy animal good husbandry practices • Awareness creation for dairy farmers (pastoralists) on good dairy husbandry practices • Develop mechanisms for quality-based payment of dairy products • Application of milk marketing directives	• Enhance demonstration and experience sharing • Strengthen implementation of quality-based payment for dairy products • Monitoring and evaluation of good dairy husbandry practices • Application of milk marketing directives • Monitoring and support on application of good dairy husbandry practices	• Enhance demonstration and experience sharing • Strengthen implementation of quality-based payment for dairy products • Monitoring and evaluation of good dairy husbandry practices, quality-based payment, and law enforcement

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Improper handling, storage and transportation of dairy products across the dairy value chain	• Awareness creation for dairy value chain actors on safe and proper milk handling, collection/bulking, storage and transportation • Develop standards and guidelines for milk collection centers • Implement standards and guidelines	• Awareness creation and training for milk collectors and collection centre actors • Implement standards and guidelines • Digitalize the dairy value chain information system to control quality and safety • Monitoring and evaluation of overall milk handling, storage and transportation practices	• Awareness creation and training for milk collectors and collection centre actors • Strengthen digitalization of dairy value chain information system to control dairy quality and safety • Monitoring and evaluation of overall milk handling, storage and transportation
• Insufficient storage facilities and inaccessibility of milk collection centers, dairy cooperatives and unions	• Organize and capacitate milk collection points in inaccessible areas and SMEs at village level to collect quality milk and supply to dairy cooperatives • Link collection centers to dairy processing cooperatives and unions • Create enabling environment for actors engaged in production/distribution of food grade milk handling and transportation utensils/facilities • Link dairy producers with producers and dealers of food grade milk handling facilities • Establish the cold chain with innovative technologies such as solar powered facilities • Building the capacity of technicians (through TVET colleges) on installation, operation, and maintenance of dairy equipment and machinery	• Strengthening existing and establish new milk collection centers with facility and equipment in production areas • Monitoring and evaluation of milk collection system • Create enabling environment for actors engaged in production/distribution of food grade milk handling and transportation utensils/facilities • Inservice training for technicians engaged in maintenance and supply of spare parts for milk facilities • Monitor and strengthen cold chain with innovative technologies	• Monitoring and evaluation of the milk collection system • Review and maintain the enabling environment for actors engaged in production/ distribution of food grade milk handling and transportation utensils/facilities • Sustain linkage between dairy producers with producers and dealers of food grade milk handling facilities • Inservice training for technicians engaged in maintenance and supply of spare parts for milk facilities • Monitor and strengthen cold chain with innovative technologies

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Poor quality and safety of dairy inputs	• Awareness creation for all value chain actors on dairy inputs quality and safety • Gap assessment and development of interventions on quality and safety of dairy inputs and technologies • Monitor the quality and safety measures, and law enforcement	• Awareness creation for all value chain actors on dairy inputs quality and safety • Enhance the implementation of quality and safety control measures, and law enforcement • Monitor the quality and safety measures, and law enforcement	• Awareness creation for all value chain actors on dairy inputs quality and safety • Enhance the implementation of quality and safety control measures, and law enforcement • Monitor the quality and safety measures, and law enforcement
• Weak/no law enforcement measures on milk quality and safety	• Finalize proclamation on dairy product marketing and quality • Develop directive for implementation of the proclamation • Awareness creation on dairy quality and safety standards, plus enforcement measures	• Implement the dairy product marketing and quality production directive • Monitoring and evaluation of the implementation process	• Implement the dairy product marketing and quality production directive • Monitoring and evaluation of the implementation process
• Absence of incentives for high-quality milk (absence of a quality-based payment system)	• Develop attractive modality for quality- and quantity-based payment mechanism for milk suppliers • Provide automated technologies for milk quality testing • Awareness creation on incentive mechanisms • Implement automated milk testing, quality confirmation system for quality-based payment systems	• Implement automated milk testing, quality confirmation system for quality-based payment systems • Monitor proper implementation of quality control incentive mechanism	• Implement automated milk testing, quality confirmation system for quality-based payment systems • Monitoring and evaluation of the incentive mechanism
3.2.5 Dairy business development services, input and output marketing			
3.2.5.1 Dairy business development services			
• Lack of defined business catalogue for enterprises along the dairy value chain	• Identify business opportunities along the dairy value chain • Develop indicative business plan for the different dairy business enterprises (DBEs) in different contexts • Develop context-specific dairy business catalogue for youth, women and any interested actors • Develop dairy business incubators	• Popularization of different dairy business enterprises (mass media, workshops, websites, social media and print media outlets) • Incubating/capacity building for actors interested in DBEs • Engage different actors in DBEs	• Implement incubation and engagement • Periodic review of the business catalogue and incubation service

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Lack of dairy business incubation centre/unit	• Develop and capacitate the dairy business incubation centre/unit • Review the dairy business catalogue and prepare for respective interventions	• Build the capacity of dairy cooperatives, youth/women groups, individual business operators in dairy business ventures • Engage the new business groups • Provide technical support/business advisory services to already existing dairy businesses found at different levels to improve their efficiency and effectiveness • Follow up and offer support service	• Build the capacity of dairy cooperatives, youth/women groups, individual business operators in dairy business ventures • Engage the new business groups • Provide technical support/ business advisory services to already existing dairy businesses found at different levels to improve their efficiency and effectiveness • Follow up and offer support service • Review process of expansion, re-orientation and other necessary adjustments
• Poor dairy business development service (DBDS) provision	• Develop pluralistic dairy business development service provision system • Design capacity building program on dairy business development services (DBDS) • Develop dairy business service provision package • Develop standards and guidelines for dairy business development service provision and regulatory framework	• Institutionalize the dairy business development services provision system • Capacitate private sector actors to provide DBDS • Operationalize dairy BDS provision	• Review the process and make necessary adjustments • Ensure continued service of public and private dairy BDS providers
• Poor business enabling environment	• Design one window service for dairy sector actors • Prepare standards and guidelines of services to be obtained from different service providers to the dairy sector and make it accessible for the public in a transparent way (notice boards, brochures, website, etc.)	• Institutionalize one window service • Popularization of the one window service • Implement one window service for dairy businesses • Provision of one window services	• Provision of one window services • Periodic revision of the service provision to align with the dynamics and emerging demands

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
	• Create and operationalize a joint task force for periodic review of progress, and to listen to grievances and put in place corrective actions		
3.2.5.2 Dairy input and output market development			
• Lack of quality-based milk pricing and functioning quality control system	• Develop a quality-based pricing framework • Develop policy framework for reward and restraining mechanisms • Acquire the necessary technology and facilities for quality testing • Engage the regulatory body to co-develop the system and build its capacity to aggressively implement the pricing and enforcement mechanisms	• Awareness creation for relevant dairy value chain actors on the pricing system • Piloting quality-based pricing system • Scaling at national level • Periodic review of the system and updating • Strengthen dairy associations • Support establishment of statutory bodies that can support public action • Enable consumers to get them involved in the implementation process	• Implement quality-based pricing at scale • Periodic review of the system and updating
• Lack of incentive mechanism to encourage supply of large volume of standard quality milk	• Develop raw milk marketing policy framework that encourages suppliers of large volume of standard quality milk • Develop legal framework for dairy out grower schemes • Develop strong contract enforcement mechanism in the dairy sector with clear accountability of contracting parties	• Enforce premium price and other incentive mechanisms for large volume standard quality milk suppliers • Implement contract enforcement mechanisms	• Enforce premium price and other incentive mechanisms for large volume standard quality milk suppliers • Implement contract enforcement mechanisms
• Lack of dairy input and output tracking digital platform	• Map dairy input and output value chain actors and functions • Review existing digital applications in the dairy sector	• Develop a consolidated, user friendly, comprehensive digital platform for the input and output production, distribution, bulking, transportation, processing, marketing and consumption of dairy inputs and outputs • Validate, institutionalize and pilot the digital platform • Review the platform based on feedback obtained at piloting phase	• Continue implementation at national level. • Review the platform to align with dynamism

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
		• Popularization of the platform • Implement at national level	
• Poor milk bulking and transportation services	• Promotion of bulking centers that can accommodate large volumes of evening milk in major supply areas • Develop business models for provision of cold storage services that can accommodate collection of evening milk • Develop investment incentive packages for actors to be engaged in raw milk bulking and transportation services • Develop proper monitoring and evaluation system	• Establish bulking centers in major supply areas • Encourage private sector actors to invest in bulking and transportation facilities • Regular monitoring and evaluation to ensure successful implementation of the bulking and transportation system	• Establish bulking centers in major supply areas • Encourage private sector actors to invest in bulking and transportation facilities • Regular monitoring and evaluation to ensure successful implementation of the bulking and transportation system • Review the system and make necessary adjustments
• Poor development of dairy inputs marketing/supply system	• Design inputs marketing plan • Develop innovative business models for dairy input marketing including heifer growing, feed supply, AI service provision, mobile vet clinic services, etc. • Develop incentive mechanisms to attract different actors to the input marketing venture • Establish community of practice involving relevant government offices including MOA, MOT, CRA, media, NGOs, input suppliers and other relevant actors to periodically review the activity of input supplies and provide necessary support • Engage youth groups and women in the different input supply models after building their capacity in business incubation services • Promote private sector engagement in dairy input marketing	• Engage different actors including youth groups, women, cooperatives, individual business entities in the different input supply models after building their capacity in business incubation service • Promote private sector engagement in dairy input marketing • Formalization and licensing of business enterprises • Convene regular meetings of the community of practice to evaluate successes and challenges, and take corrective action • Monitoring and evaluation	• Engage youth groups and women in the different input supply models after building their capacity in business incubation services • Promote private sector engagement in dairy input marketing • Convene regular meetings of the community of practice to evaluate successes and challenges, and take corrective action • Monitoring and evaluation

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Demand and supply fluctuation of dairy products	• Promote private sector investment in product diversification including production of longer shelf-life products including UHT • Media campaign and awareness creation forums • Build links to agro-processing industry parks • Promote innovative marketing strategies including roadside dairy shops for probiotic yoghurt and integration of dairy products into other instant foods such as potato chips, roast chicken, etc. • Push dairy consumption into school feeding initiatives to create a sustainable market for dairy products and enhance the nutrition and well-being of children	• Awareness creation on consumption • Investment in processing industry to produce products with longer shelf-life • Build links to agro-processing industry parks • Consider export of milk and processed products	• Investment in processing industry to produce products with longer shelf-life • Build links to agro-processing industry parks • Consider export of processed products
3.2.6 Investment in commercial farming and processing industry			
• Inadequate and ineffective remunerative incentive packages	• Review existing dairy sector investment packages and set attractive adequate packages • Awareness creation and support to the private sector to access incentive packages • Devise feedback mechanisms to provide follow-up support to investors • Results-based M&E framework to ensure effective utilization of incentive packages	• Implement provision of incentive packages • Awareness creation and support to the private sector to access incentive packages • Results-based M&E framework to ensure effective utilization of the incentive packages	• Implement provision of incentive packages • Awareness creation and support to the private sector to access incentive packages • M&E framework to ensure effective utilization of the incentive packages
• Limited clustering in the dairy sector	• Assess feasibility of alternative dairy clustering options (e.g. Dairy villages, Dairy clusters, etc.) • Delineate and map milk shed areas based on production and marketing potential • Establish dairy hubs for support coordination • Strengthen investment cluster development initiative to link with integrated agro-processing industrial parks	• Establish innovation platforms and community of practice to enhance the efficiency and effectiveness of dairy investment	• Arrange comprehensive incentive mechanism to stimulate cluster farming and vertical integration • Review progress and take corrective measures

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Lack of investment in raw materials production for compound feed processing	• Assess feasibility of different raw materials for alternative uses (food/feed) • Encourage investment of raw materials production for compound feed processing	• Encourage investment of raw materials production for compound feed processing	• Encourage investment of raw materials production for compound feed processing
• Lack of effective public-private partnership (PPP) in dairy investment	• Identify dairy investment areas suitable for PPP • Design the duties and responsibilities of potential partners to minimize the risk of crowding out one another • Develop modalities of partnership and invite the private sector for partnership	• Sign binding contractual relationship among partners • Expand areas of dairy investment in PPP model	• Review and continue PPP in the dairy sector investment
• Less allocation of suitable land for dairy production and processing including feed development	• Rationalizing suitable land for dairy investment, • Develop suitability map for dairy development with clear analysis of comparative advantage of alternative uses • Review land leasehold policies and transfer procedures, and make necessary amendments • Design and implement legal framework to regulate effective utilization of transferred land only for intended purposes	• Provision of basic infrastructure to dairy investors as per agreed contract terms • Develop mechanisms for protection of dairy investment from external factors • Regular follow-up and support for private sector investors	• Provision of basic infrastructure to dairy investors as per agreed contract terms • Regular follow-up and support for private sector investors
• Limited number of financial service providers and low financial inclusion for the dairy sector	• Set up remunerative incentive packages for financial institutions to serve the dairy sector • Encourage insurance companies to develop policies for dairy investment • Put in place a coordinated capacity building program of stakeholders on both supplier and customer side • Roll out credit schemes for dairy sector investment	• Roll out credit schemes for dairy sector investment • Strong monitoring and evaluation to protect diversion of loans to unintended purposes	• Improve regulatory environment for financial institutions to serve the dairy sector • Strengthen dairy input credit provider rural financial institutions
3.2.7 Dairy extension service/coordination and linkage			
• Lack of defined dairy extension system	• Develop pluralistic dairy extension system • Improve competencies of extension agents (DAs) in technical skills and attitudes	• Implement dairy extension system with RBME • Increase scale and coverage of dairy advisory and extension services in production systems and all dairy animals	• Review the dairy extension system and proceed with implementation

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
	• Set up dairy extension and advisory services demanded by farmers and other actors in dairy systems • Promote transfer of technology and linkage with support services (demonstrations, visit of extension agents, etc.) • Assist farmers to access knowledge and information through an educational process to improve dairy production methods, health, feed, and techniques that enhance productivity and production efficiency • Build the capabilities of farmers, other actors, and their organization in entrepreneurship, business and management skills and practices • Revise available standard extension tools such as guidelines, leaflets, posters and handbooks in the dairy production system	• Build the capabilities of farmers, other actors, and their organization in entrepreneurship, business and management skills and practices • Facilitate access to technologies, agri-business, processors, input providers, and other relevant institutions by farmers, their organizations and other actors • Create an enabling environment for private extension agents to engage in extension service delivery • Promote extensive use of informative mass media programs and ICT tools in dairy extension • Promote online dairy skill training programs such as MOOC and other digital extension support services using different modalities including participation of private sector and professional associations • Improve knowledge management of MOA including further development and accessibility of websites and databases • Scale up best practices in the dairy production system	• Increase scale and coverage of dairy advisory and extension services in production systems and all dairy animals • Build the capabilities of farmers, other actors, and their organization in entrepreneurship, business and management skills and practices • Facilitate access to technologies, agri-business, processors, input providers, and other relevant institutions by farmers, their organizations and other actors • Create an enabling environment for private extension agents to engage in extension service delivery • Promote extensive use of informative mass media programs and ICT tools in dairy extension • Promote online dairy skill training programs such as MOOC and other digital extension support services using different modalities including participation of private sector and professional associations

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
			• Improve knowledge management of MOA including further development and accessibility of websites and databases • Scale up best practices in the dairy production system
• Weak linkages among dairy value chain actors	• Establish working and sustainable forum of key dairy sector actors (Dairy Board) • Use existing formal linkage between research, extension, farmers and training for the dairy sector	• Strengthen a statutory body that coordinates the sector (Dairy Board) • Strengthen involvement of the dairy sector in the ADPLAC	• Strengthen a statutory body that coordinates the sector (Dairy Board) • Strengthen involvement of the dairy sector in the ADPLAC
• Weak institutional coordination	• Strengthen coordination among the different sectors and sub-sectors of MOA through joint planning, and progress evaluation • Use the institutional coordination between different ministries in the food systems transformation in the dairy sector • Create sustainable coordination forum for all stakeholders of the dairy sector mainly through the Dairy Board	• Joint planning and progress review of different sectors and sub-sectors of MOA • Promote the dairy agenda in the existing food systems transformation platforms (annual dairy conference, milk days, show cases) • Undertake regular meetings of dairy stakeholders' platform	• Joint planning and progress review of different sectors and sub-sectors of MOA • Promote the dairy agenda in the existing food systems transformation platforms (annual dairy conference, milk days, show cases) • Undertake regular meetings of dairy stakeholders' platform
3.2.8 Capacity development			
3.2.8.1 Institutional capacity development			
• Weak milk producers and processors association	• Undertake rapid assessment and strengthen the existing milk producers and processors association • Enable the association to become self-reliant, both technically and financially	• Follow-up and continuous engagement	• Follow up and continuous engagement

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Absence of a National Dairy Board (NDB) responsible for dairy development	• Establish the dairy board	• Strengthen the NDB	• Review progress made, challenges encountered and identify key interventions • Implement interventions and strengthen the established NDB
• Inadequate public/ private ranches as a source of genetic materials for production of replacement dairy animals (cows, camels and goats)	• Strengthen existing public/private/community ranches • Encourage private investment in the development/ establishment of dairy animal multiplication centers	• Strengthen existing public ranches • Establish new ranches for dairy animals	• Strengthen and establish new public, private and community ranches
• Inefficient regional veterinary laboratories on disease diagnosis and surveillance	• Strengthen capacity of regional veterinary laboratories	• Strengthen capacity of regional veterinary laboratories	• Establish new and standardized regional veterinary laboratories
• Absence of dedicated dairy institute to supply improved dairy breeds	• Review gaps and strengthen the current works in different research centers	• Support research centers to engage in the development of improved breeds for milk production • Establish fully fledged National Dairy Institute	• Implement the dairy institute and strengthen its activities
• Inadequate dairy recording and traceability system	• Strengthen and scale up the national dairy performance recording efforts	• Ensure dairy performance recording and traceability is conducted at federal and regional levels	• Implement and strengthen the modalities
3.2.8.2 Human and physical capacity development			
• Inadequate AI technicians	• Assess the human resource demand and capacity of training institutions • Build the capacity of training institutions • Train new AI technicians	• Refreshment training and training of new AI technicians • Provide long-term training and career development structure	• Refreshment training and training new AI technicians

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• In adequate skills and knowledge of DAs on dairy production	• Specialty training for livestock DAs in selected milk shed areas	• Specialty training for livestock DAs in selected milk shed areas	• Specialty training for livestock DAs in selected milk shed areas
• Inadequate skills and knowledge of Liquid Nitrogen (LN) processing/ maintaining technicians	• Training of LN technicians	• Training of LN technicians	• Training of new LN technicians
• In adequate knowledge and skills of semen processing technicians	• Training of technicians on semen processing	• Training of technicians on semen processing	• Training of new technicians on semen processing
• Inadequate knowledge on nucleus herd management	• Specialty training on nucleus herd management and improvement	• Specialty training on nucleus herd management and improvement	• Specialty training on nucleus herd management and improvement
• Insufficient LN production plants	• Maintain the existing LN plant • Capacitate the LN technicians through training	• Establish quality LN production units in strategic locations • Stimulate PPP involvement	• Strengthen PPP in LN production
• Under capacity laboratories for semen processing	• Enhance the existing semen processing laboratories to increase efficiency	• Capacitate the semen processing laboratories through short- and long-term training	• Continue with periodic capacity building of semen processing laboratories
• Insufficient AI kits and consumables	• Procuring and distribution of appropriate AI kits and consumables	• Procuring and distribution of appropriate AI kits and consumables	• Procuring and distribution of appropriate AI kits and consumables
• Under production of the existing LN plants	• Strengthen liquid N production unit	• Train LN technicians for all regions	• Train LN technicians for all regions
3.2.9 Cross-cutting issues			
• Gender imbalance in use of dairy extension services	• Gender mainstreaming in dairy extension services	• Gender mainstreaming in dairy extension services	• Gender mainstreaming in dairy extension services

Strategic Issue	Strategic interventions (2022–2031)		
	Short-term (2022–2023)	Medium-term (2024–2027)	Long-term (2028–2031)
• Lack of climate smart dairy farming practices	• Review best-bet practices of mitigation strategies on greenhouse gas (GHG) reduction • Prepare guidelines for reduction of GHG emissions • TOT training of experts	• Implement guidelines for reduction of GHG emissions • Reduce number of animals by maintaining more productive animals and producing more climate smart animal feeds • Support and monitor performance	• Continue implementation • Continue monitoring
• Limited environment and climate change sensitive feed production, conservation and utilization practices	• Generate information on GHG emissions, biodiversity and water footprints for feed production, conservation and utilization • Implement climate smart feed production, conservation and utilization activities	• Implementation of climate smart feed production, conservation and utilization activities continued • Implement mechanisms that reduce biodiversity loss and water footprints for feed production, conservation and utilization	• Implementation of climate smart feed production, conservation and utilization activities continued • Implement mechanisms that reduce biodiversity loss and water footprints for feed production, conservation, and utilization, continued
• Low consumption of dairy products	• Promote nutrition-sensitive agricultural practices • Promote consumption of dairy products	• Promote nutrition-sensitive agricultural practices • Promote consumption of dairy products	• Promote nutrition-sensitive agricultural practices • Promote consumption of dairy products

4 Roles and responsibilities

The roles and responsibilities of different actors in implementation of this strategy are presented in Table 5.

Table 5: Roles and responsibilities of different actors

S/N	Stakeholders	Roles and responsibilities
1	Ethiopian Ministry of Agriculture	• Approval of the dairy strategy • Prepare guidelines for implementation of strategic interventions identified in the strategy • Oversee, guide and coordinate implementation of the strategy • Mobilize and allocate financial and physical resources necessary for implementation of the strategy • Attract investors and motivate them to join the dairy development sub-sector • Facilitate ease of doing business for investors in the dairy sub-sector. • Capacity building on dairy production and processing, forage production, and on feed formulation
2	Ethiopia Agricultural Authority	• Development of regulatory framework for the dairy sector • Provide regulatory services including enforcement of directives/laws on input and output quality • Regulate product quality along the dairy value chain
3	Ministry of Irrigation and Lowlands	• Promote and support dairy development in lowland areas of the country • Promote and support irrigated forage development • Promote development of ranches
4	Ministry of Innovation and Technology	• Promote and support application of science and technology in the Ethiopian dairy sector
5	Bio and Emerging Technology Institute	• Promote and support proper use of biotechnology tools in the dairy sector
6	Ministry of Planning and Development	• Plan dairy development projects and programs, follow up funding, monitor implementation and evaluate performances
7	Ministry of Finance	• Allocate budget for development of the dairy sector, follow up proper utilization of financial resources and take corrective actions

S/N	Stakeholders	Roles and responsibilities
8	Regional Livestock and Fishery Resource Development Agency/ Regional Bureaus of Agriculture/ Pastoral and Agro-Pastoral Development Bureaus	• Lead and implement the strategy in the region • Put in place necessary government structures to support dairy development • Ensure proper staffing structures with capable human resources • Allocate necessary resources for implementation of the strategy • Compile lessons learnt towards further implementation of the strategy • Cascade the strategy, closely monitor implementation and provide feedback to MOA
9	Higher Learning Institutions	• Revise and create appropriate curriculum to produce capable dairy experts with practical skills • Undertake technology shopping from global experience and generate and avail impactful technology or knowledge for wider use • Conduct research on dairy-related activities to avail contextualized, problem-solving technologies • Demonstrate improved dairy technologies and best practices, and provide community services • Import and adapt suitable dairy technologies to the Ethiopian context • Provide training to nearby regional agricultural bureaus on dairy production, processing and management
10	Livestock Development Institute	• Conduct problem solving research in the dairy sector and support implementation of research findings, government policies and strategies. • Multiplication of technologies, including heifers • Build capacity of different actors in production, processing, marketing and utilization of quality products
11	Ethiopian Agricultural Transformation Institute (ATI)	Identify systemic constraints in dairy development by conducting studies and providing solutions
12	International Livestock Research Institute (ILRI)	Generate technology and support the NARS and the dairy developments sector
13	National Veterinary Institute (NVI)	Support the sector by producing effective vaccines and drugs
14	Animal Health Institute (AHI)	Design and implement proper dairy disease surveillance and diagnostic capacity
15	Ethiopian Biodiversity Institute (EBI)	Dairy breed identification, characterization and conservation
16	Ethiopian Institute of Agricultural Research and regional research institutes	Conduct research to generate new technologies and adapt appropriate technologies and evidence in different thematic areas of the dairy sub-sector
17	Ethiopian Standard Institute	Develop necessary standards for the dairy sector including inputs, outputs, processes, tools, machines, etc.
18	Ethiopian Investment Commission	• Investment promotion and licensing • Create enabling environment for investment in dairy sector

S/N	Stakeholders	Roles and responsibilities
19	National Bank of Ethiopia	Develop rules and regulations with respect to dairy sector's access to finance, monitor implementation and take corrective action
20	Financial institutions and insurance companies	Provide financial support to dairy sector actors
21	Ethiopian Ministry of Trade and Regional Integration	Provide business licence, monitor implementation, take corrective action
22	Federal Cooperative Commission	Organize cooperatives and create inputs-outputs market linkage
23	Ministry of Labor and Skills	Produce skilled human resources, enterprise development and promote innovations
24	Ethiopian Ministry of Social and Women Affairs	Ensure gender equity and social welfare
25	Ethiopian Dairy Producers and Processors Association (EDPPA)	• Create market linkages, organize platforms to facilitate the marketing of inputs and products • Lobby the government for development of the sector
26	Ethiopian Conformity Assessment (ECA)	Ensure testing and certification of dairy inputs and outputs
27	Public Dairy Multiplication Centers	Multiply and supply improved dairy animals
28	Private Input Supply Enterprises	Provide improved inputs and services
29	Ethiopian Animal Feed Industry Association (EAFIA)	Coordinate private sector involvement in feed production and marketing
30	Non-government development partners	Provide technical and financial support
31	Ethiopian Ministry of Foreign Affairs	Effect diplomacy work to attract Foreign Direct Investment to the dairy sector
32	Ethiopian Airlines	Provide transportation services for inputs, logistics and outputs
33	Ethio-Djibouti Railway Corporation	
34	Ministry of Transport and Logistics	Coordinate logistics in the dairy sector
35	Ethiopian Electric Power Corporation	Develop and expand electric service infrastructure
36	Ethio Telecom	Develop and expand telecommunication service, including digitalization of the dairy sector
37	Ministry of Water and Energy	Develop and expand water and energy
38	Ethiopian Custom Commission	Facilitate rules and regulations to import and export goods and services
39	Ethiopian Ministry of Revenue	Facilitate rules and regulations on revenue collection
40	AU-PANVAC	Provide International Independent Quality Control of Veterinary Vaccines produced in Africa and imported to Africa
41	National Policy Institute	Identify policy gaps and propose policy options in the dairy sector
42	Ministry of Industry	Promote and support industrial development in the dairy sector

5 Expected outputs

The expected outputs of the dairy development strategy include the following:

- Milk production increased four-fold from its current level of 7.1 billion litres a year.
- Per capita milk consumption level recommended by the WHO attained by 2031 (Self-sufficiency in dairy products achieved by 2031).
- Tailor-made dairy development programs and projects for respective production systems designed.
- Commercialization of the dairy sector improved.
- Quality of dairy products enhanced, and food safety concerns significantly reduced.
- Reduced environmental concerns due to improved productivity and better efficiency in the dairy value chain.
- Enhanced employment opportunity in the dairy sector.
- Sustainable and affordable improved breed supply system put in place.
- Supply of quality feed and feed utilization in the dairy sub-sector substantially improved.
- Dairy disease surveillance and diagnostic capacity improved.
- Access to dairy inputs (breeds and dairy animals, vaccines, drugs, equipment, machinery, feeds) improved.
- Effective national and regional coordination and linkage mechanism in place.
- Technically and practically skilled extension service providers and related staff in place.
- Adequate infrastructure and suitable facilities established.
- Consistent market linkage to build consensus toward mutual benefit of partners developed.
- Business catalogues for dairy business enterprises and different agro-ecologies in place.
- Ease of doing dairy business improved to attract large number of potential and competitive private sector entities.
- Importation of dairy and their products from abroad replaced by domestic supply.
- Duplication of mandates among different institutions minimized.
- Cross-cutting issues mainstreamed and contribution of dairy sub-sector to macro-level development goals enhanced.

References

Amsalu, A.A. 2012. A study on the impact of dairy cooperative union on women farmers: The case of Beftu Berga Dairy Union, Western Oromia, Ethiopia. MA Thesis. Indira Gandhi National Open University.

Behnke, R. and Metaferia, F. 2011. The contribution of livestock to the Ethiopian economy – Part II. IGAD Livestock Policy Initiative Working Paper 02–11. Addis Ababa, Ethiopia.

Central Statistical Agency. 2021. Livestock and livestock characteristics (private peasant holdings), Agricultural Sample Survey. Addis Ababa, Ethiopia.

Dragolea, L. and Cotirelea, D. 2009. Benchmarking – A valid strategy for the long term. *Annales Universitatis Apulensis Series Oeconomica* 11(2), pp. 813–825.

FAO, 2013. Milk and dairy products in human nutrition. Eds. Ellen Muehlhoff, Anthony Bennett and Deirdre McMahon. Food and Agriculture Organization, Rome.

Fufa, A., Nigus, T., Fikru, R., Dinka, A. and Kebede, A. 2019. Handling practices, quality and safety of milk along the dairy value chains in selected sub-cities of Addis Ababa, Ethiopia. *Journal of Scientific Technical Research* 13(1).

Gebreselassie, N. 2020. Review of challenges and opportunities in milk production in Ethiopia. *Food Science and Quality Management* 95:29–33. https://www.iiste.org/Journals/index.php/FSQM/article/view/51895/53632

Gobeze, G., 2005. Regulating Microfinance in Ethiopia: Making it more effective. Amhara Credit and Savings Institution (ACSI). Essays on regulation and supervision. No. 3.

GRM International BV (2007) Livestock Development Master Plan Study. Phase I Report-Data Collection and Analysis. Volume 1-Dairy.

IBGE (Insituto Brasileiro de Geografia e Estatistica) 2018. PPP-Municipal Livestock Production. Main results-2018. https://www.ibge.gov.br/en/statistics/economic/agriculture-forestry-and-fishing/17353-municipal-livestock-production.html.

Pal, U.K., Mandal, P.K., Rao, V.K. and Das, C.D. 2011. Quality and utility of goat milk with special reference to India: An overview. *Asian Journal of Animal Sciences* 5(1): 56–63.

Shapiro, B.I., Gebru, G., Desta, S., Negassa, A., Nigussie, K., Aboset, G. and Mechal, H. 2015. Ethiopia livestock master plan. ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Shapiro, B.I., Gebru, G., Desta, S., Negassa, A., Nigussie, K., Aboset G. and Mechale. H. 2017. Ethiopia livestock sector analysis. ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Tesfaye M., Asfaw, A., Degefa, K., and Regassa, H., 2019. Evaluate the trend of imported milk and milk products in Ethiopia. Ethiopia Meat and Dairy Industry Development Institute Milk and Milk Products processing directorate. World Journal of Dairy and Food Sciences 14(2), pp.151–160.

TRAIDE Ethiopia 2021. Investment opportunities in the Ethiopian dairy sector. Kingdom of Netherlands

Tsedey, A. and Asrat, T. 2015. Safety and quality of raw cow milk collected from producers and consumers in Hawassa and Yirgalem areas, southern Ethiopia. *Food Science and Quality Management* Vol. 44.

Yilma, Z., Guernebleich, E., Sebsibe, A. and Fombad, R. 2011. A review of the Ethiopian dairy sector. Addis Ababa, Ethiopia: FAO Sub-Regional Office for Eastern Africa (FAO/SFE).

http://www.moa.gov.et

ግብርና ሚኒስቴር
MINISTRY OF AGRICULTURE