Ethiopia livestock sector analysis

A 15 year livestock sector strategy

BILL & MELINDA GATES foundation

Ethiopia livestock sector analysis

Developed by the Ethiopia Ministry of Livestock and Fisheries and the International Livestock Research Institute Livestock master plan team

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Acronyms

ALive	African Partnership for Livestock Development
AI	Artificial insemination
ATA	Agricultural Transformation Agency
AU	African Union
AU-IBAR	African Union—Interafrican Bureau for Animal Resources
BAU	Business as usual
BMGF	Bill & Melinda Gates Foundation
CBPP	Contagious bovine pleuropneumonia
CCPP	Contagious caprine pleuropneumonia
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
CRGE	Climate resilient green economy
CSA	Central Statistics Agency of Ethiopia
DA	Development agent
DOC	Day-old chick
DM	Dry matter
EIAR	Ethiopian Institute of Agricultural Research
ETB	Ethiopian birr
FAO	Food and Agricultural Organization of the United Nations
FOB	Freight on board
FMD	Foot-and-mouth disease
GDP	Gross domestic product
GoE	Federal Democratic Republic of Ethiopia

GTP	Growth and Transformation Plan
IFD	Improved family dairy
IFP	Improved family poultry
ILRI	International Livestock Research Institute
IPMS	Improving the Productivity and Market Success of Ethiopian Farmers project
IRR	Internal rate of return
LG	Lowland grazing zone
LIP	Livestock investment plan
LMP	Livestock master plan
LSA	Livestock sector analysis
LSIPT	Livestock sector investment and policy toolkit
LSMS	Living standards measurement study
MoA	Ministry of Agriculture
MoLF	Ministry of Livestock and Fisheries
LSM	Livestock State Ministry, Ministry of Agriculture
MRD	Mixed rainfall deficient
MRS	Mixed rainfall sufficient
MT	Metric tonne
OECD	Organization for Economic Co-operation and Development
PPP	Public-private partnership
PPR	Peste des petits ruminants (goat plague)
SDS	Specialized dairy systems
SDP	Specialized dairy production
TB	Tuberculosis
TFP	Traditional family poultry
TECs	Tonnes of carcass equivalent
YASM	Young and adult stock mortality

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The development of the Ethiopia livestock sector analysis (LSA) was undertaken by the newly created Livestock Resources Development Sector (or Livestock State Ministry, LSM) of the Federal Republic of Ethiopia, Ministry of Agriculture (MoA) (now Ministry of Livestock and Fisheries [MoLF]), with technical support from the International Livestock Research Institute (ILRI). The work was funded by the then Canadian International Development Agency (CIDA) through the Improving the Productivity and Market Success of Ethiopian Farmers (IPMS) project and the Bill & Melinda Gates Foundation (BMGF). The LSA formed the basis for the Ethiopia Livestock Master Plan (LMP) for 2015–2020.

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- Asfaw Negassa, agricultural economist, ILRI
- Kidus Nigussie, animal scientist, senior dairy expert, MoA
- Gezahegn Aboset, veterinarian, senior veterinary epidemiologist, MoA
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1. Executive summary

This Ethiopia LSA was undertaken by the new Livestock Resources Development Sector (Livestock State Ministry, LSM), MoA, of the Federal Democratic Republic of Ethiopia (GoE), with technical support from ILRI. The study was funded by the BMGF to build the capacity of the MoA for fact-based planning.

To effectively launch and carry out its work, the new LSM requires a vision of what can and needs to be accomplished to develop the sector, built on a factual baseline and realistic targets and priorities, along with a realistic strategy and 'road map' or action plan – what the LSM calls an LMP. This Ethiopia LSA is a critical input into the LMP.

This report also seeks to inform other GoE policymakers involved in livestock development on the current status and future potential for poverty reduction and economic growth of the livestock sector. It is based on a quantitative analysis of the technical performance of the sector and its economic contribution to the household and national economy, using a set of LSIPT tools. This toolkit was developed by a group of international agencies[1] under the aegis of ALive at AU-IBAR. The analysis is based on field surveys, literature and expert opinions, continuously validated through consistency tests.

1.1 Development of the Ethiopia livestock sector analysis

Using the most recently available data, from 2013, ILRI and the LSM employed the LSIPT[2] to develop livestock herd and sector models and a baseline assessment of the current state of agricultural development in Ethiopia upon which to assess the potential long-term, 15–20 years, impact of proposed combined technology and policy interventions, referred to as the LSA. The LSA results then formed the basis for the development of the Growth and Transformation Plan (GTP) II targets and the LMP 2015–2020. The LMP is a series of five-year development implementation plans or 'roadmaps', to be used to implement the GTP II period and beyond.

The LSA and LMP interventions were tested using the sector model measures of GoE livestock development and policy objectives for the GTP I and GTP II. The GTP objectives employed to assess the investment interventions of the Ethiopia LMP were to:

- reduce poverty;
- achieve food and nutritional security;
- contribute to economic growth (GDP); and agro-industry development;
- contribute to exports and foreign exchange earnings; and
- contribute to climate resilience.

1. CIRAD (France) FAO and the World Bank were the main contributors.

2. The toolkit was developed by a group of international agencies under the aegis of ALive at AU-IBAR. CIRAD (France), the FAO, and the World Bank were the main contributors.

Using indicators for the above objectives, three key livestock commodity value chains – poultry for chicken meat and eggs, crossbred cattle mainly for milk, and red meat-milk from ruminants (indigenous cattle, sheep, goats, and camels) – were identified in the LSA as potentially contributing to the long-run development of the sector. The LSA, moreover, comprises two sub-value chains for each commodity value chain: smallholder family and commercial specialized production systems. These six sub-value chains are found in one or more of the three major production typology zones of Ethiopia, officially categorized by the MoA: lowland grazing (LG including both pastoral and agro-pastoral systems), highland crop-livestock mixed rainfall deficient (MRD) and highland crop-livestock mixed rainfall sufficient (MRS).

A summary of the findings of the report shows:

- The national herd, consisting of about 55.2 million cattle, 29 million sheep and the same number of goats, 4.5 million camels and close to 50 million poultry, produces currently about 1,128 metric tonnes (MT) of meat, 174 million eggs and 5.2 billion litres of milk per year. In addition, it provides about 68 million tonnes of organic fertilizer and almost 617 million days in animal traction. The technical parameters, in particular for mortality in young stock are poor, also in comparison with data from similar production systems elsewhere in Africa.
- For the purposes of this study, a typology for the different livestock systems was developed, consisting at the first level in (a) the predominantly grazing or grassland systems of the lowlands (LG), (b) the rainfall deficient (MRD) and (c) the rainfall sufficient (MRS) mixed farming systems of the higher elevations. The livestock distribution shows that most cattle are in the mixed systems, sheep are about equally distributed between the highland mixed and lowland grassland systems, whereas goats and camels are predominantly found in the lowlands.
- This national herd provides, at least in part, the livelihoods of more than 11.3 million rural households, of which 27–35% of the highland livestock keepers and large proportion of the lowland herders live below the GoE established poverty line. The national poverty line estimate for Ethiopia based on a 2010/11 Central Statistics Agency (CSA) of Ethiopia household survey is ETB 3,781 per adult equivalent/year (about ETB 20 per capita/day or USD 1.0 per day).
- The proportion of poor livestock keeping individuals is the highest in the LG systems whereas the lowest proportion (27%) is found in the MRS. The highest in absolute number poor people are found in the MRD. A more in-depth analysis shows that (a) cattle is the dominant species for 70–90% of the livestock holding households according to livestock system; (b) livestock contribution to total household income is higher for poorer households in the highland; (c) village poultry throughout all agro-ecological zones and goats in the lowlands or LG have the highest income per animal. Under a poverty reduction focus, cattle, goats and village poultry in all systems and especially the lowlands (LG) and the moisture sufficient highland (MRS) agro-ecological zones would get priority.
- The direct contribution of livestock to GDP is estimated by LSIPT at ETB 150.7 billion per year, which amounts to 17% of GDP and 39% of the agricultural GDP. This rises to about 21% of the national GDP and 49% of the agricultural GDP, if the contribution of processing and marketing (35.6 billion) is taken into account. If the indirect contribution in organic fertilizer and traction (37.8 billion) is taken into account the contribution of livestock to the GDP will rise to 25.3%.
- The direct herd/farm level contribution can be broken down into about 34% from milk and another 32% from meat, with the rest from other services or products. As far as livestock systems are concerned, it is about equally distributed over the three major agro-ecological zones, while the contribution of the specialized system (urban dairy in the case of milk, and feedlots in the case of red meat) is still incipient.
- Currently the demand for meat and milk is mainly met from domestic production. However, the projections over the next 15 years, due to exploding demand as a result of rapidly increasing population growth to 127 million people and rising per capita income, show a deficit of about 1.3 million, 53% MT of meat and 3,185 million litres, 29% of milk in 2028. Per capita meat consumption will then be about 24.5 kg/year, about par with countries currently at a similar stage of development. Meeting this gap will require substantial investments in the sector:
- In the case of cow milk, if the proposed investment interventions are successfully put in place, the LSA results project a 20% surplus of about 2 billion litres of milk by 2028. The LSA results show that the future projected surplus in milk will be realized through investment in better genetics, feed and health services to improve both traditional dairy farms, as well as commercial-scale specialized dairy production (SDP) units.

- To close the looming future projected gap in meeting meat consumption requirements, it will be essential that both traditional backyard family poultry and the number and size of specialized commercial scale broiler and layer units be vastly increased.
- Successful investment in poultry improvement can result in an overall surplus of all meat production over projected consumption requirements by 2028. The expected surplus in 2028 is projected to be about 8% or 181,000 tonnes of meat.
- Poor market access and lack of infrastructure lead to limited value added (only 31.5% of farm/herd level value added, against 100% and more in member countries of the Organization for Economic Co-operation and Development (OECD). Meanwhile, rather short supply channels lead to moderate post-harvest losses. For example, post-harvest losses in milk are estimated in the LSA value chain analysis at only 3.4 %, while losses across all types of meat range from 11–24%.
- Price analysis along the meat and dairy value chains shows that average price increases and gross margins are quite high for most of the actors in the chains, and especially for processors and food service providers who are involved in value-addition through processing or transformation. This implies that they are operating in a lucrative business environment where there are not yet enough competitors. Further constraint analysis, however, shows that policies improving access to land and credit would be needed to encourage further and easier entry into these markets.
- With improvements in animal health services and animal genetics, combined with improved feeding and better management practices, livestock performance improves substantially, nevertheless the demand-supply gap for milk remains large by 2028, thus implying that a broader effort will be required to close the gap.
- Feed supply, in particular grass and fodder, will most likely be the main physical constraint to further expansion of the livestock population. The LSIPT feed resources module estimates that in a good year, sufficient grazing and fodder is available for LG and MRD and in an average year only for LG livestock. However, by 2028 all agro-ecological zones except LG will be dramatically deficient in these feeds if the current growth in stock numbers continues.
- The animal disease constraint analysis points to the following major disease priorities: Foot-and-mouth disease (FMD); peste des petits ruminants (PPR); tsetse borne trypanosomosis (tryps), external parasites (Ekek), sheep and goat pox and contagious bovine pleuropneumonia (CBPP).
- Clear policies exist regarding the private and public sector roles, in particular in the provision of services and inputs, but implementation is limited. Unfavourable regulatory and fiscal frameworks for land allocation and feed production respectively, lead to a reluctance of private operators to invest, and are constraints to further equitable growth.

This leads to the following strategic policy recommendations:

- Priority given to the increase in productivity or production per animal by addressing the feed deficits, animal health and genetics. Key policy and investment actions to support increasing productivity would be the enhancement of veterinary coverage through private-public partnerships to reduce mortality and morbidity, promotion of fodder production through the revision of land allocation rules, and the accelerated introduction of improved genetics once feed production and health services are in place.
- LSA and climate resilient green economy (CRGE) and livestock investment plan (LIP) convergence: Through a focus on increasing low greenhouse gas (GHG)-emitting chicken production and consumption dramatically and regulating the higher GHG emitters, especially cattle, through a higher off-take rate than currently, as well as additional investments to help achieve increased productivity for all livestock species considered priorities in the LSA, the climate resilience of the sector could be improved and the other national development objectives of the nation could also be met.
- An increase in the numbers of livestock will still occur, and their environmental consequences will need to be closely monitored. With the projected dramatic increase in livestock numbers, and the resulting risk of resource degradation from overgrazing, policies introducing disincentives (such as a tax per head) could be considered.
- Success in modernizing the poultry subsector will also require complementary policy interventions, that sufficient land be allocated and put into poultry feed production (especially maize and soybean), and the private sector be encouraged to and does invest in poultry agribusinesses—especially day-old chick production and meat and egg processing.

- If poultry can substitute for red meat, then red meat can be exported to meet the GoE export goals to earn foreign exchange. However, tastes and preferences for local chicken or '*doro*' would have to be changed through promotion of exotic chicken meat and changes in cuisine.
- Moreover, while in the long run, GoE policy would have to focus on the threatening projected domestic supply gap, export promotion of beef can still now be the 'pull' factor for general improvement later. A dual policy of seeking broad animal health coverage for the poor smallholder combined with a focus on increasing exports and gaining access to attractive and remunerative markets in the region is therefore needed. This will also require a major increase in investments to enhance the quality and safety of the animal-source food products.
- The need for balanced policies to encourage investment in animal production and meat processing to meet rapidly increasing domestic demand for meat, as well for export promotion. Otherwise, the exploding domestic demand will constrain future export potential.
- Special incentives (review of the business climate, tax facilities, training) to promote more value adding, through processing and product transformation, combined with a clearer role of the public and private sector.

This, in turn leads to the following scenarios that have been tested for their economic feasibility. The agent of change will be a technology intervention; however, they have to be supported by policy adjustments to be fully effective:

- Combined policy measures to rationalize public and private sector roles in the provision of veterinary services combined with investments in animal health, feeding and management to reduce young stock mortality in all livestock systems.
- Dairy breeding improvement interventions, combining artificial insemination (AI) using exotic semen with oestrus hormone synchronization in the MRS systems. The LSA investment scenario results show the rate of return on investment in AI and hormone synchronization is not attractive in the MRD systems.
- In particular, for poverty reduction, a massive importation and dissemination of improved semi-scavenging poultry breeds by the private sector and through public-private partnerships (PPPs) where the private sector is reluctant to enter on its own, combined with private animal health services to provide critical vaccines, and GoE extension services to promote improved feeding.
- It will be essential to transform traditional backyard family poultry and this will rely on mass introduction of indigenous scavenging chickens to a market-oriented improved family poultry (IFP) system with semi-scavenging crossbred chickens, which have far higher genetic potential for both eggs and meat, when combined with supplemental feeding and adequate health services. As well, the number and size of specialized commercial scale broiler and layer units needs to be substantially increased.
- Revision of the land allocation policy framework to enable investments to promote fodder production and trade.
- Promotion of feed efficiency through the removal of the VAT (15%) and duty (currently 53%) on feed mill ingredients combined with the introduction of quality control.
- Promotion of export to more remunerative markets through the introduction of a practical and affordable system of animal identification and traceability.

LSA shows attractive economic returns for these investments, but as already stated, the resulting productivity increases have limited impact on the demand-supply gap. Closing the gap between the meat supply and demand by 2028 requires that both that the national herd will grow, and additional necessary productivity increasing interventions are put in place. The achievement of the required increase in productivity levels in milk and milk production will require substantial genetic improvement in the national herd and concomitant improvements in animal feed and health and management practices.

Finally, the report recommends the following follow-up actions:

- Prepare action plans, and start the implementation of the priority policies and investments identified in this report, i.e. in animal health, fodder and the value adding.
- Use the LSIPT database and the MoA and ILRI staff trained in its use to further refine the options already tested, and to assess new potentially attractive investments.

- Establish in the MoLF, in coordination with other relevant agencies, a livestock policy support unit with staff, hardware, access to data and budget to support the ministry in policy formulation using the LSIPT database (and eventual other tools).
- Ensure that in all future surveys that (a) data gaps identified during this exercise, in particular in LG, small ruminant systems and the value chains, are addressed in priority.

2. Livestock in Ethiopia—introduction and overview

2.1 Importance of the livestock sector in Ethiopia

In Ethiopia, agricultural development is considered a priority by the government for stimulating overall economic growth, reducing poverty and achieving food security. The agricultural sector of Ethiopia accounts for about 42% of GDP and between 80–85% of employment (MoFED 2012).

Within agriculture, the livestock subsector provides an opportunity for further development. The sheer size of the national livestock herd, one of the largest in Africa, makes it a resource with potential to contribute significantly to national development, including poverty reduction. The Central Statistical Agency (CSA) survey of 2011/12 showed that the total cattle population of Ethiopia is about 52 million. Moreover, about 24.2 million sheep and 22.6 million goats are estimated to be found in the country, while the total poultry population is estimated to be about 45 million chickens (CSA 2011/12). The LSA projections for 2013 in this report show a further increase of the livestock numbers.

The livestock subsector is also already a major contributor to the overall economy. The livestock sector contributes 19% of the GDP, and 16–19% of the foreign exchange earnings of the country (MoA 2012). It contributes some 35% of agricultural GDP; or 45% if indirect contributions are taken into account (ILRI 2011). With a rapidly growing population, increasing urbanization, and rising incomes, domestic demand for meat, milk and eggs is expected to increase significantly in the foreseeable future. Furthermore, the country's geographic location offers substantial opportunities for exportation, thus earning foreign exchange from livestock products, especially of red meat to the Gulf and within Africa, as well as leather, honey and other livestock products to Europe.

The livestock sector can also be a major contributor to poverty reduction by improving the livelihoods of rural people. Approximately 85% of Ethiopia's population is rural based, and livestock supports the livelihoods of about 80% of rural people (ILRI 2011). However, the income of 30% of the rural population is below the poverty line (MoFED 2013). Livestock perform multiple functions in the rural household economy. Besides employment, livestock provides protein rich food, income for everyday expenses and social obligations, near liquid assets, a store of wealth for savings, manure for crop production and soil fertility, and transport (ILRI 2011). Livestock development also has the potential to positively impact urban consumers through lower animal product prices.

2.2 Rationale for an Ethiopia livestock master plan and livestock sector analysis

Over the last 20 years the livestock sector has been a priority in all GoE strategies, policies, and plans, and continues to be a priority in its current GTP, running through 2015 (MoFED 2010). Although the government clearly recognizes

the potential of the sector for stimulating growth, reducing poverty and achieving food security; it also acknowledges the need for greater support in the development of the sector to realize its full potential.

One persistent gap has been a lack of clear strategy and action plan for the development of the livestock sector, built on a clear vision of what could be achieved over the medium- (five years) and long-term (15–20 years). The GoE realizes this vision needs to be built on a factual baseline and achievable targets, along with a realistic strategy and 'road map' or development action plans. The GoE is developing a long-term livestock 'road map' called the LMP. The preparation of the Ethiopia LMP is being undertaken with the support of ILRI-funded by the BMGF. The MoA (now the MoLF) requested the support of ILRI in developing the LMP. The LMP will inform future development support, investment planning, and donor funding.

A second persistent constraint to livestock development in Ethiopia has been the lack of a GoE agency within the MoA, solely dedicated to preparing and implement livestock development strategies and plans, oversee how GoE activities are carried and ensure enabling policy. In 2013, a livestock resources development sector (or LSM) was created in the MoA, led by a livestock state minister. The primary purpose of the LMP was to provide the new state ministry with the roadmap and action plans needed to implement activities. More recently, the MoLF was created. This is a major milestone for the livestock sector as it signals the GoE's commitment to the modernization and transformation of the sector. MoLF has two sectors, each with state ministries: the Livestock Production Development Sector and the Livestock Health and Feed Quality Control Sector. The new minister has requested that the LSA provide the long-run strategy for the sector.

The Livestock sector and investment policy toolkit

Purpose

The LSIPT was developed in the beginning of the last decade, as it was recognized by livestock specialists from African governments and international agencies, that the livestock sector had not been receiving the appropriate level of support from policymakers and investors. Sector stakeholders did not have adequate tools to measure and articulate its potential to reduce poverty and promote economic growth. The Partnership for Livestock Development, Poverty Alleviation and Sustainable Growth in Africa (ALive)[3] therefore, brought together specialists from CIRAD, the International Institute for Environment and Development (IIED), the Food and Agriculture Organization of the United Nations (FAO), and the World Bank[4] to develop a set of tools to help:

- Identify, collect and analyse livestock sector data, documenting the importance of the sector to households and national economies.
- Present to decision makers, on the basis of this analysis, strategic options for investment, which would provide high returns in terms of economic growth and the reduction of poverty for livestock keepers, while identifying any trade-offs.

The LSIPT consists of a set of tools (mathematical models, format questionnaires, and other aids), that have been field tested and reviewed—most notably in Zambia. It enables in-depth and systematic quantitative analysis of the major constraints facing the livestock sector, and the effects of proposed interventions on economic growth and poverty alleviation. To enable investment scenario analysis, LSIPT uses cost benefit analyses of proposed policy and technology investment options; providing guidance for prioritizing investments according to their potential impacts on private and social development goals. Further description of the LSIPT methodology can be accessed at the LSIPT website (www.alive-lsiptoolkit.org), with the username and password to be provided by contacting the authors of this report.

3. www.Alive-online.org

4. With financial support from the Government of France, the European Union and the World Bank

Main objectives of the LSA

The main objective of LSA is to inform government decision makers on the basis of the analysis of a wide range of quantitative livestock performance indicators, the most appropriate options for livestock sector development within the framework of their government's overall macro-economic development strategy.

LSIPT consists of a set of interacting and individual tools and checklists, divided into three phases of the analysis:

- A first phase, based on an initial survey of the importance of livestock (module 1), looks at how well livestock is represented in the national development strategy and budget documents, and if the sector has unnoticed and unrealized potential. A set of tools in module 2 help set up a preparatory analysis of the needs (manpower, budget) and participatory mechanisms (steering committee, stakeholder consultations) to do a detailed, quantitative sector analysis.
- In the second phase, the tools in module 3 help to develop a typology of the prevailing livestock production systems, to carry out a detailed analysis of the contribution of livestock to the household economy for each of these production systems, and to assess the defined key quantitative (volume) and financial parameters of the main value chains. Then, the tools in module 4 help define the sector's direct and indirect contributions to the national economy, and provide the instruments for assessing the main technical (feed, genetics and health) and political and institutional constraints.
- In the third phase, the tools in module 5 allow for a participatory process to set development priorities to evaluate the impact of alternative policy investment scenarios following from these priorities. In addition, the third phase uses a number of module 5 tools to test the economic, social, nutritional, and environmental impact of these scenarios. Module 6 then provides guidance for monitoring and evaluation.

Application of the LSA in Ethiopia

As the first step in creating a LMP, it was essential to carry out a long-run quantitative analysis of the sector to understand the current situation to set realistic development targets for the next planning period of the GoE (2015-2020). The LMP lays out a vision of what can be achieved through high potential combined technology and policy interventions aimed at supporting the nation's economic, social, and environmental development goals. These interventions outline the necessary livestock investments needed by the government, donors, and other stakeholders from 2013–2028.

The LSIPT was identified together by the MoA (now MoLF) and ILRI as the most rigorous set of tools to carry out the sector analysis for the LSA and LMP. ALive, housed in AU-IBAR, agreed and provided the team with training and technical support for the implementation of LSIPT and how to best capitalize data as an input into the development of the LSA.

The Livestock Resources Development Sector (or LSM) of the MoA (now the MoLF) and ILRI carried out the following actions:

- As part of the first phase, a broad-based technical advisory committee was established, which set the analytical steps to be taken in developing the LSA and LMP and met regularly to give advice on the project activities and outputs and oversee progress.
- In preparation for the second phase, about 30 specialists for the different commodities, value chains and cross-cutting issues of the subsector collected, based on their experience and available literature, the key performance parameters (fertility, mortality, productivity, prices of inputs and outputs, marketing margins).

For the definition of the importance of livestock at the household and national levels (modules 3 and 4), a small core group of MoA (now MoLF) and ILRI specialists, supported by LSIPT experts in the application of the toolkit and animal production entered 'best bet' data in the modules, and counterchecked its reliability on the basis of past performance (i.e. if a certain production system had shown vigorous growth over the last decade, the simulation for the next years based on these technical parameters should also show similar vigorous growth). The value chain analyses covering six chains (including competitiveness analysis), and the cross-cutting issues of feed, health, genetics and policy were

carried out by specialists, as well. Finally, the data was presented to the directors of the different MoA livestock sector departments (animal health, production and feed, and pastoralism). While the database has its limitations, the results give confidence that the LSA has provided reasonable, reliable and unique quantifications of the contribution of the Ethiopian livestock sector to the national and household economies.

The same directors of the MoA livestock departments (now MoLF Sectors) together with the core team, then actively brainstormed future investment scenarios (combined technology and policy support) to be tested under module 5 for their impact on supply and demand, GDP, food security and equity. The final outcomes will inform the GoE on the impact of different development scenarios, thus enabling the government to make informed investment and extension decisions based on fact-based, quantified impact results.

The data required for developing the herd model and economic sector model used to carry out the sector analysis (the LSA) was collected from available secondary sources. No surveys are carried out. From the central statistics bureaus in the countries where we support the development of livestock sector analyses (LSAs) and LMPs, we have found there is available household survey data collected in nationally representative national panel surveys which include living standards measurement study (LSMS) data and household budget survey data.

Data for the Ethiopia LSA was collected from a wide range of data sources including production system and value chain experts, and CSA-LSMS 2013 household surveys (approximately 4,000 households). Other data referenced included Save the Children's livelihoods data (2013) and CSA 2011 statistics. This data was input into the Excel format required by LSIPT, after making sure the data was representative of the households and herds found in the country.

Additional data and parameters required to fill remaining gaps for the herd model and sector models was collected from published papers and consultancy reports, as well as from other 'grey' literature. Finally, any remaining gaps were filled through consultations with national experts. Further information supporting Section 3: Livestock systems can be found in Annex 1.

3. Livestock systems

3.1 Livestock systems classification

The sector analysis using LSIPT is organized along livestock production systems and value chains. A livestock production system is defined as a group of farm operations with approximately the same characteristics of climatic conditions and farming practices (i.e. the combination of land/herd, labour and capital). The classification by production systems is critical, because interventions (i.e. improvements in animal health, feeding) are strongly livestock system specific. For example, the required type and scope of a policy support or technology differ significantly between a commercial market-oriented, intensive stall-fed dairy system and a mobile pastoral dairy grazing system.

In line with the international convention, the livestock systems classification according to Sere and Steinfeld (1996) is the main organizing principle in the study and this report. Under this classification, the first criterion concerns the origin of feed as follows:

- A grazing system: A system in which more than 90% of the dry matter (DM) fed to animals comes from rangelands, pastures and annual forages.
- A mixed system: A system in which at least 10% of feed comes from crop residues.

3.2 Rationale and production systems selection in Ethiopia

In Ethiopia, applying the Sere and Steinfeld criteria leads to differentiation between lowland grazing (LG) systems with elevation less than or equal to 1,500 metres above sea level and the mixed (MR) systems of the highlands with elevation higher than 1,500 metres above sea level. The mobile LG production systems differ enormously in species composition, age/sex structure, management, access to feed and other resources access etc., from the sedentary MR crop livestock systems of the highlands. In MR livestock systems, issues such as animal traction, contribution in organic fertilizer, etc. are significant.

Within the LG system, another category of livestock keepers is emerging; those that cannot sustain themselves from livestock alone and are supplementing with cropping. While small (only 2% of the LG to date), the lowlands agro-pastoral system (LGAP) is included as a second level system for the LSA analysis, because it is expected to grow as population pressure increases in the LG system. In the LGAP, crop residues provide more than 10% of total feed resources whereas the pastoral or LG entails larger herd size and crop residues provide less than 10% of total feed resources.

For the mixed highland systems, further differentiation is made between the mixed rainfall deficient (MRD)[5] and the mixed rainfall sufficient (MRS) systems. This designation is based on the MoA classification of woredas in the mixed (MR) crop-livestock production zone into moisture deficient and moisture sufficient woredas (MoA 2013). In Ethiopia, where the crop production systems are mainly rain-fed (due to limited development of irrigation), the impact of

5. Irrigated systems are ignored in the MRD because their contribution to the livestock sector is negligible.

sufficient and deficient rainfall on production possibilities and practices warrants the MRS and MRD to be considered first level classifications. The MRD mainly concerns the lower regions of the highlands, with lower and riskier precipitation, and generally less access to markets and infrastructure. MRS covers much of the higher elevation regions with higher biophysical potential, as well as better infrastructure (market access). These different characteristics again define the need to identify different development options, and therefore also justify a second level differentiation between MRS and MRD.

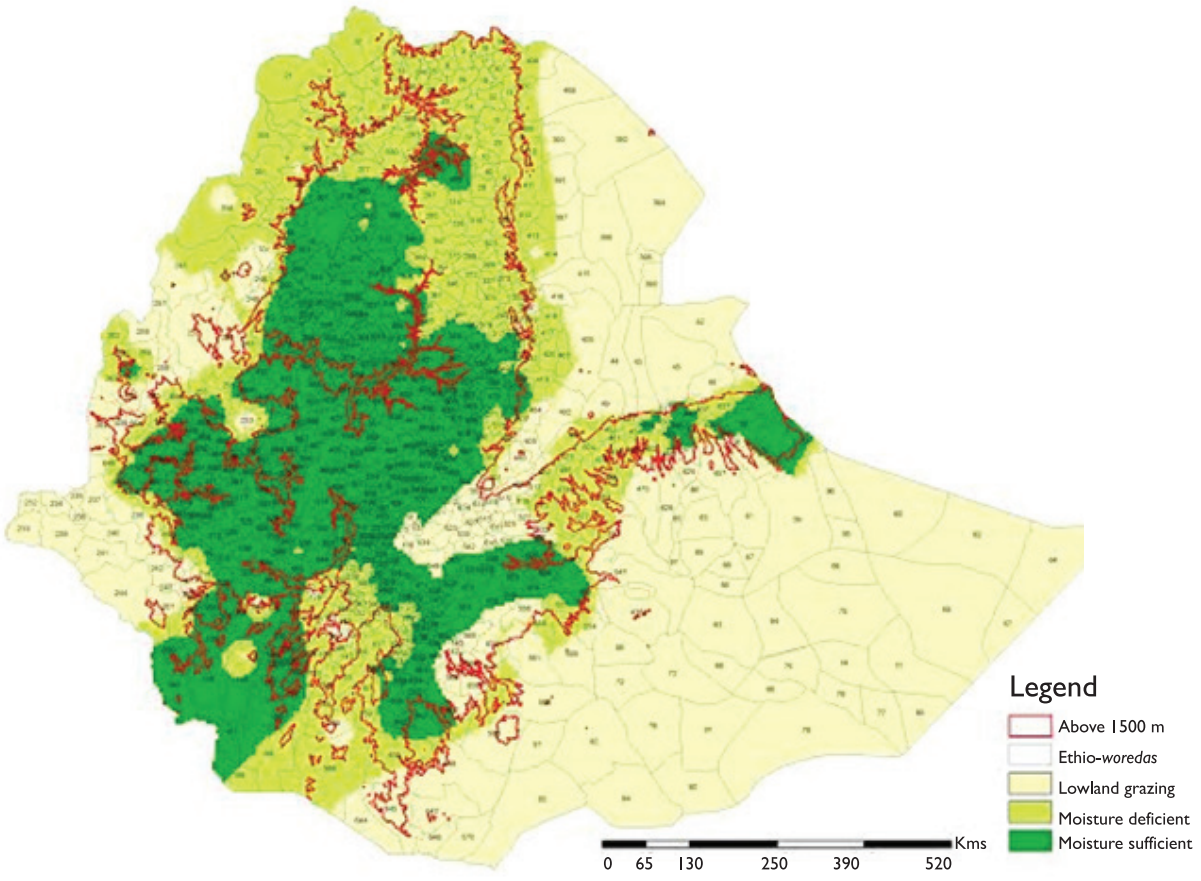
There are also a number of livestock systems whose production methods are modern, which depend mainly on the procurement of feed from outside the farm and are therefore somewhat independent of agro-ecological conditions. These specialized production systems are independently analysed due to their unique modern production characteristics and commercial orientation. Further subclasses of specialized production systems based on the size of the commercial operation: small, medium and large can also be identified.

Figure 1, a map outlining the LG, MRD and MRS systems in Ethiopia was created through a conglomeration of the following resources:

- MoA classification
- Official regional and woreda level boundaries
- Geo-referenced household survey data from the CSA
- World Bank LSMS data

All woredas not classified as MRS or MRD were considered to be LG. This method of using the MoA classification of woredas was found to be justified by cross-checking the fit of the woredas within the three systems, including the LG using data provided by the woredas and regions.

Figure 1: Map of major livestock production zones in Ethiopia (MRS, MRD and LG).



3.3 Typology of production systems and subsystems in Ethiopia

Ethiopia's first level systems have thus been classified as follows:

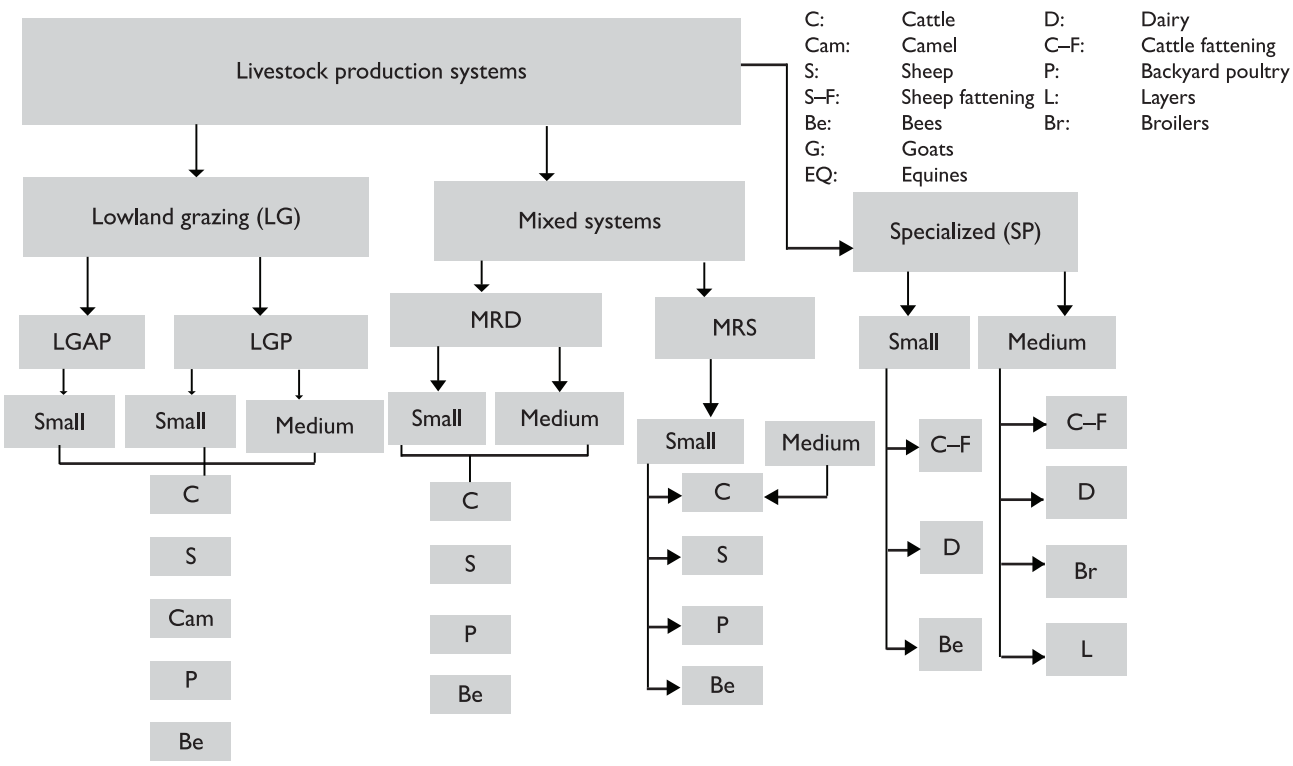
- LG
- MRD
- MRS
- Specialized systems

The specialized systems are classified as follows:

- Dairy systems (OM)—Differentiated according to herd size in specialized smallholder and larger commercial systems, but both using crossbreds based on exotic breeds.
- Cattle fattening operations (OF)—Differentiated according to herd size, but mainly using indigenous breeds.
- Poultry systems (OV)—Differentiated into commercial broiler and layer operations using exotic breeds, and family or backyard poultry livestock systems with smaller flocks of dual-purpose scavenging or semi-scavenging breeds.

Within each of the four first-level systems (LG, MRS, MRD, and specialized systems), a further differentiation between dominant species (cattle, sheep and goats) and herd/flock size was then made. This led to a total of 15 subsystems for MRD and MRS combined. Within each LG system, as well, a further distinction was made according to the dominant species in the system (i.e. cattle, sheep, goats and camels) and the size of the herd or flock. This results in a total of 18 LG subsystems. Including the seven subsystems resulted in the typology of the Ethiopian livestock with a total of 40 subsystems as illustrated below.

Figure 2: Typology of production systems and subsystems in Ethiopia.



3.4 Livestock distribution over different production systems

A first analysis of CSA data shows the following distribution of livestock and livestock keeping households (HH) over the different systems.

Table 1: Distribution of the Ethiopian national livestock herd over production systems

Species	National	LG	MRD	MRS	Specialized production
Cattle	55,212,210	15,293,782	14,796,872	23,520,401	1,601,154
Sheep	29,361,124	12,214,228	6,048,392	11,098,505	NA
Goats	28,951,303	20,257,218	4,578,885	4,115,200	NA
Camels	4,500,000	4,500,000	NA	NA	NA
Chicken	47,643,465	47,237,124			406,341
Bees	4,993,815	4,993,815			NA
Equine	7,171,014	7,171,014			NA

Source: Adapted from Central Statistical Agency (CSA) household surveys and experts' opinion.

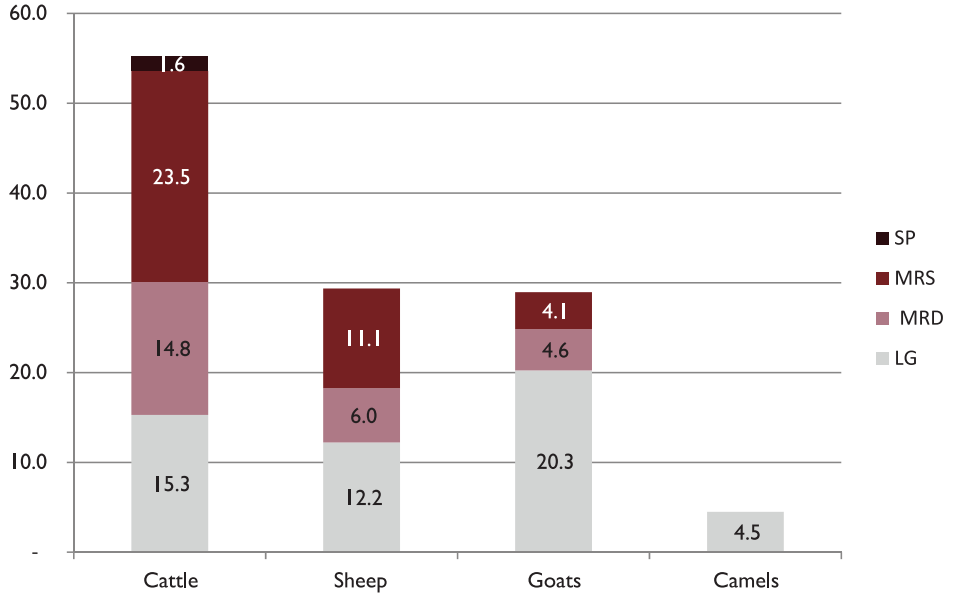
These livestock numbers differ somewhat from the official CSA data because of adjustments made as a result of available household survey data and expert opinion. One major example is that the very low official figure for the camel population (less than 1 million) in Ethiopia was raised to 4.5 million heads based on several more reliable and recent surveys for the Afar, Somali and Borena regions.

Table 2: Distribution of households per system according to dominant livestock species

Dominant livestock farming system	National	LG	MRD	MRS	Specialized production
Cattle	9,479,102	1,037,000	3,673,365.3	4,704,413.04	64,324
Sheep	355,861	17,000	122,445.51	216,415.32	NA
Goats	322,468	510,00	163,260.68	108207.66	NA
Camels	395,000	395,000	0	0	NA
Subtotal ruminants	10,552,432	1,500,000	3,959,071	5,029,036	64,324
Poultry	393,465	392,965			500
Bees	450,000	450,000			NA
Total	11,395,896	1,500,000	3,959,071	5,029,036	64,824

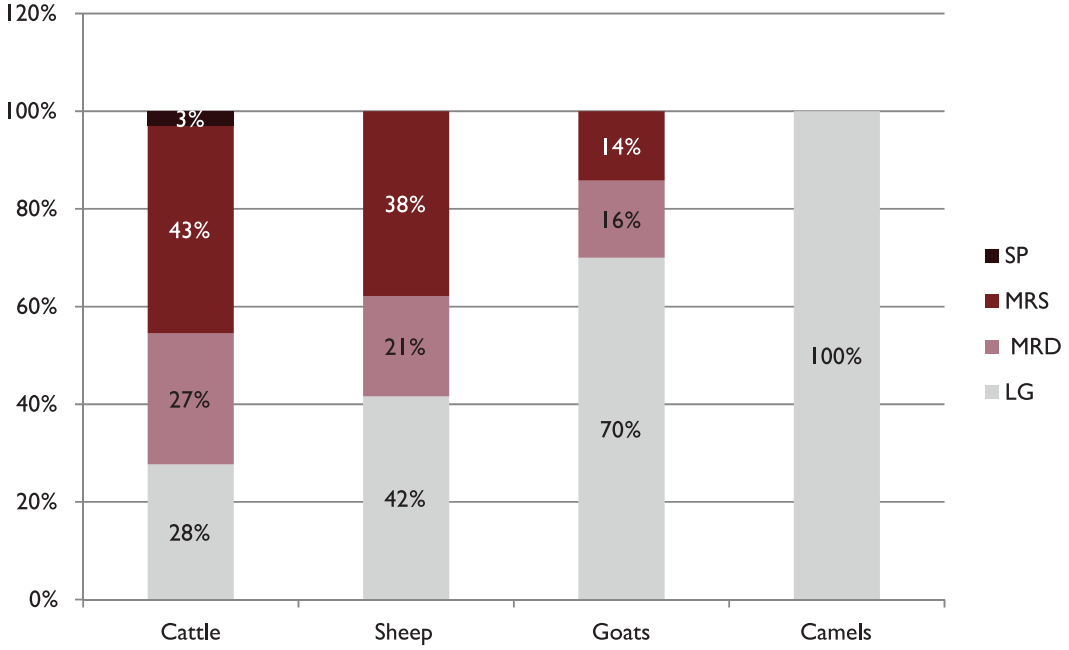
Source: Adapted from CSA household surveys, surveys of Save the Children UK, and experts opinion.

Figure 3: The distribution of the Ethiopian livestock herd by major production systems.



Source: Adapted from CSA surveys and experts' opinion.

Figure 4: The percentage of distribution of the Ethiopian livestock herd by major production systems.



Source: Adapted from CSA surveys and experts' opinion.

3.5 Technical parameters by production systems and species

Technical parameters for cattle

Based on expert opinion, published literature, and the above-mentioned surveys, the technical parameters for cattle and poultry are shown below. Other species production systems can be found in Annex 1. These parameters have been used in the projections of the 'without change' situation (business as usual (BAU) or situation with no change due to investment interventions).

Table 3: Main productivity parameters for cattle

Parameters	LG			MRD		MRS		Dairy specialized		Beef fattening specialized	
	Agro-pastoral	Pastoral small	Pastoral medium	Small	Medium	Small	Medium	Small	Medium	Small	Medium
Live weight (kg)–juvenile[1]	100	100	100	88	90	90	90	130	165	NA	NA
Live weight (kg)–subadult[2]	180	180	180	170	170	170	170	300	450	NA	NA
Live weight (kg)–adult[3]	240	240	240	255	255	255	255	425	675	NA	NA
Dressing percentage	45	50	50	49	50	50	50	50	50	50	54
Milk off-take (litre/lactation)	240	240	288	270	288	360	380	3,050	5,120	NA	NA

[1] Juveniles are calves/kids
[2] Subadults are immature
[3] Adults are matures and have at least one birth or first pregnancy

Table 4: Key demographic and production parameters of cattle according to systems

Parameters	LG			MRD		MRS		Dairy specialized	
	Agro-pastoral	Pastoral small	Pastoral medium	Small	Medium	Small	Medium	Small	Medium
Herd size	9	7	18	2	6	3	9	5	100
Parturition rate	56%	56%	58%	57%	58%	60%	65%	85%	90%
Mortality rate female calves	12%	12%	10%	11%	12%	12%	8%	8%	5%
Mortality rate female sub adults	7%	7%	6%	7%	7%	7%	6%	1%	1%
Mortality rate female adult	5%	5%	5%	5%	5%	4%	4%	3%	3%

Parameters	LG			MRD		MRS		Dairy specialized	
	Agro-pastoral	Pastoral small	Pastoral medium	Small	Medium	Small	Medium	Small	Medium
Mortality rate male sub adults	12%	12%	12%	8%	8%	8%	6%	1%	1%
Mortality rate male adults	9%	9%	9%	5%	6%	4%	4%	3%	3%
Off-take rate	11%	11%	12%	12%	11%	12%	12%	33%	35%
Growth rate	0.2%	0.2%	1.5%	0%	1%	1.9%	3.9%	8.4%	6%

Table 5: Key demographic and production parameters in poultry systems

Description of parameters	Backyard	Layers	Broilers
Number per farm	2.2	500 chicks	1,000 chicks
Number of offspring/breeding female/year	8.7	NA	NA
Mortality rate overall before marketing (%)	50	5	NA
Young stock	NA	NA	7
Growing	NA	NA	5
Adult mortality % per year	20	3	2
Kilograms of total feed/kg egg produced/kg live weight	NA	2.7kg/kg of egg	1.8 kg/kg live weight

Table 6: Main productivity parameters for poultry

Description of parameters	Backyard	Layers	Broilers
Number animals sold per breeding female/year	1.6	NA	NA
Average weight at slaughter (kg)	1.5	2.4	2.3
Dressing percentage at slaughter (%)	65	64	65.2

Further information supporting Section 3: Livestock systems can be found in Annex 1.

Figure 5: Total red meat (cattle, sheep, goat and camel) production by agro-ecological zones.

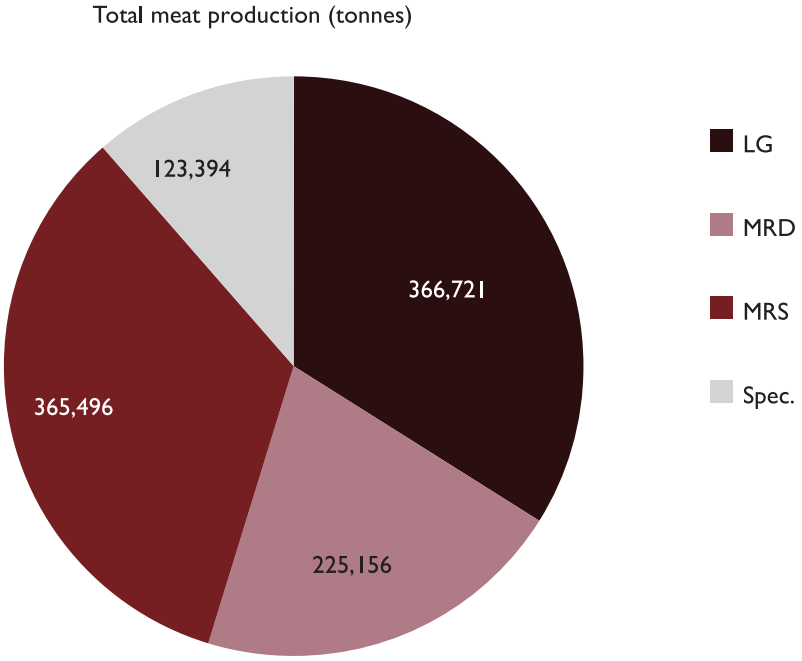


Figure 6: Total milk (cattle, goat and camel) production by agro-ecological zones.

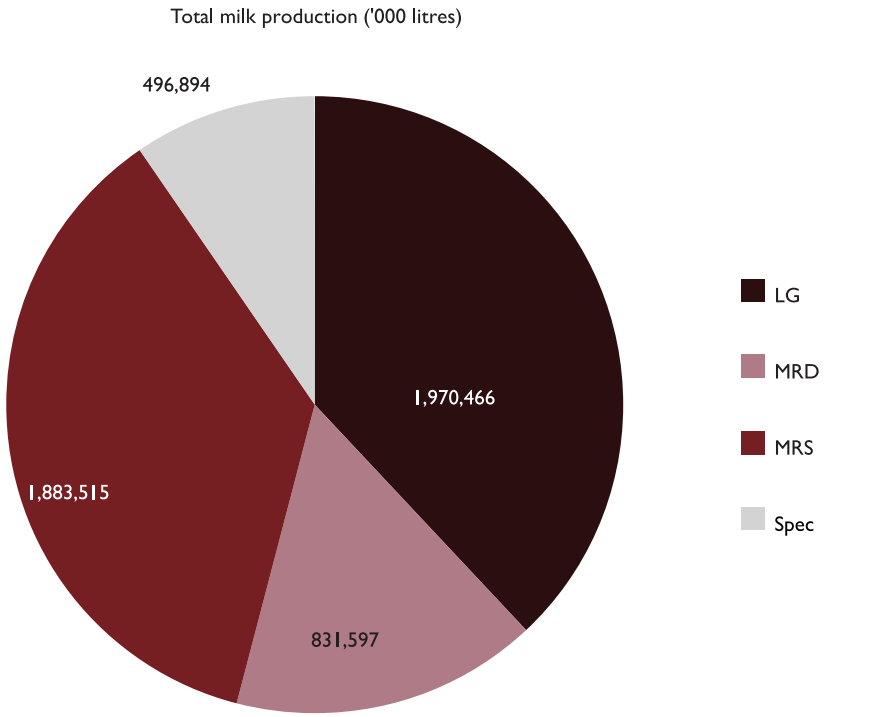
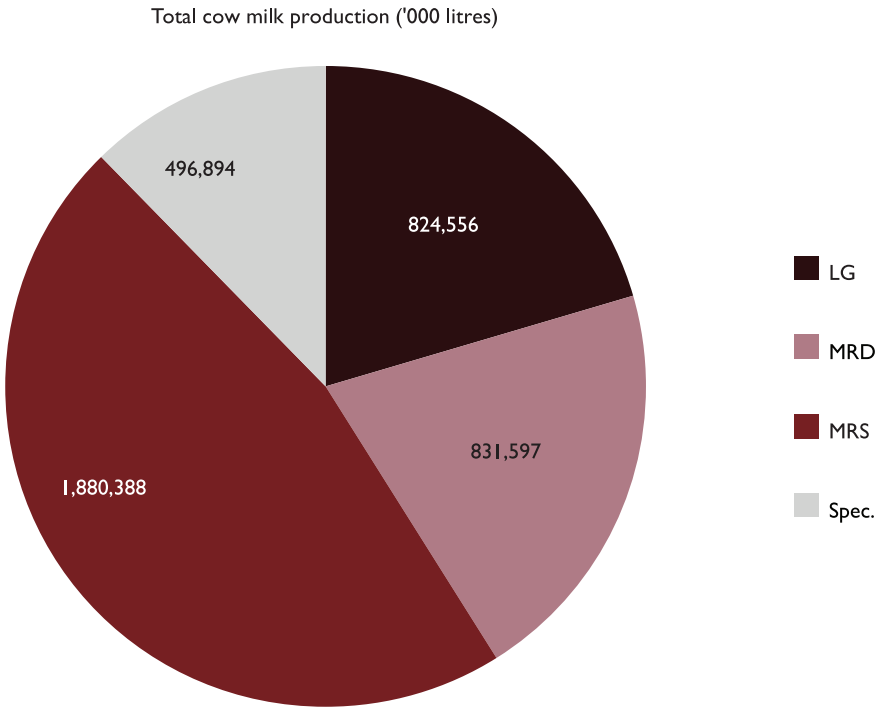


Figure 7: Total cow milk production by agro-ecological zones in 2013.



4. Livelihoods and incomes within livestock keeping households

4.1 Overview

The objective of this section is to classify or group households who are directly involved in livestock production according to their level of dependency on livestock for income and livelihood activities and to assesses the contribution of livestock production in the wellbeing of these diverse groups of households. Based on the classification, the assessment will measure and evaluate the contribution of livestock production to the total household income, poverty reduction, employment generation and food and nutrition security in terms of calories and protein requirements for household consumption. This will be done for each group of livestock-keeping households except for the LG where household survey data was limited which restricted the extent of the household analysis for the lowland system.

The tables below summarize the distribution of poor livestock keeping households across the two highland systems, MRS and MRD, and measures of inequality in wealth distribution in each system. In the MRD system the incidence of poverty, i.e., proportion of poor livestock-keeping individuals is higher than in MRS and the absolute number of livestock keeping poor households was found to be higher in MRD than MRS. This computation is based on ETB 3,781 poverty cut-off line per adult equivalent, which is used by MoLF to estimate incidence of poverty. Income inequality was also estimated in MRD and MRS with the Gini coefficient module of LSIPT. A Gini index of 0 represents perfect equality, while an index of 1 implies perfect inequality. The Gini coefficients for MRS and MRD are 0.473 and 0.542, respectively, which indicates skewedness in wealth distribution in both systems but more skewedness in MRD than in MRS.

Table 7: Poverty incidence and income inequality indicators of livestock keeping households over the different production systems

	National	LG	MRD	MRS	Specialized
Total ruminant livestock-keeping households	10,552,431	1,500,000	3,959,071	5,029,036	64,824
Other livestock-keeping households	842,965				500
Incidence of poverty in %	25%	NA	35%	22%	0%
Depth of poverty	NA	NA	0.044	0.016	
Indicators of inequality (Gini coefficient)	NA	NA	0.542	0.473	

Source: Analysis based on data from LSIPT calculations.

4.2 Methodology and assumptions

From the LSA financial performance analysis of the livestock system, the average annual net income per animal for the various livestock systems has been computed as shown in Table 8. These are the values which are used to compute household income from livestock production. Different data sets were used for the lowlands and highlands to assess household income and vulnerability. For the LG, the Save the Children 2013 data set was used while for MRS and MRD, CSA-LSMS, 2013 data set was used.

The highland systems

Raw data from the 2013 CSA-LSMS survey was used to analyse the household economy in the highlands. Households with at least one animal (cattle, camel, sheep, goat, or poultry) were selected (1,747 out of 3,423 observations) and were organized into two samples: the MRD system (693) and the MRS system (1,054). Income from each livestock was calculated based on the individual livestock assets (for all species) coming from the household survey and LSA projections. Average costs (including intermediate costs) were estimated based on literature, expert opinion and product structure from LSIPT.

The households were then classified on two major criteria:

- Based on concept of dominance and three herd size classes. Dominant species is the species that contributes most of the livestock income to the household (cattle, sheep, goats, pigs, and poultry-dominant). This helps to identify the households that have the same dominant livestock production system and are likely to share the same constraints and options for improving their living conditions. This classification is the basis for the key aspect of the LSIP analysis, such as, value chain analysis, GDP, policy and investment, poverty, food security and vulnerability analyses. The analyses were conducted for each household group classified based on dominance concept.
- Based on households' level of total income (only three levels) and main activity. Once the three levels of incomes were defined, households were further classified based on their main livelihood activity. The main household activity is the activity that contributes over 50% to total household income. See below the four activity categories used in this analysis.
    - Livestock producers if the income from livestock production constitutes over 50%.
    - Agriculture (farmers or crop producers) if the income from agriculture represents over 50%.
    - Off-farm if earnings from outside the farm constitute over 50% of household income.
    - Mixed (crops and livestock) if none of the activities are producing 50% of the household total income.

The above two classifications (I and II) of the households' differentiate which households with which dominant livestock production systems are the poorest or have incomes that depend mainly on livestock production.

For each category of households, a multi-criteria assessment of their vulnerability was followed using various indicators of financial vulnerability, food security, poverty, or employment generation.

In the lowlands

Because the LSMS-CSA data set had too few observations and thus under-represented the livestock production systems of the lowlands, data from a Save the Children 2013 survey was used to assess the technical and financial performance of the livestock system in the LG. Since this data set is not household based, but was generated using panels of key informants for the relevant categories of households, it is unreasonable and could be misleading to use it for household analysis to give a precise estimate of livestock contributions to income, food security and nutrition as it was done for the highland system, etc. However, instead of abandoning the household analysis for the LG in its entirety, available data from the Save the Children 2013 survey was organized and aggregated to make a limited analysis to estimate technical and financial performance including income per animal in the LG. Hence the following results for the LG have to be taken with caution as the timing of the study and the method of data calculation are not in line with the highlands data. It is recommended that data collection and analysis should be re-conducted as soon as available in order to better portray the lowland households of Ethiopia and their systems (pastoral and agro-pastoral).

4.3 Livestock generated income

The table below shows average net income per animal over the projection period of 20 years under a BAU or without intervention scenario. The analysis revealed substantial variations in net income per animal across the production

zones. The highest net income per head of cattle was observed in the MRS followed by the MRD, and the LG provided the lowest. The higher per cattle income could be attributed to the additional income that comes from a relatively high yielding highland cow, and additional revenue that comes from organic matter and energy in the highland systems compared to the LG. Income from organic matter and energy in the LG is almost zero. Similar variation trend in net income was observed for sheep. Sheep from the highland fetch a higher price than those in the LG. This is due to consumer preferences and willingness to pay a higher price for the highland sheep breed. Goats in the LG generated a higher income than sheep. This is primarily due to the additional income that comes from goats' milk which is uncommon for sheep. No substantial variations in net income were observed for species between subsystems in the same production zone.

Table 8: Net income per head of animal and in tropical livestock units (TLUs) in all livestock systems under a BAU scenario

Lowlands (LG)			Highlands MRD			Highlands MRS		
System	Net income (in ETB)		System	Net income (in ETB)		System	Net income (in ETB)	
Cattle	Per animal	Per TLU		Per animal	Per TLU		Per animal	Per TLU
Agro-pastoral	1,001	1,001	B1 MRD	1,235	1,235	B1 MRS	1,456	1,456
Pastoral small	767	767	B2 MRD	1,126	1,126	B2 MRS	1,432	1,432
Pastoral medium	811	811						
Sheep	Per animal	Per TLU		Per animal	Per TLU		Per animal	Per TLU
Agro- pastoral	168	1,680	O1 MRD	263	2,630	O1 MRS	273	2,730
Pastoral small	175	1,750	O2 MRD	281	2,810			
Pastoral medium	178	1,780						
Goats	Per animal	Per TLU		Per animal	Per TLU		Per animal	Per TLU
Agro- pastoral	264	2,640	G1 MRD	264	2,640	G1 MRS	239	2,390
Pastoral small	263	2,630	G2 MRD	281	2,810			
Pastoral medium	293	2,930						
Camel	Per animal	Per TLU						
Agro-pastoral	5,872	4,194						
Pastoral small	5,861	4,186						
Pastoral medium	5,870	4,193						
Poultry (hen with eight followers)								
Village	583	58,300						
Specialized per head								
Feedlot small	3,995							
Feedlot medium	1,941							
SDP small	10,427							
SDP medium	13,351							
Layer	54							
Broiler	149							

Key: B: bovine (cattle), O: ovine (sheep), G: goats, C: camels. 1: Small, 2: medium, 3: large, OF: cattle fattening, OM: dairy

If converted to TLUs[6], small ruminants and poultry seem to generate a higher return than cattle. In the extensive system, camel in the LG remains a higher generator of income next to poultry per TLU basis but the highest of all on per head bases. Note that a TLU of poultry constitutes hundreds of hens with their followers which require a lot of space to maintain them.

6. Tropical livestock units, used to convert different species into comparable units. Cattle = 1; small ruminant = 0.1; 1 chicken =0.01; and 1 camel =1.4 TLU

Table 9 shows changes in average net income per animal under limited intervention of animal health, feed, genetics and policy etc. See Table 42 for the detail of the tested interventions. Compared to the average baseline situation the interventions led to a substantial increase in income per animal for all species across all production zones. For example, in LG on average income per cattle showed a 17% increase while MRS and MRD registered 11 and 58% increase respectively. MRS was found to be more responsive to interventions in terms of milk and beef production than LG and MRD. See the table below for detail performance of the other species in the different production systems.

Table 9: Net income per head of animal and in tropical livestock units (TLUs) in all livestock systems with intervention in 15 years

Lowlands (LG)			Highlands MRD			Highlands MRS		
System	Net income (in ETB)		System	Net income (in ETB)		System	Net income (in ETB)	
Cattle	Per animal	Per TLU		Per animal	Per TLU		Per animal	Per TLU
Agro-pastoral	1,135	1,135	B1 MRD	1,330	1,330	B1 MRS	2,379	2,379
Pastoral small	839	839	B2 MRD	1,299	1,299	B2 MRS	2,147	2,147
Pastoral medium	1,032	1,032						
Sheep	Per animal	Per TLU		Per animal	Per TLU		Per animal	Per TLU
Agro-pastoral	180	1,800	O1 MRD	294	2,940	O1 MRS	298	2,980
Pastoral small	188	1,880	O2 MRD	299	2,990			
Pastoral medium	192	1,920						
Goats	Per animal	Per TLU		Per animal	Per TLU		Per animal	Per TLU
Agro-pastoral	335	3,350	G1 MRD	321	3,210	G1 MRS	279	2,790
Pastoral small	335	3,350	G2 MRD	314	3,140			
Pastoral medium	364	3,640						
Camel	Per animal	Per TLU						
Agro-pastoral	6,332	4,523						
Pastoral small	6,291	4,458						
Pastoral medium	6,333	4,524						
Poultry (hen with eight followers)								
Village	583	58,300						
IFP	158	15,800						
Specialized per head								
Feedlot small	9,734							
Feedlot medium	2,626							
SDP small	12,369							
SDP medium	14,668							
Layer	78.87							
Broiler	62.44							

Key: B: bovine (cattle), O: ovine (sheep), G: goats, C: camels. 1: Small, 2: medium, 3: large, OF: cattle fattening, OM: dairy

Main results according to livestock dominant systems[7]

The following section discusses the contribution of livestock production to household income, nutrition, and employment generation. The analysis and the discussion is based on the household survey (LSMS) data and LSA projection for the highland systems, The LG is based on the limited data from the Save the Children survey and results need to be interpreted with caution.

7. Livestock dominant system refers to the species that contributes most of the total household livestock income.

Cattle are the dominant species in all three production zones and 88% of the households in MRS get most of their livestock income from cattle. It was found that livestock in MRS contributes 21–44% of the household total income, 2–13% of the household protein requirement and 4–7% of the calories requirement. Total net income of household per capita varies from ETB 3,901 in the sheep-dominant households to 13,136 in cattle-dominant ones.

In MRD and LG, 85% and 68% of the households get most of their livestock income from cattle, respectively. Total net income of household per capita varies from ETB 2,511 to 11,597 in MRD and ETB 1,009 (sheep dominant) to ETB 12,548 (camel dominant) in LG. Total net income from cattle-dominant households in LG differs from ETB 3,017 in small pastoral households to 5,376 in medium pastoral households with an average cattle herd size of 7.

See Table 10 for details.

Table 10: Livestock contribution by dominant system MRS

Dominant livestock farming system	% Household	Dominant species number	Total ruminant TLU	Poultry	Crop cultivated in ha	Average net income per person for the dominant system	Contribution of livestock to				
							Employment (people per month/year)	Calories	Protein	Total income	Poverty threshold (ETB 3,781)
Cattle											
Small	59%	3	2.4	1	0.3	11,753	11	5%	8%	35%	34%
Medium	29%	9	6.8	2	0.4	19,349	17	7%	13%	44%	75%
Sheep											
Small	4%	10	1.9	1	0.27	5,401	7	7%	2%	26%	23%
Goats											
Small	3%	13	1.8	1	0.18	5,898	7	5%	2%	28%	22%
Poultry											
Small	5%	1	0.5		0.25	5,969	6	4%	2%	21%	16%

Table 11: Livestock contribution by dominant systems in MRD

Dominant livestock farming system	% Household	Dominant species number	Total ruminant TLU	Poultry	Crop cultivated in ha	Average net Income per person for the dominant system	Contribution of livestock to				
							Employment (people per month/year)	Calories	Protein	Total income	Poverty threshold (ETB 3,781)
Cattle											
Small	45	2	1.7	1	0.24	16,682	17	3%	3%	32%	24%
Medium	40	6	4.7	1	0.34	12,527	16	4%	8%	39%	40%
Sheep											
Small	2	3	0.4		0.07	3,428	4	2%	0.34%	17%	7%
Medium	3	13	2.9	1	0.24	14,290	7	3%	5%	30%	35%
Goats											
Small	3	4	0.5	1	0.14	4,339	6	2%	0.4%	18%	11%
Poultry											
Small	7	2	0.3		0.14	6,656	5	2%	1%	19%	14%

In both highland and lowland systems livestock is important to the household economy and any shocks related to livestock can substantially affect households' income and livelihood and poverty level. In highland MRS and MRD systems, the contribution of livestock to meeting household nutritional requirements through home-consumption of animal products (meat, milk, and eggs) is about 10% of total requirements for protein coverage in cattle-dominant systems and less than 10% in small ruminants-dominant households. These households have to look outside their own livestock production to meet their requirements of protein and calories. Own cereal and pulses production is one source of calories and protein, but for those who have small or no crop land, an accessible and affordable product market is the best option to meet their nutrition requirement for both calories and animal-source protein. With intervention in the cattle-dominant system in MRS and MRD, the average contribution of livestock to household protein and calories requirement increased from a range of 8–13–17–84% and from 5–7–11–53%, respectively. This is due to an increase in production and home consumption of own livestock products.

Sources of income and income level (MRS and MRD)

The similarity between the two livestock production systems in the highlands (MRS and MRD) is maintained once the households are characterized according to their main sources of income[8]. Both highland systems portray very similar pattern in terms of land ownership, and distribution of households' source of income (livestock, off-farm, farm income). For example, households in cattle-dominant MRS, 18–27 % of households generate more than 50% their income from livestock and are classified by activity as 'livestock producers' and 56% from crop cultivation as 'cultivators'. Similarly, 24–41% of the households in MRD are 'livestock producers' and about 53% 'cultivators'. In both MRS and MRD cattle-dominant households, off-farm activities for income generation are not important. Results in Table 12 show that cultivation is an important livelihood activity for all households across all species dominance categories. Small ruminant and poultry-dominant systems are found in households deriving their living mainly from crops. However, in cattle-dominant households both livestock and cultivation are important in MRS and MRD. It is crucial to invest in cultivation to uplift the well-being of all livestock keepers in MRS and MRD, but it is more important to invest in both livestock and cultivation to bring changes in the lives of the large majority (>85%) of the households in MRS and MRD that are cattle dominant. The finding further demonstrates the need for the integration of livestock and crop production in MRS and MRD to improve the economics and welfare of households.

Table 12: Households in MRS by main livelihood activities

		Livestock producer	Mixed	Cultivator	Off-farm activities
Cattle	Small	24%	14%	57%	5%
	Medium	41%	10%	49%	1%
Sheep	Small	13%	17%	65%	4%
Goats	Small	16%	26%	53%	5%
Poultry	Medium	6%	8%	74%	12%

Table 13: Households in MRD by main livelihood activities

		Livestock producer	Mixed	Cultivator	Off-farm activities
Cattle	Small	18%	20%	55%	6%
	Medium	27%	15%	57%	1%
Sheep	Small	7%	29%	29%	36%
	Medium	13%	17%	65%	4%
Goats	Small	5%	15%	60%	20%
Poultry	Medium	4%	16%	53%	27%

As shown in Table 12 and 13 the proportion of households with no dominant main activity (mixed categories) is considerably high in both highland systems. These could be risk-averse households that tend to engage in diverse livelihood activities. On the other hand, households who get more than 50% of their income from off-farm activities are surprisingly low, in particular in MRS. Lack of opportunities for off-farm activities in rural highlands and limited skills and knowledge that off-farm activities may require and probably face shortage of labour may explain the low engagement of household in off-farm activities.

8. Main activity represents more than 50% of total income.

Poverty analysis

The poverty analysis section shows and discusses the extent and depth of poverty among livestock-keeping households in MRS and MRD. Income inequalities were also computed using the Gini coefficient. Using the available Save the Children 2013 survey data the poverty incidence among households in the LG was estimated. The contributions of livestock towards meeting the household poverty threshold were also calculated to understand the role of livestock in poverty reduction. The contribution of livestock to meet the poverty threshold differs across the dominant species. For this analysis, GoE monetary poverty line which is ETB 3,781/adult equivalent (MOFED, 2010/11) was used to compare against per capita income of the diverse group of livestock-keeping households.

Table 14: Total (absolute) and food poverty line in ETB (average price)

	1995/96	2010/11
Kilocalorie per adult per day	2,200	2,200
Food poverty line per adult person per year (ETB)	648	1,985
Total poverty line per adult person per year (ETB)	1,075	3,781

Source: MOFED 2012

The household per capita income in the LSMS was converted into per capita per adult equivalent using the Organisation for Economic Co-operation and Development

(OECD) equivalence scale. The OECD scale can be represented by the following formula:

AE = 1+0.7(# of adults-1) +0.5(# of children); where AE refers to adult equivalent.

The contribution of livestock to the poverty threshold is 34–75% in cattle-dominant and 16–23% in poultry and small ruminant-dominant households in MRS. Similarly, it is 24–40% in cattle-dominant and 7–36% in poultry and small ruminant-dominant households in MRD. This finding again demonstrates the far greater importance of cattle in the highland systems in MRS and MRD, than the poultry and small ruminants. The pattern remained the same with interventions.

Tables 15 and 16 show the 'without' and 'with' intervention scenarios of poverty incidence and depth in MRS and MRD across the different species dominant households. Incidence of poverty is the proportion of the population whose income or consumption is below the poverty line, that is, ETB 3,781. On the other hand, depth of poverty measures how far households are far from the poverty line, which is an important indicator of how much resources are needed and the efforts needed to lift up the poor from poverty.

The average poverty incidence without intervention in the MRS is 27% which is close to the national average which is 25%. With intervention, it declines to 19% on average over the projection period. The poverty gap or the depth is 0.016 and 0.01 without and with intervention respectively. Overall it is a small gap and it is feasible to narrow it down further to move most if not all livestock keepers in MRS above the poverty line.

Table 15: Poverty incidence and depth in MRS by dominance

	Without change			With change		
	Incidence	Depth	Distribution	Incidence	Depth	Distribution
Total	0.27	0.016	1	0.19	0.01	1
Cattle						
Small	0.32	0.017	0.69	0.21	0.012	0.683
Medium	0.094	0.003	0.102	0.032	0	0.05
Sheep						
Small	0.51	0.059	0.070	0.43	0.049	0.08
Goats						
Small	0.42	0.015	0.056	0.45	0.016	0.09
Poultry						
Small	0.46	0.042	0.081	0.71	0.012	0.08

As shown in Table 15 the spread of the poverty incidence is relatively high among the households with small ruminant and poultry dominance which was not a surprising finding as it is the poor and the disadvantaged, such the women, who

heavily depend on poultry and small ruminants (because they are small capital investments) for their livelihoods. The highest incidence appears to be with sheep-dominant households. This pattern remained the same in 'without' and 'with' situations.

The poverty incidence and depth, 35% and 0.04, respectively in MRD is much higher than in MRS in both 'with' and 'without' intervention situations. The poverty incidence among small sheep- dominant households is the highest, 71%, compared to 26% among medium sheep-dominant households. This shows the importance of a higher flock size to reduce incidence of poverty among sheep-dominant households in MRD. Even among cattle-dominant households the poverty incidence is high, 42%, among small cattle keepers compared to the same group in MRS. It seems herd and flock size is crucial in MRD to help households get out of poverty.

Table 16: Poverty incidence and depth in MRD by dominance

	Without change			With change		
	Incidence	Depth	Distribution	Incidence	Depth	Distribution
Total	0.35	0.04	1	0.35	0.04	1
Cattle						
Small	0.42	0.046	0.536	0.415	0.05	0.536
Medium	0.22	0.019	0.248	0.217	0.015	0.241
Sheep						
Small	0.714	0.069	0.040	0.75	0.123	0.048
Medium	0.26	0.0287	0.024	0.25	0.025	0.024
Goats						
Small	0.55	0.0534	0.045	0.58	0.052	0.056
Poultry						
Small	0.49	0.142	0.10	0.61	0.0785	0.10

Tables 17 and 18 show poverty incidence and depth by livelihood activities. It appears that in both MRS and MRD systems the poverty incidence is high (highest in MRD) among 'livestock producers' i.e., those who are getting more than 50% of their income from livestock production. The incidence is the lowest among the 'cultivators' who are getting more than 50% of their income from crop production followed by the 'mixed' category where none (crop, livestock or off-farm activities) are producing >50 of the household income. The pattern remained the same in MRD even with intervention. However, in MRS the poverty incidence among livestock producers was reduced by half from 48–25% with intervention. In MRD under 'with' and 'without' intervention scenarios, the poverty incidence is low among cultivators. In MRS cultivators and mixed groups have low incidence but with intervention the livestock producers joined the low incidence group. This may be attributed to the health, breed and feed interventions and effective response of the MRS to the interventions.

Table 17: Poverty by livelihood activity MRS

	Without change			With change		
	Incidence	Depth	Distr.	Incidence	Depth	Distribution
Total	0.270	0.016	1.000	0.190	0.011	1.000
Mixed	0.299	0.014	0.140	0.246	0.009	0.141
Livestock producer	0.476	0.026	0.484	0.249	0.018	0.492
Cultivator	0.137	0.011	0.281	0.100	0.008	0.256
Off-farm activities	0.587	0.026	0.095	0.564	0.024	0.111

Table 18: Poverty by livelihood activities MRD

	Without change			With change		
	Incidence	Depth	Distr.	Incidence	Depth	Distribution
Total	0.354	0.044	1.00	0.357	0.043	1.00
Mixed	0.459	0.068	0.228	0.430	0.055	0.210
Livestock producer	0.739	0.081	0.415	0.738	0.081	0.444
Cultivator	0.142	0.012	0.224	0.139	0.013	0.210
Off-farm activities	0.667	0.129	0.130	0.660	0.156	0.133

4.4 Poverty and income inequality

MRD has larger proportion of poor people than MRS. It also exceeds MRS in the total number of poor livestock-keeping people. There are unverifiable findings based on the Save the Children data that put the LG with the largest proportion of poor people in all the three production zones. Since there are no household survey data for the LG it is difficult to report the finding with confidence. It is, however, safe and reasonable to conclude that in absolute number most of the poor livestock keeping people are found in the MRD and in terms of proportion, LG takes the largest proportion. MOFED 2012 reports a similar pattern with regard to proportion of poverty incidences in the nation in which case the largest proportion of people below the poverty line were found in the Afar and Somali regions in the LG. This has a significant policy implication where to focus on pro-poor development efforts. Pending an additional study, MRD and LG seem to be priority production zones for poverty alleviation.

Income inequality was also estimated in the highlands with the Gini coefficient module of LSIPT. The Gini index measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 1 implies perfect inequality. The Gini coefficient is 0.473 in MRS and 0.542 in MRD. These LSIPT results thus indicate that income inequality is high in Ethiopian livestock keeping households in the highlands and it is higher in MRD than MRS. The coefficient showed slight changes under 'with intervention' situation. It drops to 0.449 and 0.54 in MRS and MRD respectively. More research on whether income inequality is growing in the highlands is recommended using analysis of quantitative time series data.

The indicators used to assess the contribution of livestock to the household economies of livestock keepers in the highlands revealed the fact that livestock is crucial to the food and nutrition security, income, employment and poverty reduction of households in these areas. Results also showed that cattle are more important than the other livestock species and targeting cattle for investment to bring changes in the household economies is essential and appropriate. It was as well demonstrated that integration of livestock with the crop production would have a complementarity benefit. Moreover, off-farm activities were found to be limited in both MRS and MRD. It requires a targeted extension activity to raise awareness and provide training among livestock keepers to promote off-farm activities that would complement livestock and crop production in all production zones.

5. Main results of value chain assessment

The LSIPT was used to carry out an assessment of the livestock value chains in Ethiopia, entailing mapping of the value chains and subchains and an analysis of the price structure or price changes and gross margins along the chains. First, the value chains and important sub-chains were identified and mapped. Then, for the value chain descriptions, the production entering each sub-chain was derived from the EcoRum production assessment module for each farming system minus the home consumption and direct sales to neighbours. This estimate of the total production entering each sub-chain was compared with information from other secondary sources to arrive at the estimate used in the analysis of price changes and value addition. Finally, the incentives along the sub-chains were analysed by assessing percentage price increases at each stage in the chains and the gross margins. The gross margins realized by each value chain actor are the margins before costs that are deducted for products sold at each stage in the chains. The main results of the value chain analysis are summarized here for selected value chains. The details of the assessment are provided in the text, tables and maps in Annex 2 of this report.[9]

5.1 Dairy value chain and sub-chains (formal and informal)

Cow milk, camel milk and butter are the main commodities entering the dairy value chains. There are both formal and informal sub-chains, for both the domestic and export markets for all three commodities (see the dairy value chain maps, Annex 2, Figures 24–26 for cow milk, camel milk and butter, respectively). For the cow and camel milk value chains, we found only informal sub-chains in the LG, serving both export and domestic markets. However, we found both formal and informal sub-chains involving the specialized dairy systems (SDS) and the traditional smallholder systems in the MRD and MRS, but these sub-chains serve only the domestic highland markets. Meanwhile, the 'kibbeh or kibe' (traditional fermented) butter value chain is distinct and so far, still mostly informal, and the milk producers process their milk into butter themselves.

All these value chains and sub-chains provide important opportunities for development activities and thus for the LSA planning process because farm-gate prices are high relative to world market prices, while dairy productivity is low relative to nearby countries with similarly conducive agro-ecological conditions for dairying. Thus, significant opportunities exist for productivity increases at the primary production level and efficiency gains at all post-production levels in the value chains (especially in the supply and product distribution chains and in processing), with the potential to lead to increased benefits for all the actors in the chains.

As shown in the dairy value chain maps for cow and camel milk (see Annex 2, Figures 24 and 25) the total annual cow and camel milk production is 5,030 million litres out of which 80% is cow milk and the remaining 20%, or 997 million litres, is camel milk. In addition, there is production of 152 million litres of goat milk, but only very small quantities enter the value chain. The total monetary value of the milk based on the average farm gate price[10] is estimated to

9. The value chain maps include only the verified percentages or shares of products for each sub-chain for which we were able to obtain reliable data

10. The average farm gate price for cow milk was ETB 10.5, for camel milk it was ETB 8.25 and for butter ETB 116.6/kg. These figures are obtained by averaging the producer price at which each type of milk sold through different channels (as of 1 December 2013).

be USD 2.8 billion[11], which was 6.9% of the GDP of the country[12] in 2013. Cow milk is produced in all the three[13] production zones and in the specialized commercial systems of the country. The traditional smallholder production systems in all zones (in MRD, MRS and LG) contribute 88% of the total cow milk production of the nation. The contribution of the small and medium-sized SDS is thus only 12%. The main features of the smallholder-dominated systems are low productivity from local breeds (producing an average of only 190 litres of milk per animal per year)[14], and a low level of marketed surplus due to the low-level productivity and hence the low level of commercialization. Only 19% or 780 million litres of the total cow milk production entered the value chain in 2013.

As shown in Price analysis Annex 2, Table 54, for cow milk not much value addition occurs through transformation in the LG (grassland system). However, in the other production zones (MRS and MRD), the average price increases and margins are attractive for most actors, especially for processors and food services providers who are involved in value-addition through processing (or product transformation). Moreover, in the formal SDS system—the producer to processor to retailer to consumer sub-chain, it is observed that for each ETB 100 the processor invests he gets an average gross margin of ETB 82%. This high gross margin indicates a significant opportunity for investment in processing, and for every ETB 100 the retailor invests he gets ETB 10 or an 18% gross margin when he/she sells to the consumer. Retailers get far lower gross margins than processors, indicating more retailers in the value chain and thus greater competition among retailers. Since the farm gate price of cow milk is high, and there are many smallholder producers of milk, this results in cow dairying making an important contribution to GDP. Furthermore, since the price increases and gross margins for processors of cow milk is also high in both the formal sub-chain in the highlands (with mainly family or smallholder producers) and also the SDS milk sub-chain, this indicates further investment in value addition processing could add still more to smallholder income and poverty reduction by creating an assured market outlet for smallholder milk producers, thus stimulating more smallholder milk production. Such dairy development could also contribute more to GDP through the value addition from increased processing.

In the case of camel milk, it is reported that 100,000 litres are exported informally every day to Somalia and Djibouti, and camel milk processing plants are coming up. As shown in Annex 2, Table 54, in cross-border and domestic informal camel milk sub-chains, the prices paid to producers are almost the same, although generally less than for cow milk, but the total margins for camel milk are quite high, 175% for the cross-border sub-chain and 135% for the domestic sub-chain. Most actors get attractive returns in these camel milk systems. Informal camel milk exporters receive 50% of the gross margin, followed by food service providers (Somali restaurants) who receive 44%, traders 39%, and retailers 28.6% (for details see Annex 2, Table 54).

Also, as seen in Annex 2, Table 54 for the milk producers in the traditional butter value chain, the implications of the relatively small price changes and gross margins are the following. Since in the traditional butter value chain the price changes are small and the gross margins are more or less equally shared, this indicates many competing actors are involved and sharing the gross margins. These primary milk producers, meanwhile, who are also processing their milk to make traditional fermented 'kibe' butter, are able to compete well and are getting a fair share of the total margins in the chain.

5.2 Formal and informal beef and live cattle export sub-chains

About 85% (758,800 TECs) of the total cattle volume entering the cattle value chain passes through the beef chains and this reaches both domestic and foreign consumers through five sub-chains. However, in Annex 2 Table 55, only one beef sub-chain is presented since the price changes and gross margins in the sub-chains are very similar (including for slaughterhouses and backyard slaughter). Two of the five sub-chains serve domestic consumers

11. USD 1 = ETB 19.35 (as of 1 December 2013)

12. According to Wikipedia the estimated GDP of Ethiopia in 2012 was USD 43.13 billion

13. LG, MRD and MRS production zones, and the SDS.

14. Average milk productivity in the three traditional production zones

through beef slaughtered in formal slaughterhouses (one sub-chain in the mixed systems (MRS and MRD), and one in the grassland system). About 3% and 25% of the meat in the chain are supplied to individual consumers though formal slaughterhouses, respectively, in the grassland and mixed systems. Another two sub-chains in the beef value chain serve the domestic market through backyard slaughter. About 13% and 59% of the beef supplied to domestic consumers is processed through backyard slaughter respectively in grassland and mixed systems. The fifth beef sub-chain is the formal export value chain where only 0.4% of the total beef entering the chain is exported to different African and Arab countries. Ethiopia beef exports are generally not competitive internationally; domestically consumed beef can sell at twice the export price, but exporters benefit from foreign exchange advantages. Most of the exports from Ethiopia are live cattle exports.

Annex 2, Table 55 shows that for collectors and traders, a 1% increase in price paid to these actors yields almost a similar percentage increase in the gross margin. This is slightly higher for big traders than for small traders, where a 1% increase in price paid to a big trader yields more than 1% increase in gross returns. For butchers, a 1% increase in price relative to what has been paid to the big trader increases their gross margin by more than 2%, meaning their gross returns more than double. Moreover, butchers obtain about 84% of the total gross margin generated in the beef value chain, with 14% going to the other actors. This can mainly be explained by collusion among the butchers enabling them to control the beef market and impose artificially high prices on consumers. Once the price of beef is raised for any reason, including increases in the price of slaughter animals, it usually does not go down.

The live cattle value chain is also divided into formal and informal export sub-chains, as seen in Annex 2, Figure 27. In the formal live cattle sub-chain, exporters follow government rules and regulations when exporting animals. One of the basic requirements is quarantine where animals are vaccinated against major transboundary diseases and inspected for 21 days in order to get export documentation. About 29% and 8% of the live cattle from the grassland and mixed systems, respectively, are exported through the formal channel. Meanwhile, about 58% and 5% of the live animals come from the grassland and mixed systems, respectively, and are exported through informal channels.

In the informal export sub-chain, as shown in Annex 2, Table 55, for all value chain actors except the live animal exporters (who get a 116% price increase and 89% gross margin), a 1% increase in the price of animals yields less than a 1% increase in the gross margin. In the formal market, by far the highest percentage increase in price of animals (82%) is obtained by feedlot operators who get 74% of the gross margin generated in the sub-chain, but they also have very high costs from concentrate feed and other inputs, and face greater price risk if they cannot sell their animals in a timely fashion. Meanwhile, the informal cattle exporters get most of their 89% gross margin mainly because they are doing opportunistic transactions without having to feed the animals or fulfilling any bureaucratic requirements, thus buying and selling whenever they get attractive prices. Their short chains also contribute to the high proportion of the total margin they can realize. Informal exports are more than double the formal exports, which has a very significant impact on the national economy, in terms of both lost government revenues and high domestic prices.

5.3 Live camel and camel meat value chain and sub-chains

The value chain mapping and assessment (see Annex 2, Figure 29) shows that about 73,550 TECs of camel meat is estimated to enter the camel value chain per annum in Ethiopia. However, unlike ruminant animals, consumption of camel meat is not common in Ethiopia. Thus, the camel value chain is mainly the live camel value chain wherein camels are exported. There are formal and informal live camel sub-chains exporting camels to Sudan, Somalia, Djibouti, and the Middle East and North African countries. The formal camel sub-chain is the one in which animals are mainly exported through Metema to Sudan. Animals are transported from one end of the country, from as far as Moyale on the border with Kenya (and sometimes from Kenya) to Metema with a stopover at Adama to fulfil the quarantine requirements in order to get export permits. About 36% of the total volume of animals entering the camel value chain passes through this formal sub-chain. The other 64% of camels that enter the value chain are exported informally. The main reason for the informal export business is the difficulty in fulfilling formal export requirements. Analysis of the costs and margins along

the camel value chain (see Annex 2, Table 55) shows the two sub-chains are very similar in terms of margins obtained by the different actors. Efforts to properly identify the root causes of the informal trade are needed to take appropriate action to lower the transactions costs and increase formal exports and foreign exchange earnings.

5.4 Mutton and goat meat value chains and sub-chains

The goat value chain and sub-chains are depicted in Annex 2, Figure 28. The value chain assessment showed there are about 64,430 TECs of goat meat entering these value chains per annum. This is supplied through four sub-chains. Two of these supply live goats to individual consumers for slaughter at home (backyard slaughter). About 47,997 TECs of goat meat is consumed by individual consumers in this sub-chain out of which 43,810 TECs are supplied from the mixed systems. The remaining balance is supplied by the grassland systems.

The significant recent development in the goat value chain is a very high export demand for goat meat from Ethiopia. About 80% of meat exported to the Middle East is goat meat. About 12% of the goat meat that enters the value chain from lowlands (7,924 TECs) is exported to these countries per annum. Two of the six sub-chains supply live goats to the export market (one formal and one informal). Only 0.3% (193 TECs) of the goat meat entering the value chain is formally exported and 9.1% (5,992 TECs) of the total goat meat is exported through informal sub-chain. This indicates the amount of foreign exchange earnings the country is losing due to the informal livestock trade. This could be captured in the formal sub-chain through government facilitation of marketing for the pastoral community living close to borders.

The sheep value chain and sub-chains are also depicted in Annex 2, Figure 28. A total of 60,464 TECs of mutton are estimated to enter the sheep value chain. There are six sub-chains out of which three are the sub-chains serving domestic consumers, while the rest serve the export market (one for mutton and two for live export sub-chains). In Annex 2, Table 55, only two of the six mutton sub-chains are depicted. The most important market segment for sheep is domestic highland consumers, due to the high and growing population and incomes of highland consumers, and their strong preference for highland mutton rather than goat meat. About 56% (27,247 TECs in volume) of sheep entering the value chain is consumed by the highland market segment and is supplied by the highland sub-chain.

The first important domestic sub-chain supplies slaughter sheep to individual consumers. About 5,514 TECs of mutton are traded through this sub-chain. Demand for animals in this sub-chain follows festivals such as Easter, Christmas, New Year and Ramadan and is thus seasonal in nature. Individuals prefer well-conditioned (fattened) sheep so producers and traders target these festivals. Hotels are the other important domestic buyers of mutton. Demand for dishes made from mutton is also very high in hotels in the highlands, the second sub-chain. About 24% (or about 14,511 TECs in volume) of the mutton entering the value chain is absorbed by hotels. Hotels and restaurants usually buy mature ewes not kept for breeding purposes.

The other three sub-chains supply male, intact yearlings of good body condition to export abattoirs. The highest numbers of animals slaughtered by the export abattoirs are goats and sheep, rather than cattle, but this makes up only 10–20% of their total slaughter operation. As a result, this channel handles only 2% of the mutton that enters the value chain. Live sheep are also exported from Ethiopia mainly to Saudi Arabia for sacrifice at the Hajj ceremony. About 6% (3% each through formal and informal channels) of the mutton entering the value chain is exported during this time. Male, intact sheep from grasslands are needed for this purpose since highland sheep cannot tolerate the high temperature during shipment.

Annex 2, Table 55 shows that small sheep traders supplying slaughter animals to big traders and export abattoirs get the highest proportion of the gross margins (38%) generated in the grassland mutton sub-chain. This is mainly because they are the major collectors of animals from primary and secondary markets and use their network of collectors to bring them the types of animals required by the market. Hotels get 41% of the total margins in the mixed system mutton sub-chain because they process the meat into different dishes according to consumer tastes and preferences and add the greatest value to the product. The margin actually varies according to the size and standard of the hotel.

Bigger hotels prepare better quality food and charge higher prices, thus increasing their margin per unit of mutton sold. Similar to that of live cattle exporters, informal live sheep exporters get the highest proportion (42%) of the gross margin the in sub-chain since they do this business during a very high demand season (Hajj).

Similar to mutton, the highest proportion of gross margin (87%) generated in the mixed system goat meat sub-chain is obtained by hotels since they are adding value to the meat for the final consumable products. The percentage increase in price of meat is also highest for this sub-chain.

5.5 Hides and skins value chains and sub-chains

The hides and skins value chain as described in Annex 2, Figure 30, includes hides of cattle, and skins of sheep and goats, but is detailed only from producers to farmers and consumers (in this case the domestic leather producers). The value chain from farmers to consumers, domestic or export, is not detailed due to lack of data. It is estimated that 80% of cattle and 90% of shoats are slaughtered in backyards. Thus, the bulk of hides and skins in the value chain are collected from backyard slaughter and a strong network of value chain actors is required to recover all the hides and skins produced in each and every corner of the country. The hides and skins value chain is composed of a network of collectors, small and big regional traders, and tanners. About 105,714 tonnes of hides and skins are collected annually in this value chain.

The price analysis of the hides and skins sub-chains (see Annex 2, Table 56) shows that producers are paid the same prices per kg, whether the hides and skins go to modern or traditional tanneries. The average sheep skin price paid to producers (ETB 20 per kg) is two higher than the average goat skin prices (ETB 10 per kg), and almost seven times higher than other hide prices per kg (ETB 3 per kg). Prices to consumers are basically the same, as well, whether they buy from modern or traditional tanners. Most of the gross margins are captured by the tanneries since they add the most value by processing the hides and skins.

Traditional tanners get 100% of the gross margin since they buy directly from producers, and modern tanners get from 33–75% since they get more from collectors and traders in the chain. In any case, processing hides and skins is a lucrative business in Ethiopia and there appears to be significant opportunities for investment in more tanneries given the growing numbers of animals and the opportunity to do a better job in collection of hides and skins.

5.6 Poultry meat and eggs value chains and sub-chains

The poultry meat and eggs value chains and sub-chains are depicted in Annex 2, Figures 31 and 5.9, respectively. The value chain mapping and assessment (see Annex 2, Figure 31) revealed that the total production of poultry meat was 47.7 thousand tonnes in 2013, out of which 99% came from village backyard traditional system and 1% from commercial poultry farms (0.4% from layers and 0.6% from broilers). Village producers consume or direct sell 49% of the total production and the volume that enters the value chain is 51%. Almost 100% of broiler meat and 96% of layers' meat enter the value chain. The supermarket sub-chain absorbs only 7.6% of the total meat, which comes exclusively from commercial farms. About 92.4% of the backyard cocks and layer meat is channelled to consumers through traders.

Annex 2, Figure 32, shows that total egg production is estimated to be 138.6 million from the traditional backyard (79%) and 36.1 million from the commercial farms, (21%). Of the total volume of eggs reaching the value chain 57% comes from the traditional systems 43% from commercial farms. The supermarket sub-chain absorbs about 50% of the eggs entering to the value chain, from which 73 % comes from backyard village producers and 27% from commercial poultry farms. The traders-direct-to-consumers sub-chain accounts for the remaining 50% of the eggs, of which 40% comes from village backyard producers and 60% comes from small-scale poultry farms.

Although six major poultry meat sub-chains were identified in the value chain analysis, for the analysis of prices and margins, due to similarities in value chain structure and prices, these six sub-chains were consolidated into four channels which are aligned with the backyard and commercial production systems, or two for poultry meat and two for eggs, as is shown in Annex 2, Table 51.

Annex 2, Table 51 shows that the margin gained by the supermarkets is more than three times higher in the commercial system than the backyard system. Meanwhile, the poultry meat price gained by producers in the commercial system is ETB 10 higher than that of the backyard system, and they gain more of the total gross margin (74%), as opposed to 71% in backyard systems. The backyard system is, however, still an attractive investment for family backyard producers of chicken meat and eggs and the potential for improvement through crossbreeding is also significant. Poultry is an attractive investment to reduce poverty among the poor. The demand for both backyard and commercially-produced meat and eggs is both high and increasing rapidly. For eggs, the consumer price is the same in the two systems (ETB 2.5 per egg), but the price received by commercial producers is 22% higher. Commercial egg producers also gain more of the total gross margins (78%), as opposed to 64% in backyard systems, but their costs are likely much higher.

6. Livestock trends

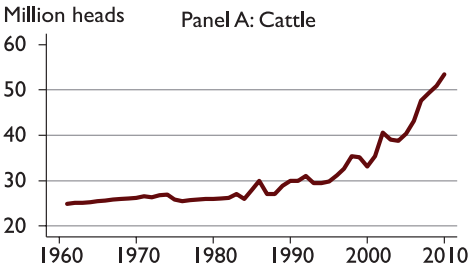
6.1 Key livestock trends

The livestock population in Ethiopia has grown significantly over the last decade since experiencing a major decrease in numbers in the early 1990s. However, in terms of productivity per animal; there has only been a small improvement in dairy cattle and chicken meat. Beef production per animal (in kilograms) from cattle has declined in recent years and meat production from sheep and goats has remained stagnant. Over the last several decades the per capita production and consumption of meat and milk was in continuous decline. However, since 2000, consumption of both livestock products has started to increase.

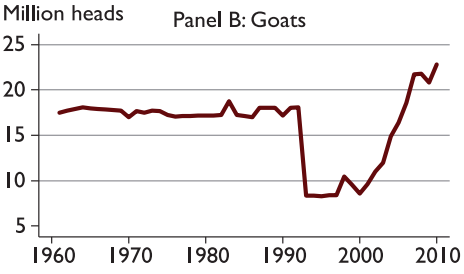
The development of the modern, intensive commercial livestock subsector is captured by the changes in the export performance in terms of value of exports. Despite the productivity decline observed above, the contribution of the livestock sector to export earnings has been steadily increasing. The 10% contribution of the livestock sector to total export earnings in 2013 is significant (ERCA 2013) and by inference has positively contributed to foreign exchange earnings. The main contribution of the livestock sector to foreign exchange earnings comes from live animal exports as opposed to the export of processed livestock products. Live animal export accounted for 69% the total exports from livestock in 2013. Both live animal and livestock product prices are trending sharply upwards indicating growing incentives to invest in the livestock sector.

The following graphs support the information above and depict livestock sector trends:

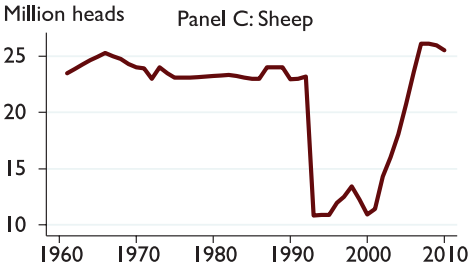
Figure 8: Trends in livestock population in (million heads) (1960–2010).



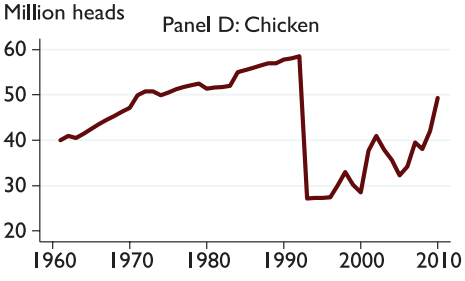
Source: Prepared by authors based on FAOSTAT database.



Source: Prepared by authors based on FAOSTAT database.



Source: Prepared by authors based on FAOSTAT database.



Source: Prepared by authors based on FAOSTAT database.

Figure 9: Trends in livestock productivity in kilogram per animal (1960–2010).

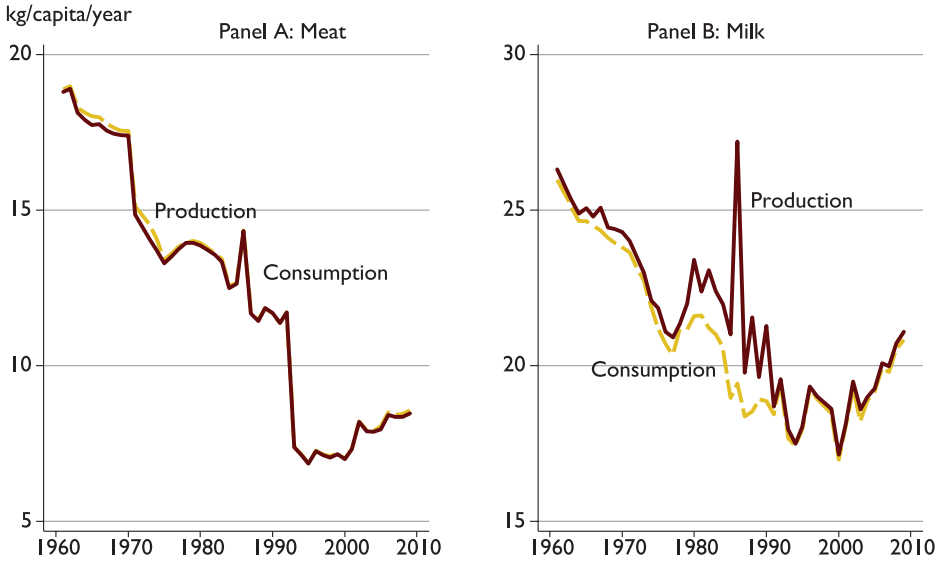
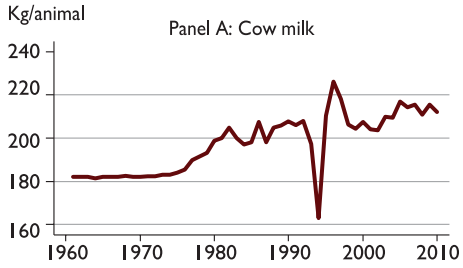
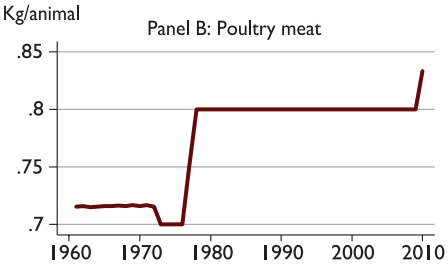


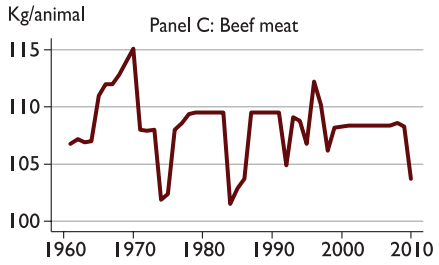
Figure 10: Trends in annual per capital meat and milk production and consumption (1960–2010).



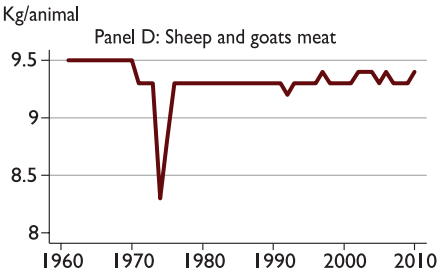
Source: Based on FAOSTAT database.



Source: Based on FAOSTAT database.

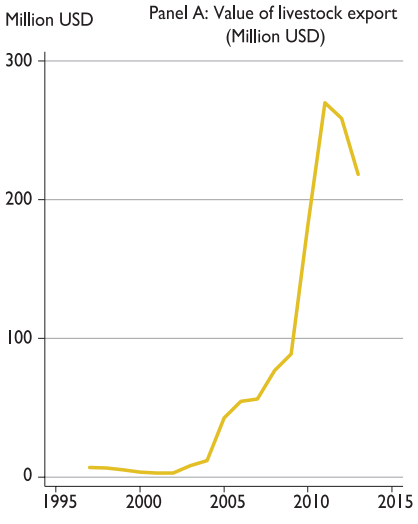


Source: Based on FAOSTAT database.

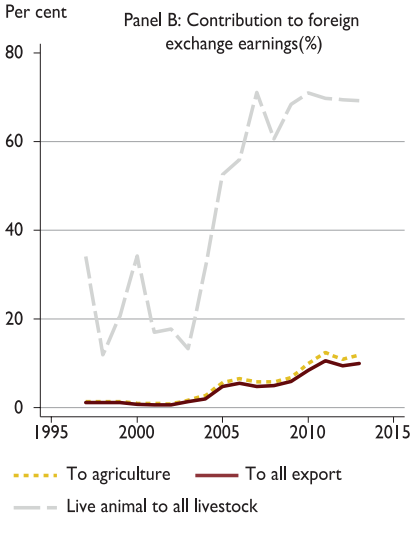


Source: Based on FAOSTAT database.

Figure 11: Trends in livestock contribution to foreign exchange earnings (1997–2013).

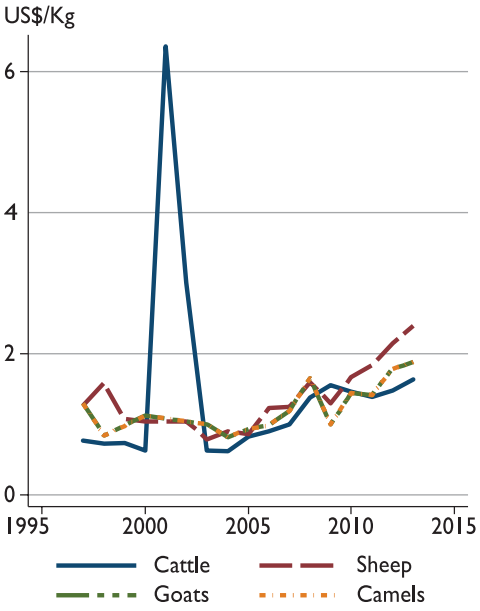


Source: ERCA (2013).

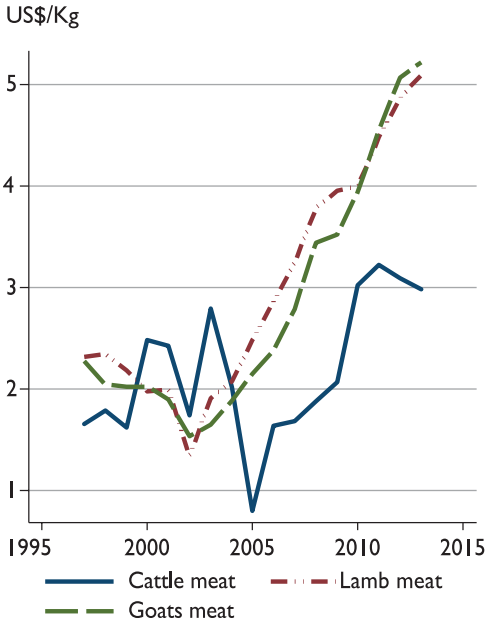


Source: ERCA (2013).

Figure 12: Trends in live animal and livestock product export prices (FOB USD/kg), (1997–2013).



Source: ERCA (2013)



Source: ERCA (2013)

6.2 Livestock sector GDP

Background

Policy decisions on resource allocation to a particular sector are often based on the relative importance of that sector in the national economy. One of the most common indicators of this relative importance is the share of a sector as it contributes to the national gross domestic product (GDP). The contribution of livestock to the Ethiopian GDP is expressed as the total added value using the total production (Q) of all animal products (meat, milk, eggs, hides and skins, manure and traction) generated by each livestock production system (S), the average price of each products (p) and the percentage of intermediate costs (% CI). The added value is represented in the following formula:

$$\text{Total AV} = \sum_{S,A} Q * p * (1 - \%C1)$$

Using estimates of the relative share of products that have been self-consumed, bartered or sold; several indicators of GDP can be distinguished:

- The direct monetary GDP consists of all the monetary transactions for animal products, including goods for final consumption (meat, milk, eggs, etc.) or intermediate goods destined for another sector of the economy in the downstream sectors (traction, manure). This is the indicator which is normally reported.
- The direct non-monetary GDP consists of the non-commercial exchanges (barter) of final consumer goods. For example, the exchanges of milk for cereals can still be common practice in some parts of the world and home-consumption of animal products (valued at market price).
- The indirect GDP consists in the contribution of livestock production to agriculture in terms of manure and draught power (as intermediate products) to the own farm.

Finally, the addition to the GDP generated at the production stage was also defined for the downstream value chains, aggregating the value added from various sub-chains. This is represented below.

Table 19: GDP contributions in the downstream value chains

Final consumer or intermediate goods in livestock related industry	Meat Milk Wool Skins Organic Matter (fuel)	Exchanges Cash In kind* Home consumption use on farm	Type Direct/monetary Direct/non-monetary Indirect
Intermediate goods for agriculture and non-livestock industries	Organic Matter Traction	Exchanges Cash In-kind Home consumption use on farm	Type Direct/monetary Direct/non-monetary Indirect

*Milk versus cereals /manure contracts (manure versus crop residues)

Production

As a first step, the total production is estimated through LSIPT and compared with various other available estimates (FAOSTAT, CSA and MoA).

Table 20: Estimated production of the different commodities from LSIPT model runs, as compared to other estimates

Item	Unit	LSIPT (est. 2013)	FAOSTAT (est. 2011)	CSA (est. 2012-2013)	Others (GTP performance report MOA 2012/13)
Beef	TEC	810,771	444,229	NA	875,000
Mutton	TEC	102,211	87,633	NA	107,000
Goat meat	TEC	94,230	68,276	NA	61,000
Camel meat	TEC	73,554	20,496	NA	10,000
Poultry meat	TEC	47,737	65,151	NA	40,000
Total meat	TEC	1,128,504	685,785	NA	1,094,000
Eggs (103)	Number	174,718	87,800	85,490	109,000
Cow milk (103)	Litres	4,033,435	4,057,998	3,804,991	3,330,000
Camel milk (103)	Litres	996,930	NA	165,117	176,000
Goat milk (103)	Litres	152,107	NA	N/A	NA
Organic matter (103)	Tonnes	67,750,198	NA	N/A	NA
Draft (days)	Number (1,000s)	617,314	NA	N/A	NA

GTP – Growth and Transformation Plan

Table 20 shows considerable variation in the available estimates. In general, FAOSTAT estimates are based on livestock population figures and average productivity per head for the entire population and therefore a generalized estimate. MoA estimates are also more approximate and generalized. LSIPT is based on CSA livestock surveys combined with expert opinion of productivity per head estimates according to production systems. Due to the rigorous LSIPT research methodology, LSIPT data therefore can be considered the most reliable livestock data presently available. Concerning beef, the LSIPT estimate is about midway between the FAOSTAT and MoA figures. For camel meat and milk, the LSIPT estimates are considerably higher than other available figures, because of the considerably higher camel population data in LSIPT. The higher LSIPT figures for milk and eggs can be attributed to the higher home consumption.

GDP estimate of livestock value addition at the production stage

Table 21 provides a summary of the composition of the subsector direct added value at the farm/herd level. As shown, as a subsector, milk contributes the most value to the livestock sector, and significantly more than beef and other meat.

Table 21: Summary of the composition of the subsector direct added value at the farm/herd level 2013

Commodity	Value (ETB million)	Share
Beef	30,688	20%
Small ruminant meat	11,913	8%
Camel meat	3,226	2%
Poultry meat	3,592	2%
Milk	51,352	34%
Eggs	307	0.2%
Hides and skins	22	0.1%
Organic matter	27,866	18%
Draft	21,770	14%
TOTAL	150,736	100%

The distribution of the total value added (monetary and non-monetary values) of the different commodities over the three main agro-ecological zones is provided visually below.

Figure 13: Contribution of red meat to GDP by agro-ecological zones.

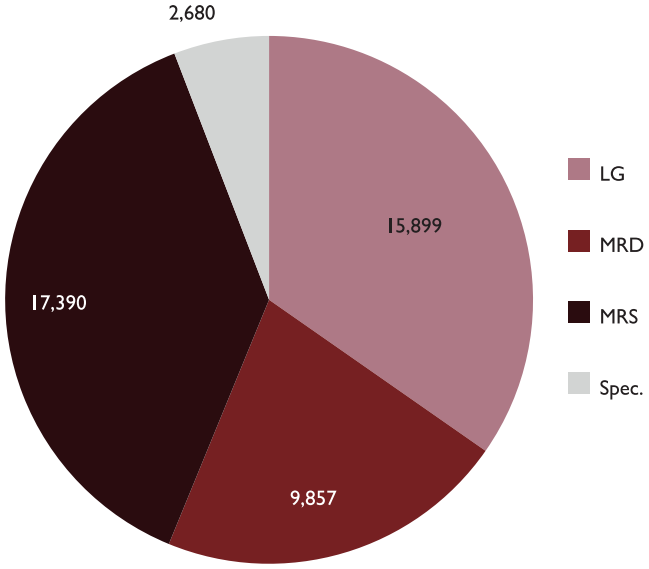


Figure 14: Contribution of milk (cattle, goat and camel milk) to GDP by agro-ecological zones.

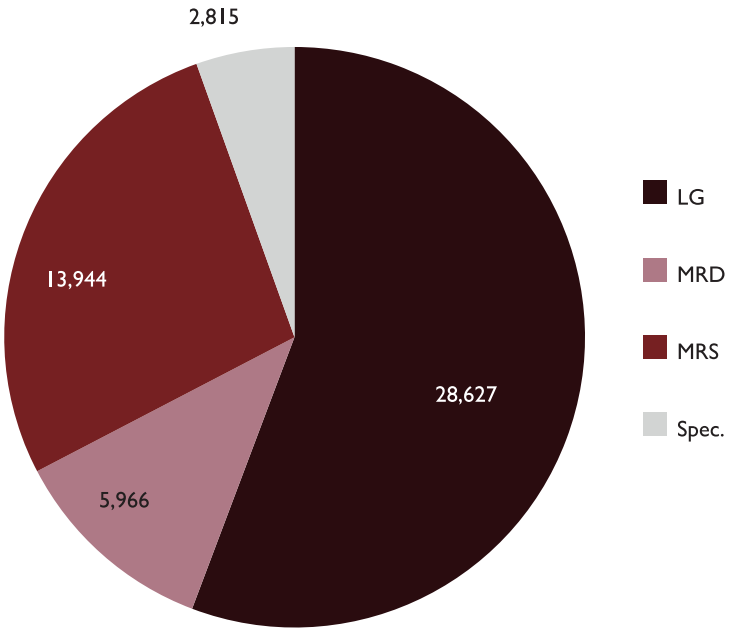
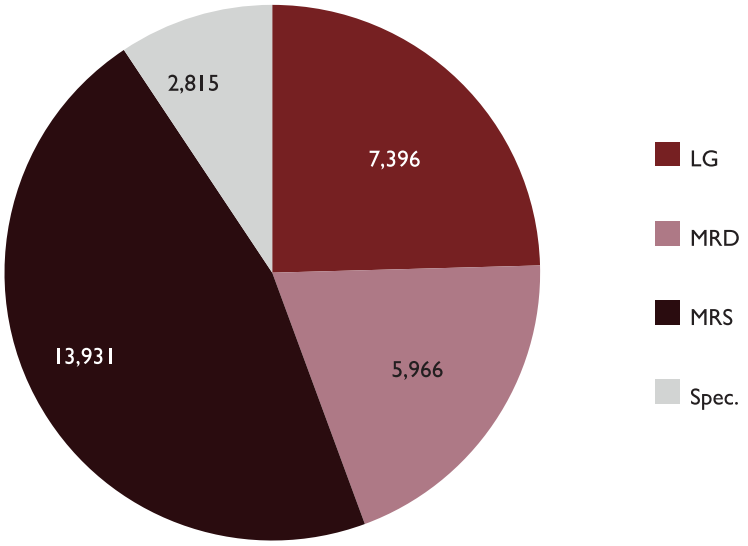


Figure 15: Contribution of cow milk to GDP by agro-ecological zones.



Figures 13 to 15 show the approximately equal contribution of milk and meat in the three major agro-ecological zones to GDP, and the still emerging contribution of the SDP system. Meanwhile, despite the MRS and MRD being responsible for almost equal contributions to GDP, the large contribution of milk and meat in LG, calls into question why the pastoral areas are often neglected in national development plans. Moreover, the larger value added contribution of milk than meat in the LG also underlines that the LG systems are mainly dairy systems.

The LSA results showed that the total value added from direct livestock sector production including processing and marketing amounts to ETB 150.7 billion or about USD 7.9 billion. With an estimated total GDP of ETB 885 billion or USD 46.6 billion (2012)[15] and ETB 380 billion from agriculture; the contribution of livestock amounts to approximately 17% of total GDP and 39% of agricultural GDP. This aligns with other figures, for example the 19% figure for livestock's contribution to GDP in FAO in 2004. The indirect contribution of the livestock sector to the economy is also substantial. LSA data shows an additional contribution of 37.8 billion or about 4% of total GDP (51% from organic fertilizer and 49% from traction).

Value addition creation through processing and marketing of animal products and services

In addition to the substantial macroeconomic input at the production systems level, the formal value chains also make significant contributions to the national economy through value addition processing and marketing. LSA figures estimate the value-added contribution at ETB 35.6 billion. Table 22 provides an overview of the contribution of the different chains as provided by the LSIPT model data runs. The total contribution to the national economy of livestock production and processing and marketing, both monetary and non-monetary values, amounts to about ETB 186.4 billion, or 21% of GDP.

According to the LSA data and based on expert opinion, the share of value addition through processing and marketing is only 19% of the total value addition of the livestock sector. This is quite low in comparison with neighbouring OECD countries where value addition often amounts to more than 100%. Consumer preferences are the main driver for more value addition. With Ethiopia's rising incomes and urbanization major investments in value addition will be important opportunities for the sector. The total value addition contributions of the different sectors are summarized in ETB billions in the table below.

15. http://www.et.undp.org/content/dam/ethiopia/docs/Country%20Economic%20Brief%201%20final%20for%20web.pdf

Table 22: The contribution of the livestock processing and marketing chain to the national economy in ETB million 2013

Commodity chain	Total value added in the chain	Percentage	Commodity chain	Total value added in the chain	Percentage
Beef	12,678.8	68.8	Milk	5,961	34.2
Mutton	1,278.6	7	Eggs	45	0.3
Goat meat	1,331.2	7	Hides and skins	751	4.3
Chicken		0.2	Feeds	7,488	43
Camel meat	966	5	Live cattle export	1,787	10.3
Honey	1,888.8	5.8	Butter	1,395	7.5
			Total	35,571	100

Regional comparison of livestock production

In general, the Ethiopian livestock sector has a lower productivity than those of its neighbouring countries, as shown in the table below by the production of milk per standing head[16] of cattle. However, it productivity of beef per standing head of cattle is higher than Tanzania.

Table 23: Comparative production of cattle in East African countries[17]

Country	Cattle population (million)	Beef production (million tonnes)	Cow milk production (million tonnes)	Beef production/ standing head (kg)	Milk production/ standing head (kg)
Ethiopia (LSIPT or LSA)	55.2	0.8	4	14.6	13.7
Ethiopia (FAOSTAT)	53	0.3	3.8	6.4	71.0
Kenya	19	0.4	3.7	21.6	194.7
Uganda	12.8	0.2	1.2	14.8	93.7
Tanzania	21.1	0.3	1.8	13.7	85.3

In summary, the value addition analysis of the LSA using LSIPT highlights the importance of the present contributions of livestock value addition to GDP, but the low productivity relative to neighbouring countries with similar agro-ecological conditions should also be noted.

6.3 Projected future production and consumption

Projections of future production and consumption for the major livestock products (meat and milk) without any policy or technology interventions (the 'BAU' scenario) were made to assess the size of the future supply and demand gaps. This projection is critical to anticipate the magnitude of required future investment in livestock research and development interventions (policies and technologies), which will be required to close any production-consumption gaps.

The main parameters and elasticities used in the demand projections are shown in subsequent tables. The parameters used are i) the size of human population and its growth rate, ii) the size and growth in per capita GDP, iii) the baseline consumption levels for meat and milk, and iv) the income elasticities of demand for meat and milk. In the case of the supply projections for meat and milk, the parameters from the herd growth model in LSIPT are used.

Future projection growth rates were calculated assuming the past annual growth rate for real per capita GDP. The CSA 2007–2037 population projection for a medium variant population growth scenario was used to project human population growth. The annual trend growth rate for real per capita GDP of 8% was obtained by taking the difference between the GDP and population growth rates over the last seven years (2007–2013). Accordingly, given the income elasticity of demand (η) for a given livestock product, trend annual growth rates (γ) of real per capita GDP, and baseline per capita consumption (LC_0) of a given livestock product, the projected per capita livestock product consumption (LC_t) for a given year (^{t}) is based on the following formula:

16. The production per standing head is calculated by dividing the total population of a species by the total annual production from that species.

17. Based on LSA results for Ethiopia, and on FAOSTAT data for the other countries. The use of FAOSTAT data for Ethiopia would have also resulted in its lowest rank for milk production.

$$(1) \quad LC_t = LC_0 * (1 + \square * \square)^t$$

Finally, the projected total consumption (TLC_t) of a given livestock product in time period (^{t}) is obtained by multiplying the projected per capita consumption with the projected population (POP_t) for a given time period (^{t}):

$$(2) \quad TLC_t = LC_t * (1 + \square * \square)^t * POP_t$$

The income elasticity parameters used in the projections of meat and milk consumption are based on Tafere and Worku (2012) using household income, consumption and expenditure data from the International Food Policy Research Institute (IFPRI) for 2004/05. Based on this study, the income elasticity estimates for beef, mutton and goat meat, chicken and dairy products are 0.9, 0.7, 0.5, and 0.4, respectively.

Table 24: Income elasticity of demand and current and projected future annual consumption of livestock products in Ethiopia 2013–2028

Livestock products	Income elasticity of demand (η)*	Annual per capita consumption (km/year)		Growth in per capita consumption (%) 2013–2028
		2013	2028	
Beef	0.9	6.5	19.5	200
Mutton	0.7	0.7	1.5	114.3
Goat meat	0.7	0.7	1.5	114.3
Camel meat	0.5	0.6	1.1	83.3
Red meat	NA	8.5	23.6	177.6
Chicken meat	0.5	0.5	0.9	80
All meat	NA	9	24.5	172.2
Egg	0.5	1.8	8.2	355.6
Cow milk	0.4	43.3	71.5	65.1
Camel milk	0.4	11.2	18.5	65.2
Goat milk	0.4	1.7	2.8	64.7
All milk	NA	56.2	92.8	65.1

Source: Income elasticity of data was taken from Tafere and Worku (2012). The current annual per capita consumption was obtained by dividing the total apparent consumption in 2013 by total human population in 2013. The total apparent consumption was computed as the sum of production and imports minus exports and losses. The production data was based on LSIPT production estimates and the exports and imports data from the Ethiopian Customs and Revenue Authority. NA denotes not applicable.

Table 25: Trends in annual population and GDP growth rates for Ethiopia 2013–2028

Year	Annual population growth rate (%)	Annual growth rate for GDP at constant 2003 market prices (%)
2007	2.5	11.5
2008	2.4	10.8
2009	2.6	8.8
2010	2.6	12.6
2011	2.6	11.2
2012	2.5	8.7
2013	2.5	10.4
Average annual growth rate (%)	2.5	10.6

Source: The growth rates are computed based CSA (2013) population projections for Ethiopia for 2007- 2037) and Ministry of Economic Development (2013) GDP estimates. The net average annual growth rate in real per capita GDP (γ) was 8% (10.57%-2.52%).

Table 26: Projected total population size (in thousands) in Ethiopia (2013–2028) used in obtaining the projected total consumption figures for different livestock products

Year	Urban population	Rural population	Total population (POPt)	Rate of urbanization (%)
2013	15,928	69,910	85,838	18.6
2014	16,676	71,276	87,952	19
2015	17,455	72,620	90,075	19.4
2016	18,256	73,949	92,205	19.8
2017	19,087	75,265	94,352	20.2
2018	19,976	76,526	96,502	20.7
2019	20,881	77,782	98,663	21.2
2020	21,828	78,999	100,827	21.6
2021	22,791	80,203	102,994	22.1
2022	23,795	81,367	105,162	22.6
2023	24,818	82,507	107,325	23.1
2024	25,880	83,609	109,489	23.6
2025	26,975	84,669	111,644	24.2
2026	28,099	85,696	113,795	24.7
2027	29,245	86,688	115,933	25.2
2028	30,423	87,641	118,064	25.8

Source: Adapted from CSA (2013) population projections for Ethiopia (2007–2037).

The results for projections of the production and consumption of meat and milk over the coming 15 years without any investment interventions are presented below.

Over the next 15 years, the consumption of red meat (beef, sheep, goat and camel meat) is projected to grow by about 276% from 775,000 tonnes in 2013 to 2.9 million tonnes in 2028. While this projected consumption figure seems high, by 2028, the estimated human population will have increased to 118 million. This figure accounts for an average annual meat consumption of 24.5 kg per year. Based on the 1990–2010 average growth rate and taking into account differential growth rates from the different production systems, the production of meat is projected to grow by about 39% from about 1.1 million tonnes in 2013 to about 1.6 million tonnes in 2028. Thus, in 2028, domestic production is expected to cover only 54% of the meat required for domestic consumption. It is estimated that there will be about a 1.3 million tonne gap between production and consumer demand.

Table 27: Current and projected production and consumption of livestock products without interventions (thousand tonnes or million litres) (2013–2028)

Livestock product	Production (in thousand tonnes and million litres)		Consumption (in thousand tonnes and million litres)		Percentage (%) change (2013–2028)		Production as a per cent (%) of consumption
	2013	2028	2013	2028	Production	Consumption	2028
Beef	810.7	1,073.2	554.1	2,301.50	32.4	315.36	47
Mutton	102.2	174.7	63.2	182.6	70.9	188.92	96
Goat meat	94,230	168.7	60.7	182.6	79.0	200.82	92
Camel meat	73.6	76.9	53.4	134.2	4.5	151.31	57
Red meat	1,080	1,493.6	731.4	2,800.90	38.3	282.95	53
Poultry meat	47.7	78.5	43.8	111.8	64.6	155.25	70
All meat	1,128.50	1,572.1	775.2	2,912.70	39.3	275.74	54
All milk	5,182.40	7,767.6	4,822.70	10,952.70	49.9	127.11	71

A similar pattern is also observed for the projected future production and consumption of milk. The consumption of milk is projected to grow by 127% from about 5 billion litres in 2013 to 11 billion litres in 2028. The size of the future production-consumption gap is relatively lower for milk as compared to meat. The domestic milk production is expected to cover more than 71% of the total consumption requirement representing a milk production-consumption gap of 3.2 billion litres.

In general, for both meat and milk, the 15-year production and consumption projections under 'BAU' or without any intervention indicate significant meat and milk production gaps. Given the government's focus on generating foreign exchange from the livestock sector through exports, domestic production-consumption gaps in meat and milk will also affect the foreign exchange balance.

Conclusions and implications

In conclusion, the value addition analysis using LSIPT highlights the importance of the present contributions of the livestock value addition to GDP, but also the need for increased attention to be given to raising productivity at all levels of the value chain—production, processing and marketing. Future investment interventions to increase animal productivity will be essential in order to close the production-consumption gaps, but this focus on production growth will also need to be complemented by investments in processing and marketing at strategic intervention points along the value chains.

These results also show the importance of, and provide justification for, the recent decision of the GoE to establish the State Ministry for Livestock Resources Development in the MoA, including a special directorate for pastoral areas (LG). However, the State Ministry and its three new directorates (animal health, animal production and feed, and pastoral areas) will need adequate resources to overcome the challenges of the livestock sector and enable it so to achieve its potential for reducing poverty and contributing to national economic growth.

7. Technical constraints and opportunities

7.1 Feed

The amount and quality of available feed will be one of the key determinants of the future livestock development potential of the country. LSIPT has a special module to assess the feed resources and needs, i.e. the feed balance of a country or region. On the basis of existing land use maps, the total area of Ethiopia of 1,145,053 km2 was distributed over the different main livestock production systems, and for each main production system, literature and expert opinions were used to estimate the total and usable biomass in grassland, fodder and crop residues (straw, stover, etc.) for good, average and bad (rainfall) years. Findings are summarized in Tables 28 and 29 (all in DM):

Table 28: Summary table with main assumptions and usable biomass production per agro-ecological zone

Agro-ecological zone	Weather	Total area (km^2)	In grassland 4%	Yield per km^2	Use rate %	Total usable biomass from grass	In crop land%	Yield per km^2	Use rate	Total usable biomass from crops[5]	Total usable DM of zone
LG +LGAP (60%)	Good	682,452	100	200	50	68,290,410	0	0	0	0	68,290,410
	Average			150	50	51,326,540		0	0	0	51,326,540
	Bad			100	45	34,183,279		0	0	0	34,183,279
MRD (15%)	Good	171,758	50	325	65	19,537,473	40	150-220	40–60	8,459,082	28,076,555
	Average			225	65	12,599,804		150-175	40–60	6,569,744	19,209,548
	Bad			175	65	9,768,736		100-150	40–60	5,324,498	15,173,235
MRS (25%)	Good	286,263	40	350	70	28,053,807	48	200-250	40–60	20,639,587	48,853,394
	Average			250	75	21,469,751		150-200	40–60	16,374,263	38,004,014
	Bad			200	75	17,175,800		150-175	40–60	14,585,117	31,920,918

The match between the available feed resources and requirements provides regional feed balances as provided in Table 29.

Table 29: Feed balances for the different livestock production systems under different climatic conditions

		Total livestock population	Average annual feed consumption per head from ECO-RUM	Total feed needs (TM per year)	Feed resources good year (TM/year)	Feed resources average year (TM/year)	Feed resources bad year (TM/year)
LG + AP	Cattle	15,293,782	1,860	28,446,435			
	Sheep	12,214,228	256	3,126,842			
	Goats	20,257,218	220	4,456,588			
	Camels	4,500,000	2,586	11,637,000			
	Total			47,666,865	68,290,410	51,326,540	34,183,279

		Total livestock population	Average annual feed consumption per head from ECO-RUM	Total feed needs (TM per year)	Feed resources good year (TM/year)	Feed resources average year (TM/year)	Feed resources bad year (TM/year)
MRD	Cattle	14,796,872	1,785	26,412,417			
	Sheep	6,048,392	280	1,693,550			
	Goats	4,578,885	190	869,988			
	Total			28,975,954	28,076,555	19,209,548	15,173,235
MRS	Cattle	23,520,401	2,100	49,392,842			
	Sheep	11,098,505	275	3,052,089			
	Goats	4,115,200	220	905,344			
	Total			53,350,275	48,853,394	38,004,014	31,920,918
Total				129,993,094	145,220,359	108,540,102	81,277,432

These feed balances show, under the assumptions provided above, that in a good year when rainfall is above the long-term average, and in average rain fall years only the LG/LGAP system will have sufficient feed resource to feed the animals in its zone, though accessibility will still be an issue due to distance from watering points and other factors like conflict. In all the other zones (MRD and MRS) there is always feed shortage for all rainfall situations. This means that under all rainfall conditions, the livestock feed intake falls short of the required standards of 2.5–3.0 kg per 100 kg live weight, which is the most critical requirement for achieving adequate production levels.

Future outlook for feed availability is also a cause for concern. Assuming a 'BAU' scenario for the feed resources (without major feed development interventions), with the growth of animal numbers at the same rate as in the past as estimated by LSIPT (for example 0.2–1.5% for cattle in LG), and the same DM requirements per animal as above, the total requirements in 15 years will have risen to 56 million tonnes of DM for the lowlands, 33 million tonnes for the MRD and 76 million tonnes per year for MRS, as shown in Table 30. The feed requirements will not be met under any climatic condition.

Table 30: Livestock numbers and feed requirements in 2028 per livestock production systems under a BAU scenario (no policy/technology intervention) (LSA report 2014)

Livestock numbers 2028	LG	MRD	MRS
Cattle	16,681,866	15,947,910	33,382,159
Sheep	18,575,233	12,429,424	18,865,174
Goats	36,188,226	9,151,560	6,411,348
Camels	4,706,808		
Total feed requirements 2028 TM/year	55,916,747	33,686,055	76,700,952

7.2 Animal health

LSIPT also provides tools to help prioritize animal diseases to inform decision makers on the most appropriate allocation of resources to combat the priority diseases. The priority-setting is based, first on a selection of the 10 most important priority diseases, based on their incidence. Those 10 most important diseases are then ranked according to three criteria:

- Impact on households and livelihood framework (perspective of the farmer on the capital of rural households. i.e. financial, natural, human, social and physical capital).
- Impact on markets and value chains (perspective of the industry on five types of impacts: causes the closure of many local markets, depreciates the value and quality of products, causes the closure of processing units, stops demand, and/or causes the closure of markets.
- Impact on intensification pathways in the production systems (perspective of the extension services, i.e. improvement in genetics, feeding, health inputs, management and husbandry inputs).

These global scores are then weighted according to the share of:

- The households in the affected production systems (where livestock is essential for household income).
- Total value added generated from the sub-chain affected.
- The animal population in production systems affected (per cent of total livestock population by species).

Table 31: Diseases ranked in descending order on degree of impacting on the attributes of household, value chain, and intensification

Diseases ranking based on impact on HHD	Diseases ranking based on impact on market and value chain	Diseases ranking based on impact on intensification of livestock production
FMD	FMD	Brucellosis
CBPP	Lumpy skin disease (LSD)	PPR, FMD
LSD	Brucellosis	TB and Newcastle
TB	CBPP, Newcastle	CBPP
Brucellosis	TB	LSD
CCPP	chicken pox	Gumboro
Sheep and Goat pox	Gumboro	Salmonella
PPR	Sheep and Goat pox	Sheep and Goat pox
Newcastle	PPR	chicken pox
Sura	Echinococosis	Sura

The order of the ranking in Table 32 changes when the aggregate information is further partitioned by species of livestock. The results are shown in Table 32 for a (cattle), b (sheep and goats), c (camels), and d (poultry).

In the case of cattle, the total scores indicate that the three most important diseases are FMD, CBPP and brucellosis. However, when the diseases' scores are examined singly against the impacts on household attributes, market and value chains, and intensification pathways, the order of ranking varies. The order of ranking was FMD, LSD, and brucellosis for market and value chains; whereas household impact ranking was FMD, CBPP and TB. In the case of intensification brucellosis, FMD, and TB were the top three in terms of their importance in impacting on the intensification attributes.

Sheep and goat diseases that showed impact on the household, market and value chains, and intensification were PPR, sheep and goat pox and CCPP, ranked in that order. Same order of ranking is shown for market and value chains. However, regarding impact on households' attributes, CCPP ranked first followed by PPR and sheep and goat pox. In the case of camels sura is ranked first.

In poultry, Newcastle disease ranks first across all attributes of households, value chains and degrees of intensification.

Table 32. Summary of scores[18] of impact of animal diseases (by species) on household[19], value chain[20] and intensification[21]

a. Cattle

Impact on	Diseases				
	FMD[6]	LSD[7]	CBPP[8]	TB[9]	Brucellosis
Household	16.8	12.4	16.0	11.6	11.5
Value chain	1.7	1.5	0.9	0.0	1.1
Intensification	2.8	2.2	2.2	2.6	6.3
Total	21.3	16.1	19.1	14.2	18.9

18. Scale for scoring from 1–5: totally disagree (1), disagree (2), neither disagree nor agree (3), agree (4), strongly agree (5)

19. Household attributes considered in the analysis are financial, human, social, natural, and physical capital. The impact of the diseases on these capital assets is considered and scored.

20. Score of impact of animal diseases on markets using the specific dimension 'disrupting markets and value chains' and attributes including: closure of collection markets, depreciation of value, closure of processing units, stoppage of demand, closure of international markets. In the LSIPT analysis each of the attributes are also given policy weight based on the extent to which the national policy highlights the importance of avoiding some aspects of disease impact.

21. Intensification of livestock systems: In this case, the proxies are genetic; feeding; artificial insemination, inputs and basic healthcare; habitat housing; husbandry practices and hygiene. The extent to which national policy highlights these intensification pathways is weighted and is referred to as 'policy weight'.

b. Sheep and goats

Impact on	Diseases		
	PPR10	Sheep and goat pox	CCPP
Household	5.9	5.9	6.8
Value chain	0.3	0.3	0.2
Intensification	4.0	3.0	0.0
Total	10.2	9.2	7.0

c. Camel

Impact on	Sura	Camel pox
Household	5.3	5.2
Value chain	0.1	0.1
Intensification	3.6	1.9
Total	9.0	7.2

d. Poultry

Impact on	Newcastle	Gumboro	Chicken pox	Coccidiosis	Salmonellosis
Household	6.0	5.2	5.1	5.0	5.0
Value chain	1.0	0.3	0.4	0.2	0.2
Intensification	4.0	3.0	2.6	3.0	0.0
Total	11.0	8.5	8.1	8.2	5.2

7.3 Animal genetics

Despite the large livestock population of Ethiopia, its present contribution to the national economy is far less than its potential. Almost 98% of the cattle, 97% of the poultry and almost 100% of the shoats and camels are indigenous. The indigenous breeds are well-adapted to the local environment, but they have low productivity potential. Yet, even to realize their inherent genetic productivity potential requires addressing poor management which prevents its full expression. The LSIPT genetics tool was used to characterize species/breeds/types by the production zones they inhabit so potential strategies for genetic and management improvement could be identified for assessment using the LSA herd and economic sector models.

The main characteristics assessed with the tool are name of breed or type, present animal numbers, main purpose why a farmer keeps specific species/breeds/types, specific qualities of the breeds/types in terms of disease resistance and adaptation to their environment, productivity parameters, and risk of extinction. Distribution of species/breeds/types within the three livestock production typology zones (LG, MRD, and MRS), as well in specialized commercial systems, was also assessed.

The productivity parameters linked to species/breeds/types are summarized in Tables 33 and 34. These parameters were vetted by national livestock specialists and included in the dynamic herd model in the LSIPT module. As shown in Table 33, indigenous livestock breeds have very low reproductive and productive performance. Indigenous cows give birth almost every two years; and produce an average of only 147 litres of milk /year. Crossbreds in the specialized commercial dairy production systems can give birth almost every year (85-90% parturition), and produce on average about 2,600–4,600 litres of milk/year. High mortality rate and low body weight at maturity are also features of indigenous breeds, and these mortality figures tend to be very high for juveniles (35% for camel calves, 21–26% for lambs, and 23–28% for goat kids), thus negatively impacting the profitability of the indigenous livestock production systems.

Table 33: Productivity parameter[22] estimates for Ethiopia livestock genetic resources by typology of livestock production zones

	LG			MRD		MRS		Dairy specialized (crossbred)	
	Agro-pastoral	Pastoral small	Pastoral medium	Small	Medium	Small	Medium	Small	Medium
Cattle									
Adult live weight (kg)	240	240	240	255	255	255	255	475	675
Parturition rate (%)	56	56	58	57	58	60	65	85	90
Milk off-take (average litres/ year per breeding female)	147	168	209	279	357	276	390	2593	4608
Goat									
Adult live weight (kg)	31	30	29	30	29	30			
Parturition rate (%)	100	105	110	119	120	133			
Mortality rate female juvenile (%)	20	21	21	16	16	26			
Sheep									
Adult live weight (kg)	28	28	28	30	30	28			
Parturition rate (%)	108	109	120	120	123	120			
Mortality rate female juvenile (%)	26	29	24	23	24	28			
Camel									
Adult live weight (kg)	500	500	500						
Parturition rate (%)	45	45	45						
Milk off-take (litres/year per breeding female)	405	405	405						
Mortality rate female juvenile (%)	35	35	35						

Table 34 shows that improved chickens in the commercial poultry system can produce about seven times more eggs than indigenous chickens. Broilers, meanwhile, can give 1.5 times the meat in just five weeks compared to indigenous chickens which give 1.5 kg of meat in two years.

Table 34: Key demographic and production parameters in poultry production system typologies

Description of parameters	Backyard (indigenous breed)	Layers (crossbred)	Broilers (crossbred)
Mortality rate overall before marketing (%)	50	5	
Young stock	-	-	7
Growing stock	-	-	5
Adult mortality (%) per year	20	3	2
Egg production/ hen per year (number)	42	308	NA
Kg total feed per kg egg produced or per kg live weight	NA	2.7 kg per kg of egg	1.8 kg per kg live weight
Number animals sold per breeding female per year	1.61	NA	NA
Average weight at slaughter (kg)	1.5	2.4	2.3
Dressing percentage at slaughter (%)	65	64	65.2

Genetic improvement

According to the Ethiopia Institute of Biodiversity Conservation (IBC 2004) there are 25 indigenous cattle breeds/types, 13 indigenous sheep breeds/types, 15 indigenous goat breeds/types and four indigenous camel breeds/types in the country (for more details see the Genetics section of the LMP (LMP 2015). This indigenous diversity is an opportunity for research to develop the animal genetic resources of the country by taking advantage of their

22. These parameters were used in the herd and sector models built using LSIPT, leading to the LSA results.

resistance to disease and ability to survive under feed and water stress, which indicates their capacity to produce in harsh environments. Presently, genetic improvement strategies and activities in Ethiopia focus on selection within local breeds or crossbreeding between locals and exotic breeds.

According to expert opinion gathered by the Ethiopia LMP project, improvement through selection within local breeds will continue for the foreseeable future to be the most practical genetic improvement strategy for all species of livestock in family smallholder, pastoral, and agro-pastoral systems not effectively tied to markets, and in production areas where feed resources are limiting. In livestock activities aimed at producing animals for meat production, genetic improvement can be best achieved through within-breed selection, and this goes for cattle, as well as for sheep and goats. Moreover, even in smallholder family operations which are oriented to dairying to produce milk mainly for butter, improvement through selection of local cattle breeds will also be the most practical strategy where urban markets are not accessible.

According to Yilma et al. (2011), meanwhile, crossbred dairy cattle under present Ethiopian conditions can increase milk per lactation sixfold in per-urban dairy systems and tenfold in commercial dairy systems compared to local breed cattle managed in traditional dairy production systems. Various studies have also shown that farmers who own improved/crossbred animals in relatively intensified production systems get more income and have better access to animal source foods than households which own unimproved animals and keep them in traditional production systems (Reijo 1989; Mohamed et.al. 2004; Negussie et.al. 2006). These studies and many others show that genetic improvement needs to be a priority intervention area for improving livestock productivity. However, genetic improvement interventions need to be combined with better feeding, health, and management and applied as a package whenever resource conditions allow.

Adequate evidence from Ethiopia and neighbouring countries where agro-climatic conditions are similar (Kenya, Uganda, and Tanzania) shows that in the family dairy production systems where there is good market access and adequate feed, genetic improvement can best be achieved through crossbreeding local cows with exotic dairy breeds using artificial insemination (AI) and hormone synchronization or bull services. Crossbreeding in Ethiopia is thus expected to be practical and successful mainly in areas both close to markets and where altitude makes for temperate local conditions and where rainfall is sufficient (MRS) to produce enough feed locally to support the high milk-producing crossbred animals which are comparatively voracious eaters and sensitive to environmental stresses. However, dairying with crossbreeds (and thus crossbreeding schemes) might also be successful in moisture stress environments (MRD, or even agro-pastoral LG systems) that are peri-urban and thus have good market access since the dairying can be sufficiently profitable to enable purchase of feed transported from moisture sufficient areas or dairy farmers can afford to buy feed which can be produced locally under irrigation. This possibility needs to be tested with the sector model to see if the potential returns on investment will be attractive enough for smallholder farmers and private entrepreneurs.

In the case of improved family poultry (IFP) production, the experts consulted maintain that priority can be given to improving local breeds in the long-term. However, in the short-run crossbreeding with selected exotic breeds or the use of tropical pure breeds needs to be emphasized, where these crossbreds are sufficiently well-adapted to local conditions and on-farm management of the birds is also adequate.

In specialized commercial dairy, red meat and poultry operations, where management is already modern, any type of improved genetics can be used (usually crossbreeds or pure exotics), as is the case currently, but it is necessary to restrict these breeds from being passed or distributed to traditional smallholder farms where the farmers are not yet trained in their proper management.

Genetic improvement activities through crossbreeding or the use of exotics, as well as local breed improvement will not, off course, be free of challenges. The appropriate targeting and implementation of all aspects of genetic improvement is affected by an absence of breeding policy and/or poor implementation of regulations to control genetic improvement activities, and poor on-farm genetics record keeping. Inefficient AI services, focusing on number of cattle that receive AI and hormone synchronization services instead of the success rate and the

achievement of productivity and production increases in the context of total management (combined with health and feed interventions, and adequate training provided by extension services), and thus not adequately addressing feed shortages, as well as unregulated and inefficient bull/buck services are some of the key challenges related to crossbreeding activities.

Efforts toward developing improved locals and crossbreeds are both hampered by limited and poor on-farm record keeping systems, the absence of a certification system for commercial/improved breed multiplication and distribution by ranches and breeding centres, and limited awareness of farmers on handling and managing improved breeds. Meanwhile, underdeveloped and poorly regulated private day-old chick (DOC) production and distribution systems are also challenges in poultry improvement.

To overcome these challenges the following strategies are proposed for scenario analysis:

- To improve the efficiency of AI services the physical and human resource capacity of inseminators and semen production centres needs to be addressed with adequate training and budget.
- AI and oestrus hormone synchronization campaigns need to be phased and continual with sufficient budget and extension staff allocated for both to go hand in hand with feed and health improvement activities.
- To ensure sustainability, payment for AI services needs to be phased in and subsidies phased out over time so that as public sector inseminators gain expertise and experience they can go on to work as private sector AI technicians.
- To improve local breeds over the long period required, continuous farmer engagement in structured within-breed on-farm selection schemes is needed. Farmers will need periodic training on handling of animals with improved genetics, as well as handling and marketing of livestock products whose quality will improve over time.
- The private sector should be encouraged to establish commercial heifer, ewe, doe and poultry multiplication and distribution centres, starting with PPPs where the risks are too high for private sector to go it alone (not by the public sector going it alone).
- The effectiveness of the day-old chick (DOC) production and distribution system should also be assured in this same way, mainly by the private sector or by PPPs where the private sector is not ready to go it alone. A well-functioning private DOC industry is required for the efficient production and distribution of the chicks to both the specialized broiler and layer operations, and to smallholder farms trying to improve chicken and egg production.

8. Priority institutional and policy constraints and opportunities

A detailed policy review was carried out as part of the formulation of intervention strategies for the LSA. It covered animal health, dairy, poultry, hides and skins, live animals and meat, apiculture, lowlands development (pastoralist and agro-pastoralist livelihoods), and cross-cutting issues: breed improvement, land policy, agricultural research, and human resource capacity building. Detailed descriptions in policy matrices are provided in the Institutions and policy environment section of the LMP (LMP 2015, pp 102–112).

The review of existing policies, institutions, laws and regulations related to the livestock sector in Ethiopia indicates that several relevant national policies have been enacted. However, the lack of capacity to enforce these policies is one of the key problems identified in the review. There are also several outdated policies which need to be replaced or modified to deal adequately with the circumstances currently facing the livestock sector.

This section highlights the main policy issues and recommended actions. The proposed actions are essential to enable the introduction of key technologies to increase productivity. They are fully in line with the main objectives of the overall GoE livestock development strategy, i.e., a combined focus on economic growth and poverty reduction by improving smallholder systems.

In general, a more appropriate division of responsibilities between the public and the private sector is needed, in particular in the provision of veterinary services, where the establishment of market and consumer demand-driven regulations and incentives for privatization of animal health clinical services are recommended. As well, revisions of the regulations for land allocation to stimulate the private sector to invest in the production of feed locally to address the dramatic feed gaps, is also recommended.

8.1 Animal health

The animal health strategy has as a first priority to make animal health services accessible to all, (now only 30% of livestock keepers are reached) and it focuses in particular on reducing young cattle and small stock mortality. At the same time the GoE wants to promote more commercial 'modern' systems to meet the exploding domestic demand for meat and milk predicted in Figure 22, as well as to increase exports of live animals and red meat. In the strategy for animal health services, the main approaches to the promotion of the commercial sector need to be providing an enabling environment for privatization of clinical veterinary services and their extension to the smallholder systems for improved dairy and poultry. The strategy for increasing exports of live animals and meat, so the more remunerative export markets can be the 'pull factor' in modernizing and intensifying the domestic sector involves the introduction of an animal identification and traceability system, and strengthening of epidemiological surveillance systems to provide for a more rapid detection and response to transboundary diseases. Key to achieving both the domestic and export goals of the country will be achieving the rationalization of public and private sector roles, together with appropriate professional oversight.

8.2 Dairy

Smallholder dairy development can be the major engine of growth for the highland rainfall sufficient or MRS zone. The moderate highland climate makes this zone ideally suited to dairy development. The major existing yield gap in production per lactation augurs well for potential fast improvements, provided the key constraints of poor genetics and animal nutrition, and the diffuse leadership structure are addressed. The policy response will consist in finalizing and implementing the draft breeding policy (including the introduction of a milk recording scheme), the establishment of a dairy board, and implementing effective regulations, and a quality standards and testing system to encourage the production of better quality milk and other dairy products.

8.3 Poultry[23]

Over the next decade, under a scenario of growing per capita income and urbanization, the demand for poultry meat and eggs can be expected to skyrocket as population and incomes continue to grow. The competition from the world market, with highly efficient producers of poultry meat such as Brazil and Thailand, can be expected to be very strong and will require trade protection. If Ethiopia wants to save foreign exchange, and generate domestic employment in this sector, it will have to improve the efficiency and quality of its advisory and health services, as well as feed, health (vaccinations) and genetic inputs. It is recommended to clarify the role of the public and private sector in the provision of inputs (grandparent (GP) stock, and veterinary health services, particularly vaccines), ensure an enabling environment for the importation and dissemination of improved semi-scavenging and tropical pure breeds by the private sector, relax the regulations for land allocation to enable modern poultry enterprises and feed production to develop, and provide a 'level playing field' for the indigenous and nascent feed processing industry by reducing or removing the VAT on feeds and feed ingredients.

8.4 Hides and skins

Ethiopia, with its vast livestock population has a significant potential to increase the export of hides and skins, but currently there are major quality constraints to be addressed upstream, as well as during processing, to be able to gain more access to international markets. The recommendations, therefore, give necessary attention to creating advisory services, incentives, and standards and regulations to improve the quality of hides and skins produced in the country.

8.5 Live animals and meat

Live animals are presently the cornerstone of the livestock export market. The GoE has prioritized increasing these exports to raise foreign exchange and, therefore, ensuring efficient marketing channels is essential. Increasing export earnings and revenues from live ruminants and red meat can be accomplished by improving government-provided export services such as traceability and quarantining, streamlining the facilitation of letters of credit, government engagement in export promotion, and ensuring contract enforcement of exporters with importers. Ensuring quality control and lowering transaction costs are also important aspects of the recommendations given in the LMP. They also include the introduction of market-led standards (in particular for feedlot stock), enabling the development of more efficient, safer and cheaper transport systems, and the creation and implementation of more efficient, and hence more friendly regulations for formal cross-border trade.

Meanwhile, only about 0.4% of the total meat entering the beef value chain is exported to African countries and the Middle East. Despite a preference for lean Ethiopian beef in Middle East countries due to taste and the fact that it is recognized to be organically grown (although there is a need for formal organic certification), beef exports are not yet developed mainly because of low price competitiveness internationally. The FOB price of Ethiopian beef is often twice

23. Based on a review of Tadesse Sori, at the time the Acting Head, Animal Production and Feed Directorate, MOA.

the world market price and domestic demand for beef is growing very rapidly; it usually sells domestically high above the cost at which Ethiopia can at present export. A strong economic efficiency argument can therefore be made to focus on the development of the beef value chains for meeting domestic demand.

Rationalization of the ETB exchange rate, if not full liberalization, to make live animal and meat exports more competitive in international export markets, to raise foreign exchange earnings and GoE revenues is also required. As well, devaluation of the ETB would lead to more attention being given to domestic meat production and market development leading to more rational pricing of domestically sold meat and being able to meet future expected increases in domestic demand.

8.6 Apiculture

In apiculture, the emphasis is recommended to be on protection of the bees against the import of diseases and the use of pesticides, the development of standards and procedures to enable economies of scale, and a proper regulatory and incentive scheme to induce producers to produce better quality products.

8.7 Lowland areas of Ethiopia (pastoral and agro-pastoral systems)

As described earlier, the lowland pastoralist (LG) and agro-pastoralist (LGAP) systems are an important sector of the economy (although often neglected in the past), with substantial potential for development that would contribute to economic growth, poverty reduction, export earnings, and achieving mitigation of climate change through animal and grazing land productivity enhancement. Recommended for the LG is ensuring adequate access rights to critical resources, in particular to dry season grazing and water by establishing reserved areas, enforcing of marketing trade corridors, and creating/enforcing conflict management institutions, with a substantially extended role for customary institutions. Marketing information and drought alert systems should also be improved.

8.8 Breed improvement

Breed improvement needs to be focused mainly on the dairy sector, through AI and oestrus hormone synchronization, the privatization of the AI service wherever feasible, and the development of bull selection and service systems where AI is not feasible. In the poultry sector, it involves incentivizing the importation, production and sale of improved semi-scavenging poultry breeds by the private sector and through PPPs, combined with encouragement of private animal health services.

8.9 Land availability

Land is one of the critical factors of production upon which the livestock production is based. The shortage of land for animal feed production is a very critical constraint in livestock production. By law, land in Ethiopia is the property of the government and the farmers and others only have the right to use it. There is a growing demand and competition for land for many uses: farming, real-estate development, forestry, protected areas, etc. In order to increase the availability of land for animal feed production, there needs to be the right of allocation for feed production, security of land use rights, and security for contractual agreements between those who lease and those who contract land. Land contracts for investment purposes need to be clearly regulated, creating clear rights and responsibilities for those who hold the right to use land and sub-contractors.

8.10 Agricultural research

Domestic research is mainly concerned with the improvement of primary livestock production. Research on secondary production, like processing and food manufacturing, is less developed. In order to improve the productivity and competitiveness of the sector, research on the agro-processing and manufacturing sector is both critical and timely.

8.11 Human resource capacity for planning

The LSA and LMP were conducted with the support and collaboration of ILRI. The MoLFD needs to build in-house capacity to use LSIPT to conduct detailed LSAs, LMPs and other quantitative planning exercises, as well as to implement, monitor and evaluate and formulate new policies and to revise or develop new LSAs and LMPs. The MoLFD needs to develop the institutional capabilities to generate and compile reliable social, economic and environmental data and statistics to facilitate the monitoring and evaluation of the impact of new investments, policy and institutional changes. It is important for the ministry to establish a livestock policy and planning support unit and train its staff in the use of LSIPT and other policy analyses and investment planning tools.

9. *Ex ante* assessment of strategic options (combining technology interventions with supporting policy)

Introduction

Based on the GoE development objectives outlined in Section 2.3, the policy priorities outlined in Section 8, and the LSA baseline analysis in the preceding chapters, the critical existing constraints and opportunities are identified below. This leads to identification of the strategic intervention options included in the foresight scenario analysis reported in this section. Through the foresight analysis these interventions are assessed for their potential to help meet the development objectives of the country by transforming the livestock sector in Ethiopia.

On the constraints side, the priority technology focus areas that emerge from the analysis are:

- Limited availability of feed resources is the overriding production constraint. The LSIPT module shows that only in good and average rainfall years is there adequate feed availability in LG, but there are deficits in MRD and MRS areas in average and good years, while there are feed deficits in the whole country in poor rainfall years. As shown in section 7.1, this deficit could be even worse in future if the livestock population will maintain the same rate of growth and productivity levels, as over the past decade.
- Deficient or even absent veterinary services in rural areas (due to national coverage now estimated at only 30%) leads to a high average young stock mortality (15–30%) for all species and production systems, as shown in section 3. These rates of calf and lamb/kid mortality are also among the highest in the Horn and East Africa regions. High mortality and morbidity result in the very low productivity (production per animal) and inefficiency of the Ethiopian livestock sector, also in comparison with neighbouring countries. Ethiopia shows, for example, productivity per standing head in cattle that is up to only half of that of its neighbours (Table 23). However, improving animal health, with known technologies, can be one of the most effective and efficient first steps in improving productivity.
- Even if the feed and health interventions are improved, the poor genetic composition of the current livestock population would still constrain increased productivity and efficiency. However, the Kenyan dairy development experience has demonstrated, and it has also been verified under experimental conditions, that in a temperate climate which also prevails in much of Ethiopia, rapid genetic gains are possible through crossbreeding. Similarly, the current genetic potential of indigenous chickens is very low, but, as shown elsewhere, for example in India, Egypt, Kenya and Uganda, rapid gains are also possible with crossbreeding to produce improved dual-purpose semi-scavenging chicken breeds.

Additionally, the priority constraints which emerge from the policy analysis summarized in section 8 which need to be resolved are:

- Land use policy bias against investment in commercial-scale seed and feed production exasperates limited availability of feed resources to raise animal productivity.
- Poor market access and bureaucratic procedures discourage private investment in agro-industries, and lack of infrastructure lead to very limited value added.

- Unclear policies regarding appropriate private and public sector roles, in particular in the provision of animal health services and inputs, lead to reluctance of private operators to enter these markets.

On the opportunities side, the priority positive livestock development forces that emerge are:

- Population growth, urbanization, and rising per capita income are leading to exploding domestic demand for meat and milk, and resulting in high market prices, as shown in section 6.3.
- Livestock is one of the most important means of improving farm livelihoods (usually accounting for more than 50% of total net income in rural areas), and especially for the rural poor which represents about a third (33%) of the total rural population as shown in section 4.
- While not competitive internationally for all commodities and products, the Ethiopian livestock sector could compete well in export of live ruminant animals and chilled small ruminant carcasses to the Gulf Area, as shown in section 6.4.
- The government has become increasingly interested in developing the contribution of the sector to economic growth, poverty reduction, and enhancing food security, as well as improving climate resilience. It is also, in particular, interested in enhancing the contribution of livestock to foreign exchange earnings.
- Moreover, the government is taking concrete steps to ensure its livestock sector transformation strategies mitigate climate change and enhance the resilience of smallholder farmers, and thus is aligned with its Climate Resilient Green Economy (CRGE) strategy.

From a poverty reduction and economic growth perspective, the picture is more nuanced:

- Cattle systems are the dominant system (for 70–90 % of the households), whereas in terms of poverty reduction, the priority would go to poultry throughout the country and to small ruminants in lowland areas (LG). However, since about a third of livestock keeping households are poor (MOFED 2013), and productivity is at such a low level, any productivity enhancing intervention could reduce poverty.
- Based on the LSA results, MRD has a larger proportion of poor livestock keeping households than MRS in the highlands, as well as a higher absolute number. Meanwhile, based on the LSA results and corroborating studies (Save the Children 2012; MOFED 2012), it is reasonable to conclude that in terms of absolute numbers most of the poor livestock keeping people are found in the MRD and in terms of proportion LG areas (such as Afar and Somali) have the largest proportion. This has significant policy implications for where to focus pro-poor development efforts. Pending additional study (to improve the data for the LG), MRD and LG seem to be the priority production zones for poverty alleviation efforts.

With this summarized LSA analysis in mind, the key main elements of the strategy that emerge are:

- The overarching priority is increasing the productivity or production per animal, without increasing the livestock population growth rate. Key policy and investment actions to support this strategy are enhancing veterinary coverage through rationalized private and public roles and PPPs, in particular to reduce mortality and morbidity, and improve extension (including through PPPs and private processors) to promote complementary improved feeding and animal husbandry;
- Reversing unfavourable investment policies to allow for land allocation to increase livestock inputs (DOCs, forage, feed rations (from mills), etc.), production, and processing. An alternative policy that could be considered is the introduction of a livestock head tax, but past experience shows it is difficult to induce farmers to keep less but more productive animals until factors such as prices favour intensification;
- A dual policy of seeking broad and differentiated animal health coverage for poor smallholders and in particular a focus on addressing potential disease epidemics and parasites in ruminants, mostly publically provided, combined with measures to increase exports of all ruminants by gaining access to attractive and remunerative markets in the region (both in the Gulf and Africa). This will require investments in this area to achieve a major increase in the quality and safety of the products for export. Although exploding domestic demand currently constrains exports and could constrain future export potential, development of the export sector at the present stage can still provide the 'pull' for general improvement now and later.

- Hormone synchronization and AI applied to dairy animals in areas with access to urban markets and combined with complementary improved feeding and privately provided health interventions to realize the productivity increases from improved genetics.
- Importation and/or development, and massive dissemination of well-adapted improved semi-scavenging poultry breeds by the private sector or with government through PPPs where the private sector is reluctant to enter on its own, combined with private or PPP animal health services to provide critical vaccines, and GoE extension services to promote improved feeding.
- Special incentives (tax holidays, credit facilities, training) to promote more value addition through product processing and input production.

In Sections 9.1, 9.2, and 9.3 the ex ante technical and economic evaluations of the three highest priority investment interventions are presented.

First, improvement in the coverage of veterinary services through rationalization of public and private roles leading to an improvement in animal health to reduce young and adult stock mortality (YASM) is combined with improved feeding and better management practices (through improved extension). Second, an investment in the improvement of animal genetics and productivity in dairy cattle through the introduction and increased use of AI and synchronized breeding services is tested. Third, the importation of exotic breeds to cross with local chicken breeds to create well-adapted and much more productive crossbred, semi-scavenging breeds, combined with required supplemental feed, health services (primarily vaccines), and housing is evaluated.

The investment analyses of these three highest priorities combined with policy and technology interventions are then followed with a summary of the results for these scenarios, as well as four others which are complementary to, and support, the priority improvements in animal health, feed, breeding and policy. The cost figures and potential benefits (physical improvements in performance, leading to increasing yields, incomes, etc.), are the result of intensive consultation with local experts and practitioners, but are approximate, and must be refined as more data becomes available. The full assumptions are presented in Annex 3. The economic results are presented here in terms of the internal rate of return (IRR), net present value (NPV), and benefit cost ratio (BCR), as well as contribution to GDP, poverty reduction, and food security where appropriate.

9.1 Reducing young and adult stock mortality in ruminants: combined animal health, feeding and management interventions

The investment context – intervention and assumptions

Livestock mortality and morbidity are important causes of economic losses, leading to poverty and food insecurity in Ethiopia. Since funds for various interventions are scarce, ex ante assessment of the technical feasibility, cost-effectiveness, and economic impacts of proposed investment interventions is critical. The high incidence of animal disease indicates a lack of adequate investment in animal health. Appropriate disease control measures are required to reduce the negative impacts of livestock diseases and parasites on the household herd and economy, and the national economy.

The intervention to reduce young stock mortality is improved veterinary services and improved extension to bring about an improvement in animal health, through a full package of vaccinations and deworming, plus mineral supplementation, combined with better management practices (improved feeding, housing, and sanitation) and annual disease surveillance. It is expected to reduce young stock mortality which in turn enables higher weight gain, higher milk yield, and earlier calving. The combined investment intervention is expected to result in reduction in young stock mortality by 20% over the 20-year investment time horizon, as well as in the reduction of older stock mortality by 10% over the same 20-year period.

The key assumptions for the economic impact analysis are as follows: (1) the time horizon for the investment is 20 years; (2) the total investment cost is estimated at ETB 6.9 billion to be spent over the 20 years of the project life, to cover the training and installation of private veterinary and paravet clinics (with basic supplies), subcontracts for vaccinations, procurement of vaccines and medicines; (3) for all species, it is assumed that a full vaccination regime (once–twice per year depending on the disease risk) and deworming plus mineral supplementation package is applied; and (4) for all scenarios the annual discount rate is 10%, the assumed current social opportunity cost of capital in Ethiopia. The details of the assumptions on the annual incremental costs associated with the investment are presented in Table 35.

Table 35: Assumptions on annual recurrent costs associated with the investment to reduce young stock mortality (ETB/head)

Animal health intervention recurrent cost item	Costs (ETB/head)			
	Cattle	Camel	Sheep	Goats
Foot-and-mouth disease (FMD)	20	20	10	10
Costs of other vaccines (package)	13	13	7	7
Anti-parasitic drugs (dipping or spraying)	14	14	6	6
Improved extension services (feed, housing, and sanitation)	1	1	0.5	0.5
Annual disease surveillance (additional cost)	1	1	0.5	0.5
Additional cost for improved veterinary services	4	3	1	1
Total annual recurrent costs (ETB/head)	53	52	25	25

Source: Based on expert consultation, including MALF experts.

The baseline livestock growth rates were maintained in the simulation by increasing the off-take of males in milk systems (including cattle in the agro-pastoral production system), while increasing milk production. The animal population currently reached by veterinary health services is 30% (the baseline scenario) and the percentage of the animal population at risk that are targeted by the intervention is 70%. The adoption rate for interventions is assumed to grow slowly over 20 years. The adoption rate is expected to reach 20% by the fifth year of the intervention; 40% by the tenth year; 80% by the fifteenth year; then remaining the same through to the twentieth year.

Proposed interventions to improve animal feeding practices

To ensure the effectiveness of the YASM animal health interventions, there also needs to be complementary improvement in animal feeding and management practices. The feeding practices are improved for all species—cattle, camels, sheep and goats. The adequate feeding of pregnant animals at the late stage of pregnancy and early stage of lactation is emphasized and realized by providing more concentrates. The assumed average cost for animal feed is 3 ETB/kg for all the four species. However, the amount of concentrate recommended varies by type and class of animals.

The details of the proposed animal feeding management interventions and impacts for different livestock species are presented in Table 42. The supplementary feed is given to all species just before giving birth and for one or two months after birth. It is expected to increase milk production so that the kid/calf will be fed better and making it stronger and able to resist diseases. It is thus assumed there may not be an increase in weight due to this supplementation of feed to cows, camels, and goats.

Table 36: Assumptions on interventions for animal feeding practices

Livestock species	Proposed feeding practices	Expected outcome
Cattle	0.5 kg concentrate provided to the dam for 3 months over 2 years	Milk yield increased by 1 kg
		Half goes to the calf which will result in incremental weight gain of 22 g/day
		The remaining half is sold to increase income for the livestock keeper
Goats	0.275 kg of improved feed per day will be provided	Milk yield increased by 0.55 kg
		Half goes to the kids which will result in incremental weight gain of 23 g/day
		The remaining half is sold to increase income for the livestock keeper
Sheep	No feed is purchased but it is assumed that improved feed will be available	Incremental weight gain of 12 g per day
Camels	0.5 kg of concentrate will be provided to the dam for 3 months in 2 years	Milk yield increased by 1 kg
		Half goes to the calf to result in incremental weight gain of 22 g/day
		The remaining half is sold to generate income for the household

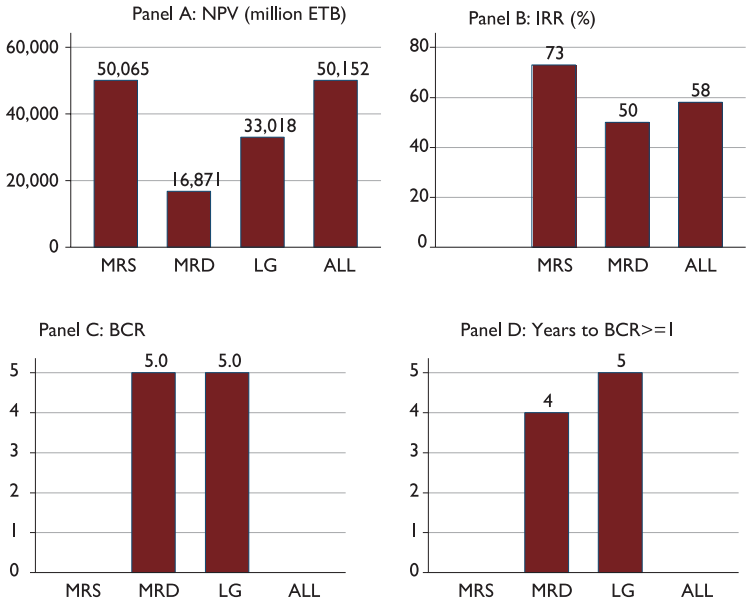
Source: Based on expert consultation, including MALF experts.

YASM simulation results

Several criteria were used to assess the performance of the proposed YASM reduction intervention: the NPV, the IRR, and the BCR. The results are summarized in graphical form for the major livestock production zones (LG, MRD, MRS and for the livestock sector as a whole, and are presented in Figure 16 (panels A to D). The intervention is economically viable if the NPV is positive, i.e. the proposed interventions generate a positive NPV over the 20-year time horizon after the social opportunity cost of capital is accounted for.

The combined intervention in LG, MRS and MRD generates an additional ETB 14 billion impact on GDP (about USD 700 million) over the 20 years. All the IRRs obtained were more than the 10% discount rate, the assumed social opportunity cost of capital. The BCRs obtained were all greater than 1 indicating the cost-effectiveness of the investment interventions in all three zones. The time it takes for the BCR to become equal to 1 or greater was less than 6 years (out of 20 years) for all zones. The IRR is greater than 10% in all cases indicating the economic profitability of investments. It is important to note that the IRR for MRS could not be computed since there was no negative cash flow for the investment in MRS during the entire planning horizon. The higher IRR in the MRD system as compared to the LG can be explained by the greater disease pressure under the riskier rainfall conditions in the MRD region, and this leads to the greater impact of the health and improved feeding intervention. The intervention was not tested in the specialized commercial production systems since it is the case and thus assumed here that the specialized producers have already adopted these interventions.

Figure 16: The impacts of combined investment interventions to reduce young stock mortality in Ethiopia: A 20-year net present value, internal rate of return, benefit cost ratio and number of years required for benefit cost ratio to be equal or greater than one.



Source: Based on the LSIPT results.

YASM impact on food security and GDP from increased meat and milk production over time

The impact of the young and adult stock mortality (YASM) intervention on meat and milk produced and consumed over the investment time period is given in Figure 17, panels A (meat) and B (milk).

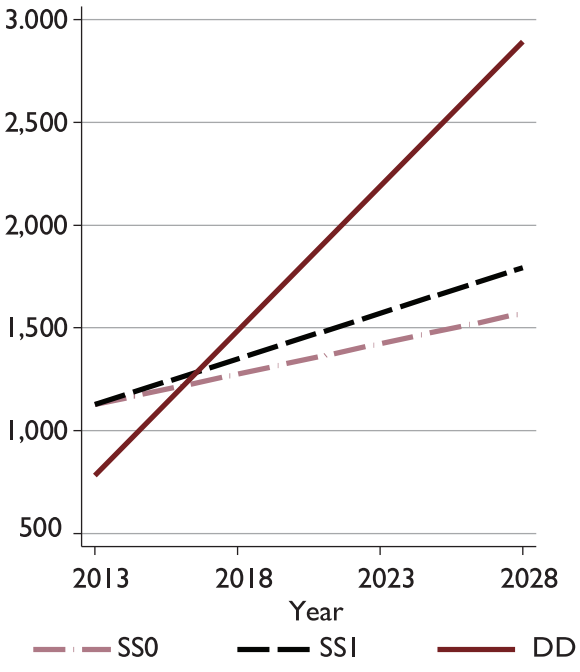
The quantity of meat consumed nationally is projected to increase to 2,890 thousand tonnes equivalent by 2028 from the baseline level of about 783,000 tonnes in 2013, an increase of about 270%. None of the projected increase in meat available for consumption is due to the YASM intervention, but rather to changes in population, urbanization and incomes. Meanwhile, the quantity of meat produced is expected to increase by 39% and 59%, respectively, without

and with the YASM intervention. Although with the intervention livestock performance improves substantially in terms of decreased mortality, leading to increased productivity in terms of milk and meat production per animal, the national herd size was held constant at the baseline growth rates. The use of without intervention growth rates is reasonable due to policy that limits access to land for feed production and thus inadequate access of livestock farmers to marketed feed. Given the constant overall national herd growth rate, and due to the rapid expected increase in demand for meat and milk, the impact of the YASM investment on closing the gap between the meat produced and consumed is not significant over the 15-year investment period.

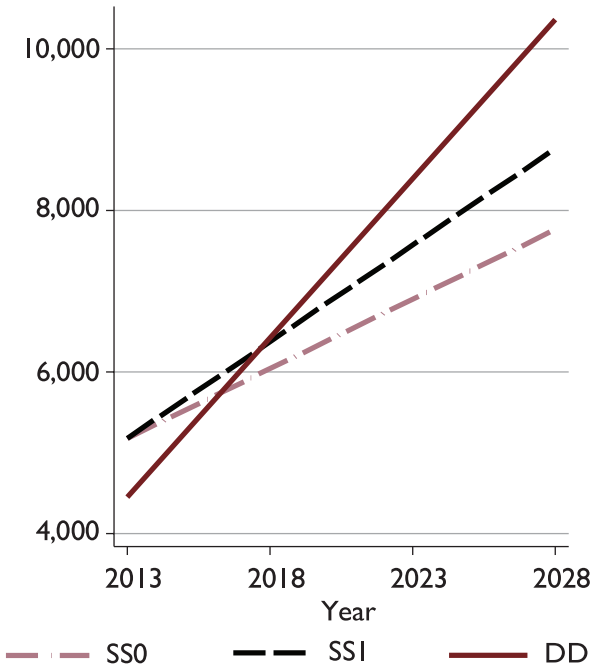
Similar YASM impact results were obtained for milk. Milk consumption is projected to grow from 4,455 to 10,368 million litres (a 233% increase). Without the YASM intervention, the milk produced is projected to increase by only 50% from 5,182 to 7,768 million litres, while with the intervention, the milk produced is expected to grow by 69% to 8,770 million litres. Again, the projected production-consumption gap for milk remains large, indicating a broader effort is needed to close the food security gap. Additional productivity increasing interventions such as genetic improvement through crossbreeding and more comprehensive improvements in management will be required to close the production-consumption gap, and/or the national herd will have to grow to close the projected gap.

In the case of milk, the magnitude of milk productivity growth (litres/cow per year) required to close the production-consumption gap is assessed under two livestock production scenarios: (a) maintaining the baseline cattle population of about 55.2 million to 2028 and (b) assuming a constant baseline livestock growth rate of 0.5 to 2.9%, leading to a cattle population of 74 million in 2028. Assuming that 34% of the cattle population are milking cows, in the first scenario the milk yield per cow is required to grow from the current 314 litres/cow per year to 873 litres/cow per year (a 278% increase in productivity or litres/cow per year). In the second scenario, with the national herd growing to 74 million head of cattle and the same proportion of milking cows assumed, the milk yield has to be about 613 litres/cow a year. In this case, an increase of 95% in productivity is required per cow by 2028 to close the production-consumption gap in milk. The achievement of such increases in milk productivity and production would require substantial genetic improvement of the cattle herd through crossbreeding and concomitant improvements in animal feed, health and management practices.

Figure 17: Projected meat and milk consumed (DD), production without the YASM intervention (SS0), and production with YASM (SS1) (meat in 1,000 tonnes equivalent and milk in millions of litres).



Source: LSIPT results.



Source: LSIPT results.

The impact of reduction in YASM on livestock GDP

The scenario tested to reduce YASM through the targeted animal health intervention substantially increases livestock GDP. Comparing production values for the 'with' and 'without' intervention cases after 15 years (in 2028) there is an overall increase of 6.4% or ETB 14 billion in the livestock GDP. This increase is higher than the 4% reduction in mortality rate because of the 'ripple' effect, i.e., the effects of a decrease in mortality impacts the overall herd structure, with an increase in the share of reproductive females, which in turn translates into an increase in the number of calves born. It is therefore not a 1 to 1 relationship. As expected the main growth in GDP comes from milk and meat. Milk from cows, camels and goats constitute 74% of the added value or the change in the livestock GDP, and meat from cattle, sheep, goat and camel constituted 27%. These results are shown in Table 37.

Table 37: GDP 2028 without intervention and GDP 2028 with intervention to reduce YASM

Products	Base year 2013	Total livestock GDP 2028 (millions) – without change (baseline)	Total livestock GDP 2028 (millions) – with reduction in YASM by 20% on average	Differences (millions)	% contribution to the change in livestock GDP
Meat					
Cattle	30,688	40,734	43,543	2,809	21
Sheep	6,135	10,611	12,756	2,145	16
Goats	5,778	10,371	13,192	2,450	18
Poultry	3,226	5,274	5,274	0	0
Camels	3,592	3,757	4,847	1,090	8
Milk	51,352	74,834	84,865	10,031	73
Eggs	307	639	639	0	0
Hides and skins	22	36	70	34	0
Organic matter	27,866	37,283	36,943	-340	-2
Energy	21,770	29,629	25,064	-4,565	-33
	150,736	213,168	227,193	13,654	100

9.2 Dairy improvement

The investment context – intervention and assumptions

An investment in the improvement of animal genetics to realize greater productivity of dairy cattle through the introduction and increased use of AI and synchronized breeding services was next assessed. It was tested only in the MRS and MRD since there is little comparative advantage for dairying in the LG, even in agro-pastoral systems. A complementary feeding intervention is required and included, but it is assumed dairy farmers have already adopted other aspects of better management, especially recommended health interventions.

It is assumed that about 70% of the households in MRS and MRD will be reached via the hormone synchronization and AI investment intervention. Furthermore, in the first and second year, it is expected that about 400,000 cows (which is a 10% adoption rate) will have taken advantage of the AI and hormone synchronization program (which has actually been realized since 2013, the baseline year for the LSA). In the case of MRS, it is expected that starting from the second year the adoption rate increases gradually from 10% to 80% in the fifteenth year of the project life and remains the same thereafter to the twentieth year. On the other hand, the adoption rate for small and medium herd size MRD systems is assumed to be 50% and 60%, respectively, and assumed to be constant for all years. The expected impacts of the breeding investment interventions are in terms of changes in animal weight (see Table 38), and increased milk yield. For medium MRS systems, as a result of the synchronized AI (crossbreeding) intervention, it is anticipated that the milk yield will increase from 1.8 litres/animal per day to 6 litres/animal per day. For the MRD medium herd size the milk yield increases from 1.6 litres/animal per day to 4 litres/animal per day. These average increases are likely to be the minimum increases possible—far larger increases are highly probable so the investment returns analysis is very conservative.

A complementary feeding intervention is required to realize the productivity increases from hormone synchronization and AI. The feed provided per animal is 1.5 kg/animal for the small herd size systems in MRS and MRD zones and 2 kg/animal for the medium herd size MRS and MRD systems. In addition, a recurrent feeding cost of ETB 4.2 /kg per adult female was assumed for both MRS and MRD systems to account for purchased feed. The annual recurrent cost for AI and hormone synchronization is estimated at ETB 340 /animal for both MRS and MRD. The total investment required for hormone synchronization and AI is estimated to be ETB 677 million (about USD 33.9 million), an initial ETB 16 million spent over the first two years and then again, the same investment in year five and ETB 30 million spent in the tenth year of the project.

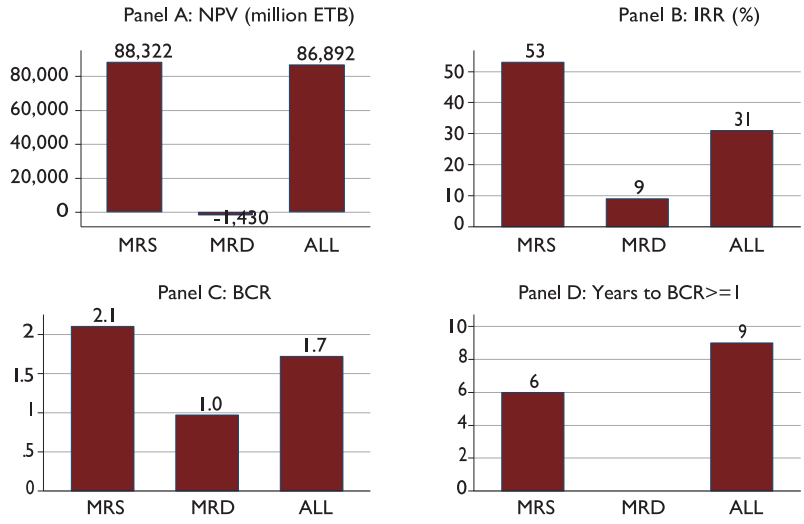
Simulation results

The results of the ex ante impact assessment of the hormone synchronization and AI investment are presented graphically in Figure 18 (panels A to D). For MRS and MRD combined, the investment resulted in a 20-year NPV of ETB 86,892 million (about USD 4.35 billion). A positive NPV was generated from the investment in MRS as compared to a negative NPV for MRD production systems due to the expected difference in productivity (this can be contributed to buy more limited feed due to lower rainfall). The AI and hormone synchronization investment in the MRD is not viable in general because the MRD areas of the country have high ambient temperature, poor moisture, inadequate grazing resources, and limited availability of crop residues, resulting in lower productivity impact (less milk and weight gain (leading to later calving) of the combined hormone synchronization and AI intervention on the cattle. The investment criteria thus indicate that over the 20-year time horizon, the investment intervention is only economically viable in the MRS. The IRR obtained for MRS is greater than the acceptable minimum investment return of 10% and the 20-year BCR is also greater than one. However, it takes about six years for the investment to generate a BCR equal to or greater than one which will discourage some investors. Moreover, it needs to be noted that although in general the dairy intervention in the MRD is not viable, there would be pockets of intervention viability such as peri-urban areas or milk sheds close to urban markets. As well, it is also possible that the intervention is not viable in some areas in the MRS, especially those far from urban markets, with access limited by poor infrastructure, especially the absence of all-weather roads and milk cooling facilities (tanks and/or trucks).

Table 38: Assumptions on weight change as a result of AI and synchronized cattle breeding in MRS and MRD systems

Sex	Age group	Small herd size		Medium herd size	
		Local baseline weight (kg)	Crossbred weight (kg)	Local baseline weight (kg)	Crossbred weight (kg)
MRS					
Female	Juvenile	90	100	90	110
	Subadult	160	200	160	220
	Adult	230	350	230	375
Male	Juvenile	90	100	90	110
	Subadult	180	220	180	220
	Adult	280	400	280	400
MRD					
Female	Juvenile	85	95	90	100
	Subadult	160	200	160	200
	Adult	230	350	230	350
Male	Juvenile	90	100	90	100
	Subadult	180	220	180	220
	Adult	280	400	280	400

Figure 18: Impacts of hormone synchronization and artificial insemination: 20-year net present value, IRR, BCR, and number of years required for BCR to equal to or be greater than one.



Source: Based on the LSIPT results.

AI and hormone synchronization intervention impact on livestock GDP

Results in Table 39 for livestock GDP in 2028 as a result of the AI/hormone synchronization intervention show an overall increase of 12.7 % as compared to added value without the intervention. As expected the major growth in GDP came from milk production followed by a small increase in meat from the heavier crossbred cattle. The net contribution of milk to the livestock GDP appears to be very high with the intervention (41%) as opposed to 35% under the without intervention situation. The net change in energy contribution became negative because the AI intervention encourages herders to keep more female cattle than males.

Table 39: GDP in 2028 without and with AI/hormone synchronization intervention

Products	Base year 2013	Total GDP 2028 (millions)–without change (baseline)	Total GDP 2028 (millions)–with AI using hormone synchronization	Differences (millions)	% contribution to the change in value added
Meat					
Cattle	30,688	40,734	46,674	5,940	22
Sheep	6,135	10,611	10,611	0	0
Goats	5,778	10,371	10,371	0	-1
Poultry	3,226	5,274	5,274	0	0
Camels	3,592	3,757	3,757	0	0
Milk	51,352	74,834	99,121	24,287	91
Eggs	307	639	639	0	0
Hides and skins	22	36	39	3	0
Organic matter	27,866	37,283	37,153	-130	0
Energy	21,770	29,629	26,500	-3,129	-12
	150,736	213,168	240,139	26,971	100

9.3 Poultry improvement

The investment context—intervention and assumptions

Poultry is an important source of food and income for the rural poor in Ethiopia and especially women. Traditional family poultry (TFP) which is low input and low output in terms of chicken meat and eggs production is the major poultry production system in the country, accounting for 97% of the total chicken population, 92% of the egg production and 93% of the total chicken meat production (CSA 2013).

There have been efforts made by the MoA to transform the TFP to IFP through distribution of exotic breeds such as Rhode Island Red (RIR), White Leghorn, Fayoumi, Bovans Brown, Arob Acre and Bubcocks to individual smallholders. However, success has been limited mainly due to the high mortality rates of these exotic breeds.

There are also emerging commercial or specialized poultry production (SPP) farms, but the industry is at an infant stage. SPP accounts for only 3% of the total poultry population, 1% of the chicken and 7% of the egg production. Since this production system is high yielding, the government of Ethiopia is counting on it to increase the production of chicken meat and eggs as quickly as possible to narrow down the consumption gaps in national meat and eggs.

Moving scavenging traditional family poultry to semi-scavenging improve family poultry

The proposed interventions to increase chicken meat and egg production vary across the existing two major production systems, i.e., TFP and SPP.

The intervention in the traditional smallholder family poultry or TFP aims at upgrading the family backyard system (currently with 2 hens and 8 followers) to a higher yielding IFP system (with 25 hens) system. The IFP intervention is based primarily on the importation of exotic breeds to cross with local breeds and create crossbred, semi-scavenging breeds with greatly improved productivity. Well-adapted, higher yielding dual-purpose semi-scavenging exotic tropical breeds are also now available for import, after having proven their adaptability under family backyard conditions analogous to those in Ethiopia and can also be imported for multiplication and distribution to smallholders. Health and feed improvement will be key complementary components of this intervention package. The highly-productive crossbred, semi-scavenging breeds will require 10% supplemental feed, professional health services (primarily vaccines), and improved housing.

The adoption rate for the intervention package is expected to be slow at the start, 0.7% in year two, reaching 14% in year five, and 58% in 2028. The expected impacts of the interventions (as IFP continues to replace TFP) are a reduction in mortality rates from 50–10%, increase in chicken weight from 1.5 kg average slaughter weight to 2.5 kg, and eggs production from 42 to 150/hen/year. The start of the laying period for IFP hens is expected and assumed to come down to 5.5 months compared to 6.8 months in TFP. Average weight of an egg increases from 40 to 60 g.

Specialized poultry production

The intervention in favour of SPP involves increasing the scale of operations or average number of commercial layers and broilers kept per farm, and increasing the number of farms. The number of specialized poultry units for layers increases from 290 in year one (2013) to 2,400 by 2028, and for broilers the farm number increases from 30 in year one to 2,415 in 2028, then both staying constant over the investment period. The average number of birds kept per unit increases for layers from 500 in 2013 to 6,250 in 2028 and for broilers it increases from 6,400 in 2013 to 35,200 in 2028. The total number layer and broiler birds reach 73.2 million and 375.5 million in year 2028, respectively. The mortality rates for layers and broilers become 5 and 7%, respectively, and their average slaughter weight is 2.3 kg. Egg production per layer per year is 308.

The infrastructural, technological and extension interventions and investments that are needed to develop the poultry sector to achieve the above targets are detailed below. A total of ETB 7.9 billion (USD 397 million) investment and recurrent costs are required for implementing IFP and expanding the specialized poultry layers and broilers. This investment is over a 15-year period. The investment costs cover the:

- Identification, importation and testing of suitable tropically adapted specialized and breeds for IFP (grandparent or pure breed).
- Establishment of grandparent farms which eventually produce 110 million DOCs per year in 2028.

- Establishment of feed processing plants, at a cost of ETB 130 million (private investment).
- Allocation of sufficient land to produce the key ingredients of poultry feed (maize and soybean). ETB 5.6 billion is required to lease land to grow soybean and maize.
- Establishment and management of the program for 15 years, at a recurrent cost of ETB 100 million.
- Establishment and management of chicken meat and egg processing plants, costing an additional ETB 770 million (about USD 35 million). This will be a private sector investment.

In total, the investment and recurrent costs, including the costs of establishing grandparent farms and processing plants is ETB 8.7 billion (for the detailed budget see the LMP Poultry Roadmap).

Complementary activities which are required for the success of the proposed interventions revolve around alleviating anticipated feed, health, marketing, and policy constraints:

- Land needs to be allocated for the maize and soybean production to meet the feed requirements of the rapidly growing poultry industry.
- Additional attractive incentives will need to be provided to private investors such as tax holidays to encourage them to establish the agro industries required to increase availability of by-products for poultry feeds.
- Exportation of oil crops and importation of cooking oils need to be regulated.
- The animal health challenges would be better addressed through strengthening the regulatory capacity of the livestock ministry and by enhancing private investment in animal health service delivery, as well as input production and distribution.

Other conditions that need to be met to enhance the quick growth of the poultry industry include:

- Provision of incentives to the private sector to develop efficient market distribution systems and retail outlets for chicken meat and eggs.
- Promotional educational activities via the mass media to change the attitudes of consumers towards consuming eggs and meat from hybrid and exotic breeds.
- Technical training to develop the skilled labour needed for production and processing.
- Business extension support provided to producers and processors (private entrepreneurs, farmer groups, and cooperatives) to develop marketing and distribution strategies.
- Consumer training to develop more diverse skills in cooking and serving of chicken meat and eggs to meet the needs of a different consumers.

Investment impacts

Impacts on chicken numbers and production

The interventions in IFP and SPP poultry production bring huge increases in meat and egg production. With the proposed interventions poultry meat production reaches 564,000 tonnes in 2028 compared to 78,000 tonnes under the BAU scenario or the current investment level with current technology. Egg production grows to 8.9 billion eggs in 2028 compared to only 305 million without intervention during the same period. These changes come from the increase in the number of specialized layers and broilers units and flock make-up and improved individual chicken productivity in the IFP.

Table 40 below shows the change in the number of poultry over the 15-year investment period. As shown, TFP comes down as IFP goes up. The low yielding scavenging TFP decreases as adoption of the higher yielding semi-scavenging IFP picks up over time.

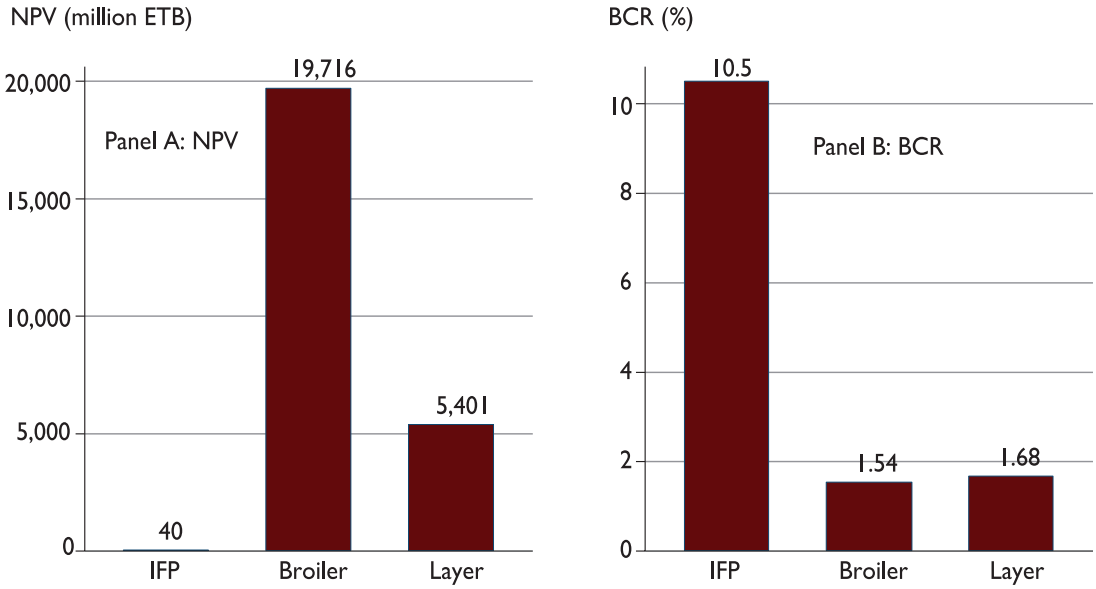
Table 40: Poultry number in TFP, IFP, SPP-broiler and SPP-layer subsystems for the years 2013, 2018, 2023 and 2028

Poultry production system	Numbers of chickens estimated (with intervention)			
	2013 (base year)	2018	2023	2028
TFP (hen with 8 followers)	47,186,332	27,863,057	16,452,857	16,452,857
IFP	50,793	26,677,230	42,769,009	42,769,009
SPP-layer	184,123	36,544,734	58,588,620	73,186,917
SPP-broiler	22,218	87,479,539	300,567,722	375,459,005
Total	47,643,465	278,564,560	418,378,207	507,867,788

Investment impacts for all the proposed interventions

Results in Figure 19 below shows that the returns from the investment in the IFP, SPP-layer and SPP-broiler subsystems are very large and attractive. The benefit cost ratios for SPP-broiler and SPP-layer are 1.54 and 1.68, respectively, while the BCR for IFP is 10.5. Internal rates of return (IRR) are very large (so large that the toolkit could not calculate them).

Figure 19: Investment impacts of the poultry improvement interventions: 20-year net present value, benefit cost ratio.



These very attractive investment returns for both the IFP system and the SPP-broiler and SPP-layer systems. Moreover, these high returns are not driven by the increases in numbers of chickens per unit or number of units, but by the increases in productivity or output per bird. Moreover, the return to investment in the IFP system is much higher than that of the SPP-broiler and SPP-layer systems. This demonstrates investment in improving the traditional smallholder family poultry system to become the IFP system is a very good investment option for Ethiopia which can not only increase national income, but also result in poverty reduction and increased food and nutritional security at household and national levels. Investment in both the IFP system and the SPP-broiler and SPP-layer systems is warranted and could be complementary.

Impacts on GDP

As shown in Table 41 below, the GDP contribution of the investment interventions in improving the poultry production systems is extremely high. By 2028, with the proposed interventions scenario, the poultry meat and eggs GDP contributions will grow to ETB 100 billion compared to only ETB 5.9 billion under the 'without intervention' scenario.

Table 41: GDP contribution 2028 with and without intervention scenario (ETB billions)

Products	Base year 2013 (ETB billions)	Poultry GDP 2028 (ETB billions)— without change	Poultry GDP 2028 (ETB billions) — IFP and SPP interventions
Poultry meat	3.226	5.274	22.026
Broiler and eggs	307	639	78.775
Total	3.533	5.913	100.801

Summary results for the three proposed commodity value chain and priority complimentary interventions

Finally, for ease of comparison, four other priority interventions which are complementary to and support the primary interventions in the three priority commodity value chains (live animals and red meat (YASM), cow dairy (AI and hormone synchronization), and poultry (dual-purpose crossbred chickens) are presented below in Table 42. The results are presented in terms of IRR and NPV.

Table 42: Summary of six strategic scenario assumptions and results of tested options

	Priority investments	Scenario/Intervention	System impacted (average herd size)	Proposed total investment (ETB '000)	IRR per subsystem	NPV (ETB) per subsystem
1	Reducing YASM	Animal health and feeding improvement	LG	6,887,726	50%	33,017,602,684
			MRS		NA	50,064,665,337
			MRD		73%	16,870,818,198
2	Raising genetic potential of dairy cows	AI and hormone synchronization	B1MRD and B2MRD (6 cattle)	677,300	9%	-1,430,506,665
			B1MRS (3 cattle) and B2MRS (9 cattle)		53%	88,322
3	Improving feed availability—quality and quantity	Promotion of fodder trade (seed industry, forage outsourcing and contract enforcement); Establish wheat flour mills; Establish milk processing plants	B1OM (5 cows)	1,225,000	30.2%	42,495
			B2OM (100 cows)		34.3%	1,794,818
			B2OF (1 50 male cattle)		NA	30,434,840
4	Improving export market access	Piloting Tractability and export promotion	B3LG (18 male cattle)	18,000	22.1%	2,208
5	Reducing feed prices	Remove 15% VAT	B1OM (5 cows)	8,000	154.3%	112,999
			B2OM (100 cows)		124.3%	4,013,466
6	Introducing dual-purpose crossbred chickens	Input and service delivery (feed, breed, and health); research to develop improved local breed	V2OV (25 poultry)	783,000	NA	40,140
	Increase number of exotic poultry breeds	Feed production, processing facility for poultry and poultry products	V2OL (3,000 poultry)	7,163,000	NA	5,401,461
			V2OF (55,998 poultry)		NA	19,716,326
Total				16,762,026		

NA = not available

10. Convergence of the Ethiopia livestock sector analysis and CRGE livestock investment plan

In 2011, the GoE launched its Climate resilient green economy (CRGE) vision and strategy. The vision document identified key sectors threatened by climate change: agriculture, transport, industry, energy, health and environmental resources. Within the agriculture sector, livestock was identified as one of three 'fast track' pillars for rapid implementation of the CRGE strategy. A CRGE coordination unit was created in the MoA and a Livestock Investment Plan (LIP) was developed to implement the CRGE in the livestock sector.

Then, in 2013, the GoE created a new Livestock Development State Ministry and in 2016, the MoLF, with responsibility for livestock development. To more effectively carry out its mandated livestock development activities during the five-year GTP II running from 2015-2020, the State Ministry, with technical backstopping from ILRI, used a set of quantitative tools, the LSIPT[24], to build a 15-year economic livestock sector model (LSM) for Ethiopia based on a 20-year dynamic herd model. The sector model was then used to carry out an ex ante impact assessment of potential combined technology and policy interventions over 15 years, the LSA, and this resulted in a long-term sector's strategy.

The LSA results then formed the basis for the Ethiopia LMP for 2015–2020. The LMP is made up of a five-year investment plans or investment roadmaps to implement the GTP II for the livestock sector. The three LMP roadmaps cover six key livestock commodity value chains, including their production systems, with both smallholder family and commercial production systems for poultry, dairy, and red meat and milk. Each roadmap has a factual baseline for each value chain plan, specific visions and development targets, challenges and strategies, and also specific combined investments in technology and policy interventions, with expected outputs, outcomes and impacts over the five-year period.

After the LSA and LMP were completed, GoE policymakers, along with livestock development investors (development partners or donors and the GoE), asked that the convergence of LMP and CRGE investment options also be analysed to ensure the resilience of the LSA and LMP investment priorities to climate change, thus ensuring the consistency between the GoE GTP II development objectives (see below) and the CRGE strategy, while minimizing potential trade-offs.

In analysing the convergence of the LSA and CRGE LIP, the key criteria at the centre of the analysis are the GoE development and policy objectives for GTP I and GTP II and the contribution of the investment interventions to climate resilience for the various commodity value chains, as measured by GHG emissions (whether positive or negative).

With the addition of climate change resilience, the GoE development objectives are:

- Reduction of poverty (increase production and incomes)
- Achievement of food and nutritional security (consumption-production balance)

24. The LSIPT was developed by CIRAD (France), FAO, and the World Bank under the aegis of ALive at AU-IBAR.

- Contribution to economic growth (national income or GDP)
- Contribution to exports (amount and foreign exchange earnings)
- Contribution to climate change mitigation and adaptation (GHG emissions)

In the process of developing the LSA, the assumptions of the CRGE were actually considered. The major assumptions in the CRGE include enhancing production and consumption of low GHG emitting animals (chicken, sheep and goats), poultry taking the leading role and targeted to cover 30% of the national meat consumption share by 2030. This intervention assumed to reduce 17.2 t CO_2e emission by 2030. The other assumption is to lower emission by keeping the cattle population at 53 million all the way to 2030 and lower emission per animal due to increased productivity of animals through improvements in feeding, health, genetic and handling of animals.

Most of the assumptions in the CRGE were also the assumptions that were built into the process of carrying LSA/LMP to make it climate resilient. The share of poultry in the total meat production is targeted to increase even more than the 30% in the CRGE. The GHG emission from the livestock is reduced by regulating the livestock growth for ruminants, in particular cattle, through introducing off-take rate much higher than the BAU rate. The GHG emission per animal is also reduced by introducing ambitious genetic improvement programs with improved feeding, health and management interventions. The growth rate of cattle was kept as much as possible closer to what is proposed in CRGE, at 1.57% growth rate (including the huge population increase proposed in the commercial dairy and feedlot systems) without compromising the achievement of meeting the development objective of the country, like meeting consumption demand, export need, and livelihood of the farmer.

The three key commodity value chains analysed in the LSA were measured for their potential contribution to the long-run climate change resilience of the sector, or the GHG impact of the interventions on the three individual commodity value chains and then all of them together:

- Chicken meat and eggs from poultry
- Milk from crossbred dairy cows and indigenous cows
- Red meat/milk from crossbred cows and indigenous cattle, sheep, goats, and camels.

To measure the convergence of the LSA/LMP with the CRGE-LIP, the GHG emissions (the actual CO_2 e emissions) and production of livestock products are compared using two ranges of livestock off-take rates and two investment scenarios:

1. LSA scenarios for 'without additional investment interventions' and using the LSA 'BAU' off-take rates,
2. LSA scenarios for 'with additional investment interventions' to improve productivity and production and using the 'with' case off-take rates, which are much higher than the BAU rates, especially for cattle.

These off-take rates are compared in Table 43 below. The BAU off-take rates are based on the literature and meant to depict the current or baseline situation. The biggest increases in off-take are in the LSA 'with' case scenarios for cattle to keep their number down since they are the highest GHG emitters and are targeted to be replaced by chickens to ensure animal-source food security.

Table 43: BAU off-take rates used for the 'without-case' scenarios and higher 'with-case' off-take rates used in the with-case investment scenarios in the LSA

Species	BAU off-take rates with no additional investment (without-case scenarios)	With-case off-take rates used for additional investment intervention scenarios tested ('with' case scenarios)
Cattle	17%	43%
Sheep	32%	40%
Goats	28%	37%
Camels	7%	9%

The GHG (CO_2e) emissions and meat, milk and egg production results for the two ranges of off-take rates for the 'without' and 'with' case scenarios are compared in Tables 44 and 45.

Table 44: Livestock commodity production for the BAU case and off-take rates and the with-case for additional intervention investments and increased off-take rates (or 'with-case' rates)

Scenarios	Chicken and egg (tonnes)	Read meat (tonnes)	All meat (tonnes)	Cow milk ('000 litres)
Production with BAU intervention and BAU off-take rates	94,417	1,528,415	1,607,463	6,521,453
Production with additional investment and increased or 'with' case off-take rates	4,939,012	2,583,150	3,004,775	10,872,904

As shown in Table 44 and Table 45, as well as in Figure 20, investing in improvements in animal productivity and increasing the number of low-emitting animals (chickens) results in an increase of all meat by 87% and cow milk by 67%. Meanwhile the increase in GHG (CO_2e) emission is only 6.3% for the LSA 'with additional investment' and increased off-take rates compared to the 'without' case and BAU off-take scenarios.

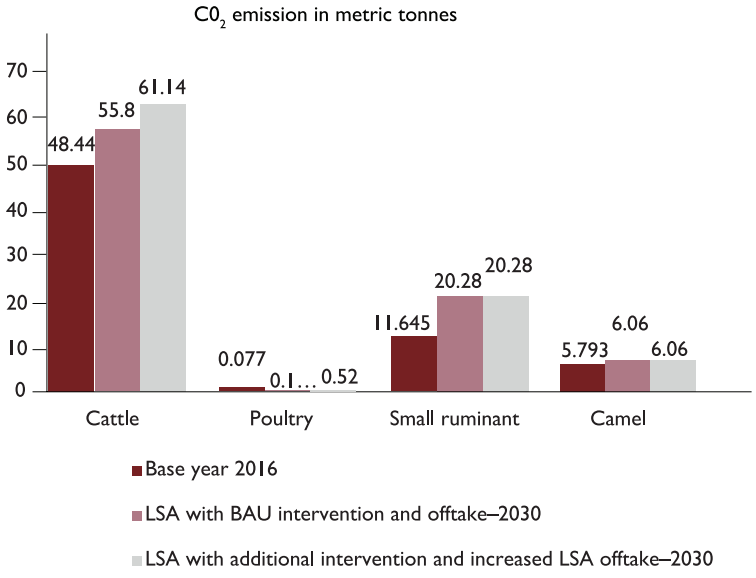
Table 45: GHG emissions and livestock number for base year, LSA BAU—2030 and LSA 'with additional intervention' and increased off-take scenarios by time horizon in MT CO_2e/year

	GHG emission (MT CO_2e/ year)			Livestock number ('000)	
Value chain	Base year 2015	LSA with BAU intervention and off-take - 2030	LSA with additional investment and with-case off-take - 2030	Base year 2015	LSA with additional investment and with-case off-take - 2030
Cattle	48.44	55.8	61.14	56,241	75,517
Poultry	0.077	0.127	0.52	47,956	498,001
Small ruminants	11.645	20.28	20.28	62,697	109,190
Camels	5.793	6.06	6.06	4,527	4,735
Others	3.6	8.973	8.98	8,859	23,219
Total	69.555	91.24	96.98		

As shown in Table 45 and Figure 20, cattle by far have the highest GHG emissions followed by small ruminants and camels. However, in terms of percentage change in GHG emissions between the BAU or 'without' case and the 'with' case and increased off-take rate, poultry shows the biggest increase due to the increase in the number of chicken.

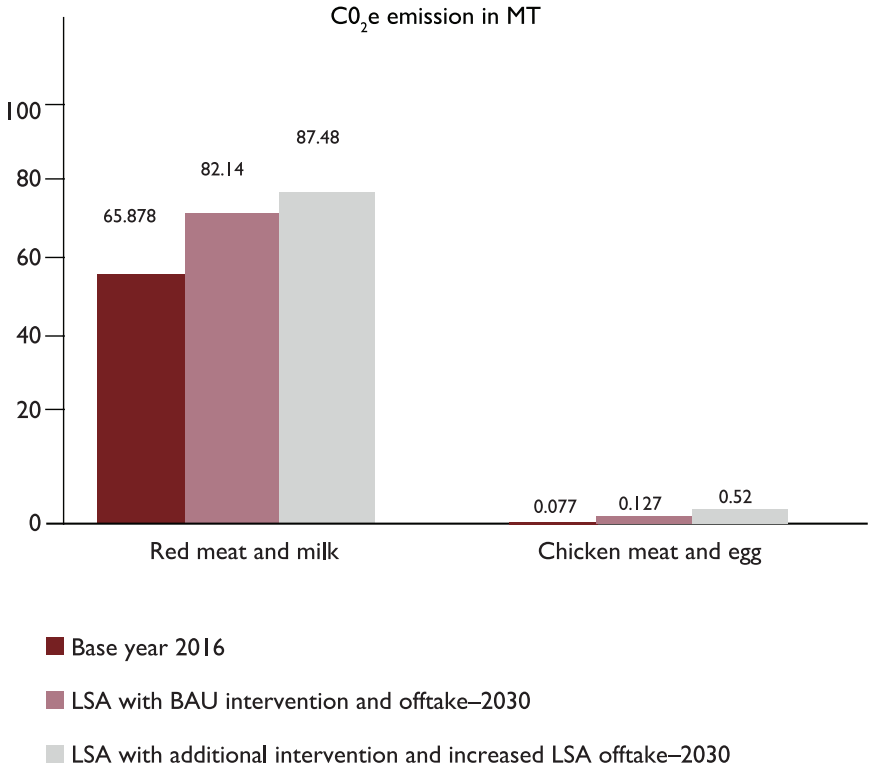
Table 44 above and Figure 20 show that the proposed 'with' case intervention scenarios and the increased off-take rate will result in a 69% increase in red meat production and 67% increase in cow milk and 87% increase in all meat production by 2030. Meanwhile, Table 45 shows that the overall increase in GHG emissions is very low (6%).

Figure 20: GHG emissions for base year, LSA BAU—2030 and LSA 'with additional intervention' and increased off-take scenarios in MT CO_2e/year.



Similarly, Figure 21 shows that the amount of GHG emitted from producing red meat and milk is very high when compared to that from producing chicken meat and eggs. Thus, despite the big increase in poultry proposed in the LSA, the overall GHG emissions remains at about the same level as in the baseline since the GHG emissions for chicken meat and eggs is so low.

Figure 21: GHG emissions by commodity value chains for base year, BAU—2030 and LSA 'with additional intervention' and increased off-take scenarios in MT CO_2e/year.



In Table 46, the CO_2e emissions from the various livestock species given the LSA 'with' case intervention scenarios and higher off-take rates are compared to the emissions levels found in the CRGE LIP.

Table 46: GHG emission comparison LSA and LIP

Livestock species	GHG emissions in 2030 (in metric tonnes CO_2e/year)	
	LSA with intervention	LIP
Cattle	61.14	58.09
Poultry	0.52	0.42
Small ruminants	20.28	11.87
Camels11	6.06	1.7
Equines	8.98	9
Total emissions	96.98	81.08

The emissions from livestock projected in the CRGE LIP are lower than the projected LSA values, but the lower LIP emissions come at a cost in terms of the ability to achieve the other national development objectives of Ethiopia. Moreover, the CRGE LIP assumes a 4.5% productivity increase per annum across all the livestock species in order to produce enough meat (which includes eggs) and milk to meet the future national demand for these products while keeping GHG emissions at only 81.08 MT CO_2e/year. Achieving and sustaining a 4.5% increase in productivity per annum across all livestock species is biologically unrealistic and the presumed related emission levels can only be achieved by compromising production of animal-source foods which would hinder the attainment of the other national development objectives, in particular balancing meat and milk production and consumption (or contributing to food security), and meeting export earnings and foreign exchange earning goals of the government from trade in live animals and meat. On the other hand, the livestock emissions from the LSA scenarios with additional investment and the higher off-take rate are as close as they can be to the level of the CRGE LIP emissions, without compromising achievement of the other national development objectives of Ethiopia.

Conclusion

The LSA focuses on increasing chicken production and consumption over time to improve the climate resilience of the sector and converge the LSA as much as possible to the CRGE LIP, while ensuring that all the national development objectives of Ethiopia can be addressed and achieved to the extent possible. The LSA strategy and results show that through a focus on increasing the number of low GHG emitting animals, especially chicken, and regulating the growth of the number of high emitters, in particular cattle, through a higher off-take rate; alongside additional investments to help achieve increased productivity for all livestock species considered priorities in the LSA, can improve the sector's resilience to climate change over time because the total emissions from livestock can be brought down to 96.08 CO_2e MT in 2030, which is close as possible to the LIP GHG level. Thus, the LSA interventions converge as well as possible to the CRGE LIP interventions and outputs, while leading to balanced achievement of all of Ethiopia's national development objectives.

11. Conclusions

Using the most recent available data from the last national livelihoods panel survey done in 2013, the then LSM of the Ethiopia MoA (now the MoLF) and ILRI worked together to employ the LSIPT [25] to develop national herd and economic sector models. These models were then used to do a baseline assessment of the current state of livestock development in Ethiopia, and then to carry out projections of what could be accomplished to modernize the sector over the coming 15 years to 2028. The analysis comprises future development scenarios involving changes in primary and post-harvest production brought about by investment interventions involving combinations of technology and policy interventions. The models were used to assess the 15-year impacts of the most promising combined technology and policy interventions on key indicators of economic development to identify those interventions with the most potential to contribute to Ethiopia's national development goals. The results of the analysis form a long-term strategy referred to as a LSA.

The resulting LSA provides the basis for the development of livestock targets for Ethiopia's GTP II (the five-year economic development plan running from 2015–2020) and also provided the basis for the Ethiopia LMP for 2015–2020. It is a series of five-year development implementation or investment plans or 'roadmaps', to be implemented during the GTP II in the livestock sector.

The LSA and LMP interventions were tested ex ante in the scenario analysis using measures of the GoE livestock development and policy objectives for GTP I and GTP II. The GTP objectives used to assess the various investment interventions of the Ethiopia LMP were based on the investment options' ability to contribute to:

- poverty reduction,
- achievement of food and nutritional security,
- Economic growth or national income (GDP),
- Exports and foreign exchange earnings, and
- Climatic resilience.

Using measurable economic or environmental indicators for the above objectives, three key livestock value chains – live animals and red meat and milk, dairy with crossbred cows, and poultry – were identified in the LSA as potentially contributing most to the long-run development of the sector and the national economic development objectives. Furthermore, each of these commodity value chains is comprised of two sub-value chains involving a smallholder family production system and a commercial specialized production system, which were found to be complementary and supportive of one another. These six sub-value chains are found in one or more of the three major production typology zones of Ethiopia, officially categorized by the MoA as: LG, including both pastoral and agro-pastoral systems, highland mixed crop-livestock rainfall deficient (MRD) and highland mixed crop-livestock rainfall sufficient (MRS).

The results on the sector and national development goals were also analysed to gauge the impacts if no additional investment and changes in technology and policy are made to raise livestock productivity. The LSA projections for

25. This toolkit was developed by a group of international agencies under the aegis of ALive at AU-IBAR. CIRAD (The International Agricultural Research Centre of France), FAO and the World Bank were the main contributors.

the 2028 show a deficit of 53% for all meat (1.332 million tonnes) and 27% for cow milk (1,987 million litres) due to exploding demand (as a result of rapid population growth, urbanization, and rising per capita income) (see Figure 22, panels C and D). The LSA scenario analysis then seeks to identify the species and interventions which would erase these deficits and should thus be prioritized for investment in the GTP II.

The LSA results show there were about 11.4 million livestock producing households in Ethiopia in 2013 (CSA 2013). Cattle were found to be the dominant species[26] in 70% to 90% of livestock producing households, depending upon production zone. Thus, cattle dominate smallholder income generation and meat/milk production in all production zones – lowland and highland (MRS, MRD and LG[27]), as well as in the specialized commercial-scale production systems. Moreover, as of 2013, cattle were found to account for about 72% of the meat and 78% of the milk produced annually. Cattle thus play a dominant role in producing smallholder income and in meeting domestic meat and milk consumption requirements. Furthermore, based on potential returns per ETB invested (e.g. the IRR) in available technologies (genetics, feed, and health), the LSA results show investment in cattle productivity in all the production zones has high potential to reduce poverty, contribute to national income growth, meet future domestic consumption requirements, and also enable increased meat and milk exports and foreign exchange earnings.

Red meat (and milk) improvement (cattle, sheep, goats, and camels)

The aim of the proposed interventions in live ruminant animals (cattle, sheep, goats, and camels) is to increase individual animal and herd productivity, leading to significant increase in total production and the quality of meat produced. It entails investments in interventions at the primary production level and post-production levels along the value chain to increase value added, and impact on the national development goals, including export earnings from meat rather than just live animals.

Broad-based improvements in animal health services and genetics for cattle, and other major red-meat producing species (sheep, goats, and camels), could be achieved in Ethiopia, when combined with improved feeding and better management practices including:

- Rationalization of public and private veterinary services following the veterinary services privatization roadmap set out by the MoLF to increase service coverage and quality, while improving coverage and making services more affordable and thus accessible.
- Increasing productivity of local breed animals in all production typology zones through health interventions to reduce YASM, other critical diseases such as FMD through vaccinations, and parasite control (endoparasites and ectoparasites).
- Improving grazing lands (pasture and range) for more and better feed production.
- Improving availability of improved feed from forages, crop residues and industrial by-products.
- Improving the reproductive and weight gain performance of ruminants, through better provision of animal health services and more and better feed.
- Investments in milk collection, product transformation (slaughter, meat processing, tanneries, and leather manufacturing), as well as product distribution along domestic and export value chains to add value and improve meat and hides and skins quality, thereby increasing exports and foreign exchange earnings.
- Investments in meeting international sanitary and phytosanitary standards to promote exports: identification and traceability, disease surveillance, quarantine facilities etc.

The LSA results show it is profitable to invest in cattle improvement in all production zones, as well as sheep in MRS, goats in MRD, and camels and goats in the LG. But, even with these interventions, the projected red-meat deficit

26. A livestock species is classified as dominant if more than half of the household income from livestock comes from that species.

27. According to the MoA typology of production zones:
    1. MRS is the highland mixed crop-livestock moisture sufficient systems zone.
    2. MRD is the highland mixed crop-livestock moisture deficient systems zone.
    3. LG is the lowland grazing systems zone (both pastoral and agro-pastoral systems).

will be 7% or 187,000 tonnes in year 2028 (Table 47 and Figure 22, panel A). Therefore, investing only in cattle improvement (and other red meat species) is not sufficient to reach the GTP II goals for meat production and does not eliminate the projected overall meat consumption deficit for 2028. It turns out investment in poultry improvement is the key to erasing the meat deficit.

Poultry improvement

According to the LSA findings, the transformation of traditional backyard family poultry into a more modern and more productive system and massive expansion of specialized commercial-scale broiler and layer units will be necessary to close the future projected gap in total meat consumption requirements. It will be essential to transform traditional backyard family poultry that rely on indigenous scavenging chickens into a market-oriented IFP system with semi-scavenging crossbred chickens. When combined with a limited amount of supplemental feeding (10%) and adequate health services (especially all required vaccines), this would greatly increase the chicken genetic potential for both eggs and meat. Moreover, the number and size of specialized commercial-scale broiler and layer units will also need to be substantially increased.

Success will also require complementary interventions; including the allocation of sufficient land for production of the main ingredients in poultry feed (maize and soybean) and the effective encouragement of increased private investment in the poultry sector – particularly in DOC and pullet production, and meat and egg processing.

Poultry improvement impact on meat production-consumption balance

The LSA results show that successful investment in the poultry improvement intervention could lead to an overall surplus in all meat production over projected consumption requirements by 2028. As shown in Table 47, the expected all-meat surplus in 2028 is projected to be about 11% or 320,000 tonnes (also see Figure 22, panel C).

Table 47: Projected national meat production-consumption balance with combined investment interventions in 2028; with poultry interventions to increase chicken meat

Animal product	National production		National consumption		Production - consumption balance (+/-) (thousand tonnes)	Production deficit (-) or surplus (+) as a percentage (%) of consumption
	(thousand tonnes)	(%)	(thousand tonnes)	(%)		
With combined interventions						
Beef	2,081	64	2,302	7	-221	-10
Mutton	216	7	183	6	33	18
Goat meat	218	7	183	6	35	19
Camel meat	100	3	134	5	-34	-25
All red meat	2,614	81	2,801	96	-187	-7
Chicken meat	619	19	112	4	507	453
All meat	3,233	100	2,913	100	320	11

The surplus chicken meat produced (about 507,000 tonnes in 2028, a surplus of 453% (see Table 47 and Figure 22, panel B) would then enable Ethiopia to meet its domestic consumption requirements for all meat. Furthermore, if chicken meat could substitute for domestic red meat consumption, this would enable the exportation of beef, mutton and goat meat to raise foreign exchange earnings, in line with the meat export policy of the GoE. However, tastes and preferences for cooking with the local chicken, known as 'Doro', would have to be modified through the promotion of exotic chicken meat and changes in cuisine.

The surplus of eggs produced (about 8.9 billion by 2028, or an increase of 919% and resulting in 75.4 eggs available per person) would more than meet domestic needs, (Figure 22, panel E). The surplus could then need to be processed into egg powder and used domestically for new or additional industrial purposes (e.g. in the baking industry), or could be exported as egg powder to raise foreign exchange earnings.

Cow milk improvement

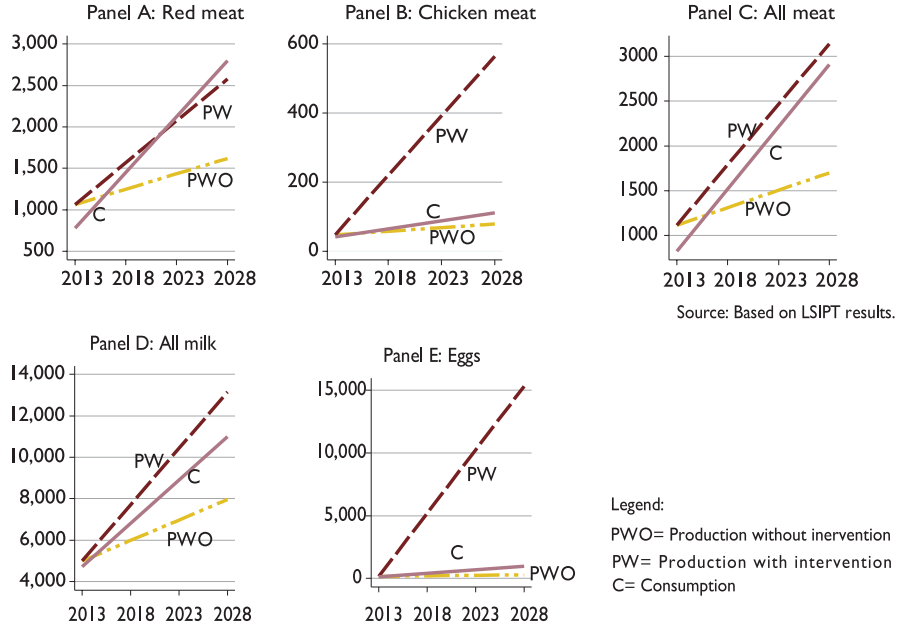
Given the comparative advantage of the Ethiopian highlands for dairy production, the goal of investment in diary, especially from cows, but also from camels, is not only to vastly increase the quality and quantity of milk and other dairy products marketed domestically, but also to eventually export dairy products, at first milk powder, and eventually create and promote new value-added milk products as exports to raise foreign exchange earnings. The LSA results show that a significant future milk surplus could be realized through investment in better genetics, better feed and health services, and improving both traditional dairy farms and commercial-scale SDP units. The investment interventions proposed to improve cattle milk production and the value chain would transform family dairy farms in the highland moisture sufficient production zone (MRS) from traditional to market-oriented improved family dairy (IFD) systems. The proposed interventions would also vastly increase the commercial-scale SDP units, and increase milk production from indigenous (or local) cattle breeds.

The LSA results show increasing the contribution of all types of cow dairy farms to national milk production could be brought about by:

- Raising the genetic potential of local breeds for significantly higher milk production through crossbreeding with exotic dairy breeds using AI and hormone synchronization, in the MRS and in the dairy sheds and peri-urban areas in the MRD.
- Improving the reproductive and weight gain performance of crossbreds, through enhanced provision of animal health services and better feed.
- Changing policy to make land available to investors for forage seed and feed production, and promoting and enforcing outsourcing of forage production contracts.
- Increasing the milk productivity of local breed cows in all production typology zones (MRS, MRD and LG) through health interventions to reduce YASM, coupled with improving grazing land (pasture and range) for more and better feed production.
- Improving the SDP systems through better genetics, feed and health services, while expanding the number of the SDP units to increase the number of dairy cows.
- Promoting forage and fodder production and trade, and the production of supplemental concentrates.
- Investments in milk collection, product transformation, and product distribution along the value chain to increase processed milk and improve milk quality, including by creating less perishable dairy products (e.g. milk powder, UHT, etc.).

Meanwhile, it assumed that the feed and health interventions are already in place in SDP operations. If the proposed investment interventions are successfully put in place, the LSA results project a 29% surplus of 3.2 billion litres of milk by 2028 (Figure 22, panel D).

Figure 22: Production and consumption requirement projections from 2013–2028, 'with' and 'without' investment interventions.



Source: Based on LSIPT results.

Source: Based on LSA results.

Thus, these results suggest that the GTP II should not just endorse the substitution of imported dairy products, particularly milk powder, but should aim for the creation and promotion of new value-added milk exports to raise foreign exchange earnings. The production of value-added products would most likely begin with powder milk and long-shelf life products like UHT, but could later be expanded to include cheeses, yogurt, ice cream, etc.

Value chains to be targeted in the LMP roadmaps

Based on the LSA results, the investments proposed for the LMP roadmaps include appropriate combinations of genetic, feed and health interventions and related policy changes to improve livestock productivity and the performance of the value chains. The interventions are meant to transform traditional family farms into improved market-oriented systems, improving household incomes, food security, livestock product consumption and nutrition, and contributing to national economic growth (GDP). In addition, and perhaps most importantly, the LSA results recommend targeting and transforming traditional smallholder family farms, as well as specialized production systems. Targeting specialized production systems in each value chain (cow dairy farms, beef feedlots, and poultry broiler and layer units) is a means of increasing their contribution to national livestock production and GDP, but they also can provide demonstrations of modern and other practices which result in higher productivity and quality, thus leading to higher incomes for farmers.

Again, investing in the smallholder family production systems and the commercial specialized production systems are both highly profitable, and were found to be complementary and supportive of one another. GoE policy needs to focus on the threatening projected domestic supply gaps for meat and milk, and the commercial specialized systems can now be the 'pull' factor for transformation of the smallholder systems, providing 'industry leader' examples of modernization and commercialization of production practices and the value chains.

Finally, based on results of the LSA analysis, to reach the objectives and goals of the GTP II, the key commodity value chains targeted in the LMP roadmaps are:

- Red meat (and milk) from cattle, sheep, goats and camels
    - Improved traditional red meat and milk systems in all production zones (MRS, MRD and LG)
    - Commercial specialized cattle feedlots
- Poultry
    - Improved (smallholder) family poultry (IFP) in all production zones
    - Commercial SPP—broilers and layers
- Cow dairy
    - Improved (smallholder) family dairy (IFD) systems in MRS and peri-urban MRD
    - Commercial SDP operations

LSA and CRGE LIP convergence

The LSA focuses on increasing chicken production and consumption over time to improve the climate resilience of the sector and converge the LSA as much as possible to the CRGE LIP, while ensuring that all the national development objectives of Ethiopia can be addressed and achieved to the extent possible. The LSA strategy and results show that increasing the number of low GHG-emitting animals, especially chicken, and regulating the growth of the number of high emitters, in particular cattle, through a higher off-take rate, the total emissions from livestock can be brought down to 96.08 CO_2e MT in 2030, which is close as possible to the LIP GHG level. Thus, the LSA interventions converge as well as possible to the CRGE LIP interventions and outputs, while leading to balanced achievement of all the Ethiopia national development objectives.

Annexes

Annex 1 Tables supporting section 3: livestock systems and their performance

Table 48: Key demographic and production parameters of sheep and goats according to their production systems

	LG						MRD				MRS	
	Agro pastoral		Pastoral small		Pastoral medium		Small		Medium		Small	
	Sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat
Herd size	16	15	6	9	22	25	3	3	11	12	5	6
Parturition rate (%)	100	108	105	109	110	120	119	120	120	123	125	120
Mortality rate female Juvenile (%)	21	26	21	29	21	24	21	23	21	24	26	28
Mortality rate female subadults (%)	15	12	15	12	15	14	12	13	12	10	10	17
Mortality rate Female adults (%)	10	10	10	10	10	10	10	14	10	12	8	14
Mortality rate male juvenile (%)	22	26	22	24	22	24	23	23	23	28	26	28
Mortality rate male subadults (%)	15	12	15	12	15	12	12	12	12	15	10	22
Mortality rate male adults (%)	10	10	10	10	10	10	10	14	10	14	9	14
Off-take rate (%)	28	27	29	28	29	28	32	30	34	31	35	27
Growth rate (%)	1.6	2.7	2.9	1.1	3.3	4.8	4.3	4.2	5.2	5.9	3.6	3.0

Table 49: Main productivity parameters for sheep and goats

	LG						MRD				MRS	
	Agro pastoral		Pastoral small		Pastoral medium		Small		Medium		Small	
	Sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat
Dressing percentage (%)	42	42	42	42	42	42	42	41	42	41	42	41
Milk off-take litre per year/breeding female	NA	36	NA	55	NA	60	NA	43	NA	44	NA	43

Table 50: Key demographic and production parameters in different poultry production systems

Description of parameters	Backyard	Layers	Broilers
Number per farm	2.2	1,000 chicks	1,000 chicks
Number of offspring/breeding female/year	8.7	NA	N/A
Mortality rate overall before marketing (%)	50	5	
Young stock			7
Growing			5
Adult mortality (%)/year	20	3	2
Kg total feed/kg egg produced/kg live weight	NA	2.7 kg/kg of egg	1.8 kg/kg live weight

Table 51: Main productivity parameters for poultry

Description of parameters	Backyard	Layers	Broilers
Number animals sold per breeding female/year	1.61	NA	NA
Average weight at slaughter (kg)	1.5	2.4	2.3
Dressing percentage at slaughter (%)	65	64	65.2

Table 52: Key demographic and production parameters of camels according to their production systems

	LG		
	Agro pastoral	Pastoral small	Pastoral medium
Herd size	11	1	16
Parturition rate (%)	45	45	45
Mortality rate female Juvenile (%)	35	35	35
Mortality rate female subadults (%)	6	6	6
Mortality rate female adults (%)	3	3	3
Mortality rate male calves (%)	35	35	35
Mortality rate male subadults (%)	6	6	6
Mortality rate male adults (%)	3	3	3
Off-take rate (%)	7	7	7
Growth rate (%)	0.3		0.3

Table 53: Main productivity parameters for camels

	LG		
	Agro pastoral C	Pastoral small C	Pastoral medium C
Dressing percentage (%)	50	50	50
Milk off-take litres/year per breeding female	583	583	583

Annex 2 Value chain analyses

Methodology for value chain analysis

A quantitative description of the livestock value chains in Ethiopia, entailing mapping of the value chains and a quantitative assessment of the quantity of livestock products moving through the value chains and sub-chains, as well as an analysis of the price structure or changes and gross margins along the chains. First, the value chains and important sub-chains were identified and mapped. Then, the production entering the chain was derived from the LSIPT production assessment of each farming system minus the home consumption and direct sales to neighbours. This estimate of the total production entering the chain was then compared with other sources of information available (aggregate statistics) to arrive at the best estimate which was then used in the analysis of price changes and value addition. Next, the main value chain actors and the quantities and values of commodities and/or products at each stage in the value chain were identified. Finally, organizational analysis was done (how/where farm output is sourced; level of vertical or horizontal integration, functioning of intermediary and final markets, as well as consumers). Producer and value chain actor numbers were also estimated, when available, but the size of the sub-chains in terms of the number of marketing agents was not documented.

Tables 48–51, in Annex 2, document the value addition or the structure of prices, and the gross margins along the chain and sub-chains. In the tables, the first figure in each cell (i.e. figure with the + and % sign) indicates the average percentage price increase (%) paid to each relevant actor in the value chain and the figure in the brackets indicates the percentage of the total gross margin realized. The price change or increase indicates the percentage proportion of each ETB 1 of revenue that the value chain actor retains as gross profit since costs are not accounted for in the analysis of margins. It should be noted, however, that further studies on the costs in each part of the chain are needed to also determine the net margins and profits.

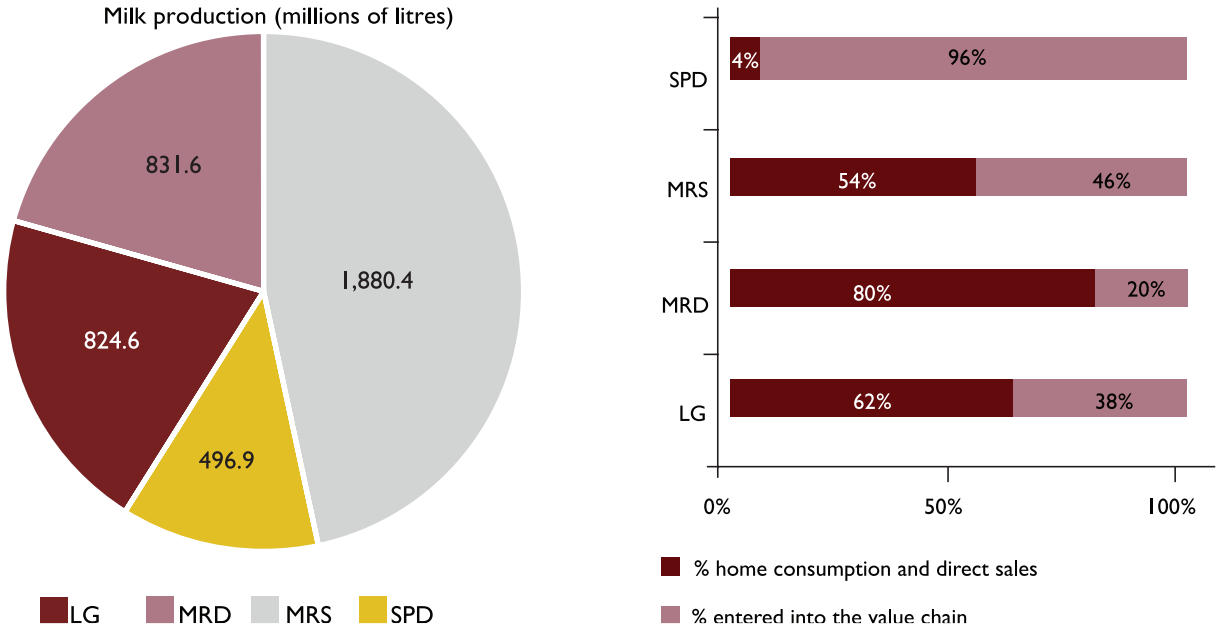
Description of the dairy value chains

Cow milk, camel milk and butter are the main commodities in the dairy value chains. These value chains are described in Annex 2, Figures 24–26. The LSA analysis identified that the total annual cow and camel production is 5,030 million litres out of which 80% or about 4,033 million litres is cow milk and the remaining 20% or 996.9 million litres is camel milk. In addition, there is a production of 152.1 million litres of goat milk, but with only very small quantities entering the value chain. The total monetary value of the milk based on the average farm gate price[28] is estimated to be USD 2.8 billion[29], which is 6.9% of the GDP of the country[30]. Cow milk is produced in the four[31] main production systems of the country. The traditional smallholder production systems (in MRD, MRS and LG) contribute 88% of the total cow milk production of the nation. The contribution of the small and medium-sized SDS is only 12%. The main feature of the smallholder-dominated system is low productive local breeds (190 litres per animal per year)[32], low level of marketable surplus due to low level productivity and hence low level commercialization. According to the LSA results, only 19% or 780 million litres of the total cow milk production entered the value chain in 2013.

Butter is, of course, a derived or processed product from cow milk. From the total cow milk volume which enters into the formal chain, 46% or 665.8 million litres enters the value chain in the form of butter, or 51,213 tonnes of butter worth of USD 308.8 million. In the remote areas, because market accessibility is low, smallholders tend to transform their milk to butter. Two reasons support this trend: the price of butter has been rising over time, and butter increases the product shelf life.

On the other hand, in the smallholder MRS, MRD, and LG systems, 75% or 4,355 million litres of the milk produced is consumed at the household level or goes to direct local sales (see cow milk value chain map below). Moreover, the LSA analysis shows that the small size dairy farm households consume a greater share of milk than the medium size ones. The small and medium farms in MRD consume or directly sell 90% and 82% of their total milk production, respectively. The figures for small and medium farms in MRS are 80% and 70%, for LG they are 70% and 87% and for SPP 50% and 1% respectively. Thus, the proportion of milk that enters the formal value chain is around 15%, in the smallholder production systems and ranges from 10–30% of total production according to the production system.

Figure 23: Cow milk share by production system, and the average proportion of milk consumed or which enters the value chain by system, respectively.



28. The farm gate price for cow milk is ETB 10.5, for camel milk it is ETB 8.25 and for butter ETB 116.6/kg. These figures are obtained by averaging the producer price at which milk is sold through different channels (as of 1 December 2013).

29. 1USD= ETB 19.35 (as of 1 December 2013)

30. According to Wikipedia the estimated GDP of Ethiopia in 2012 was USD 43.13 Billion

31. LG, MRD), MRS, and SDS.

32. Average milk productivity figure in the three traditional production systems.

All camel milk comes from the LG system. Out of 692.6 million litres total production, 28% comes from agro-pastoralists and 72% from pastoralists. The proportion of camel milk that enters the value chain is 50% (see camel milk value chain map below). However, agro-pastoralists consume more cow milk than camel milk. Producers say that cow milk has more fat to nourish children and the family. The proportion of milk (both camel and cow) that enters the value chain also varies by season. In the dry season the volume decreases by up to 50–60% (the figures in LSPIT used represent seasonal averages).

Description of the dairy sub-chains

The sub-chains were analysed based on the value chain maps developed for the cow milk, camel milk and butter chains. Six main sub-chains were identified in the cow milk value chain, out of which two are formal and vertically integrated. The other four are informal and traditional sub-chains through which a total of 472.7 million litres or 12% of the national cow milk production is traded. From this volume, 22.2% or 104.9 million litres (with a value of USD 56.9 million) is lost post-harvest and the remaining 367.8 million litres or USD 329.5 million worth of milk is traded and reaches consumers through these sub-chains. Of the total amount of cow milk marketed, about 78% of the total cow milk enters through informal chains and the remaining 22% through formal chains. Among the informal chains, the food service providers[33] to consumers' chain accounts for 49% of the milk that enters the market. The cross-border and trader-to-consumer value sub-chains in the pastoral and agro-pastoral areas account for 15% and 14%, respectively. In the formal chain the link with traditional smallholder to processors takes a 15% share and the SDS follow with 7%.

Milk is exported formally and informally to neighbouring countries (Somaliland and Kenya) through cross-border markets. However, these sub-chains are not well developed. The market is controlled by an oligopoly, with three formal exporters dominating the market and colluding with each other to prevent competition. During the wet season the producers are price takers. The quality of the milk is low: sellers use plastic jerry cans that are difficult to wash, no collection and chilling centres exist, and a traditional transport system exposes the milk to direct sunlight. These pictures indicate the type of milk collection centres, means of transport and trading points in informal LG chains.

Camel milk is traded in four major informal traditional sub-chains. Unlike cow milk, the greater proportion or 58% of the camel milk is traded in open market trader-to-consumer sub-chains, followed by 40.5% through the food service-to-consumer sub-chain. Only 1.45% of camel milk is sold through cross-border markets to traders and consumers. Likewise, butter is sold in three main sub-chains and the longest one, i.e. the producer-to-rural collector-to-wholesaler-to-retailer consumer sub-chain accounts for 60% of the total butter production. The retailer to consumer sub-chain comprises 25% and foodservice sub-chain 15%.

Collection

Transportation

Trading point

33. Cafés, yogurt and milk shops, restaurants and hotels

Price analysis of the cow milk value sub-chains

Six sub-chains were identified in the cow milk value chain, two of which are formal and vertically integrated. Annex 2, Table 54, indicates the price structure along the sub-chains (average % price increases at each stage) and the gross margin or margin before costs are deducted) for products sold at each stage in the sub-chains. The price analysis of the dairy sub-chains shows that on average the producers linked with the informal chains receive higher prices than in the formal vertical integrated chains. On the other hand, the producers in both SDS receive higher prices than the producers in other production systems. The reasons SDS producers receive higher prices is better milk quality (more hygienic), more reliable and sustainable milk supply, and more timely delivery. Among the demand side actors, the food service providers in the informal chains received the highest margins. The lowest price paid by processors is ETB 7 to the traditional smallholders, 57% less than the price paid to SDS producers by the processors.

The average price increases and margins are quite high for most the actors in the cow milk sub-chains, especially the processors and food service providers who are involved in value-addition through milk processing or transformation. This implies that they are operating in a lucrative business environment where there are not yet enough competitors. For example, on average in the producer to processor-to-retailer-to-consumer sub-chain, as shown in the SDS in Annex 2, Table 54, an 82% higher price than the producer price is paid to the processor by the retailer for an 82% gross margin, followed by a 10% higher price or 18% gross margin for the retailer when he/she sells to the consumer. This means that from the ETB 100 a processor invests they get a gross margin of ETB 82 when they sell to the retailer, and for every ETB 100 the retailor invests they get ETB 10 or a 10% gross return when they sell to the consumer. Meanwhile, retailers get far lower gross margins, indicating more retailers and thus greater competition.

In the grassland, sub-chains the average price increases and total margins are 60% in the cross-border Informal sub-chain and only 22% in the informal domestic sub-chain which entails sales at local markets and then directly to consumers. However, among the other cow milk sub-chains involving the other production systems (SDS, MRD, and MRS), the price increases along the value chain, from producers to consumers is at least 100% with the total margins thus ranging from 100% in the SDS formal sub-chain to 214% in the formal sub-chain involving the MRD and MRS production systems. In the SDS the processors pay higher prices to producers than they do from the MRD and MRS systems in both the formal and informal chains since the costs of collecting milk is substantially higher, and the quality and reliability better.

In cross-border and domestic informal camel milk sub-chains, the prices paid to producers are almost the same, and generally less than for cow milk, but the total margins for camel milk are quite high, 175% for the cross-border sub-chain and 135% for the domestic sub-chain. Most actors get reasonable returns in the camel production systems. Informal camel milk exporters receive 50% of the gross margin, followed by food service providers (Somali restaurants) who receive 44%, traders 39%, and retailers 28.6% (for details see Annex 2, Table 54).

In the domestic informal butter market, the total price increase and margin is only 37% with retailers getting 30% of the margin, rural collectors 23%, food service providers 26%, and wholesalers 21%. The butter value chain appears to function efficiently.

Table 54: The average price changes and gross margins for the dairy value sub-chain in Ethiopia

Actors	Cow milk						Camel milk		Butter
	Grassland		SDS		MRD and MRS				
	Cross-border informal	Informal domestic	Formal	Informal	Formal	Informal	Cross-border informal	Domestic informal consumers	Domestic informal market
Producers (price)	10	9	11	14	7	12	8	8.5	117
Rural collectors	+40% (67%)						+37.5% (21.4%)	+23.5% (17.4%)	+8.54% (23.3%)
Open market traders		+22.2% (100%)				+25% (15%)		+42.8% (39.1%)	

Actors	Cow milk						Camel milk		Butter
	Grassland		SDS		MRD and MRS				
	Cross-border informal	Informal domestic	Formal	Informal	Formal	Informal	Cross-border informal	Domestic informal consumers	Domestic informal market
Exporters							+63.6% (50%)		
Wholesalers									+7.1% (20.9%)
Retailers			+10% (18%)		10% (+13%)		+22.2% (28.6%)		+9.5% (30.2%)
Food service providers				+128% (100%)		+113% (85%)		+33.3% (43.5%)	+7.4% (25.6%)
Consumers (price)	16	11	22	32	22	32	22	20	160
Total margin	60%	22%	100%	129%	214%	166%	175%	135%	37%

Figure 24: Cow milk value chain map

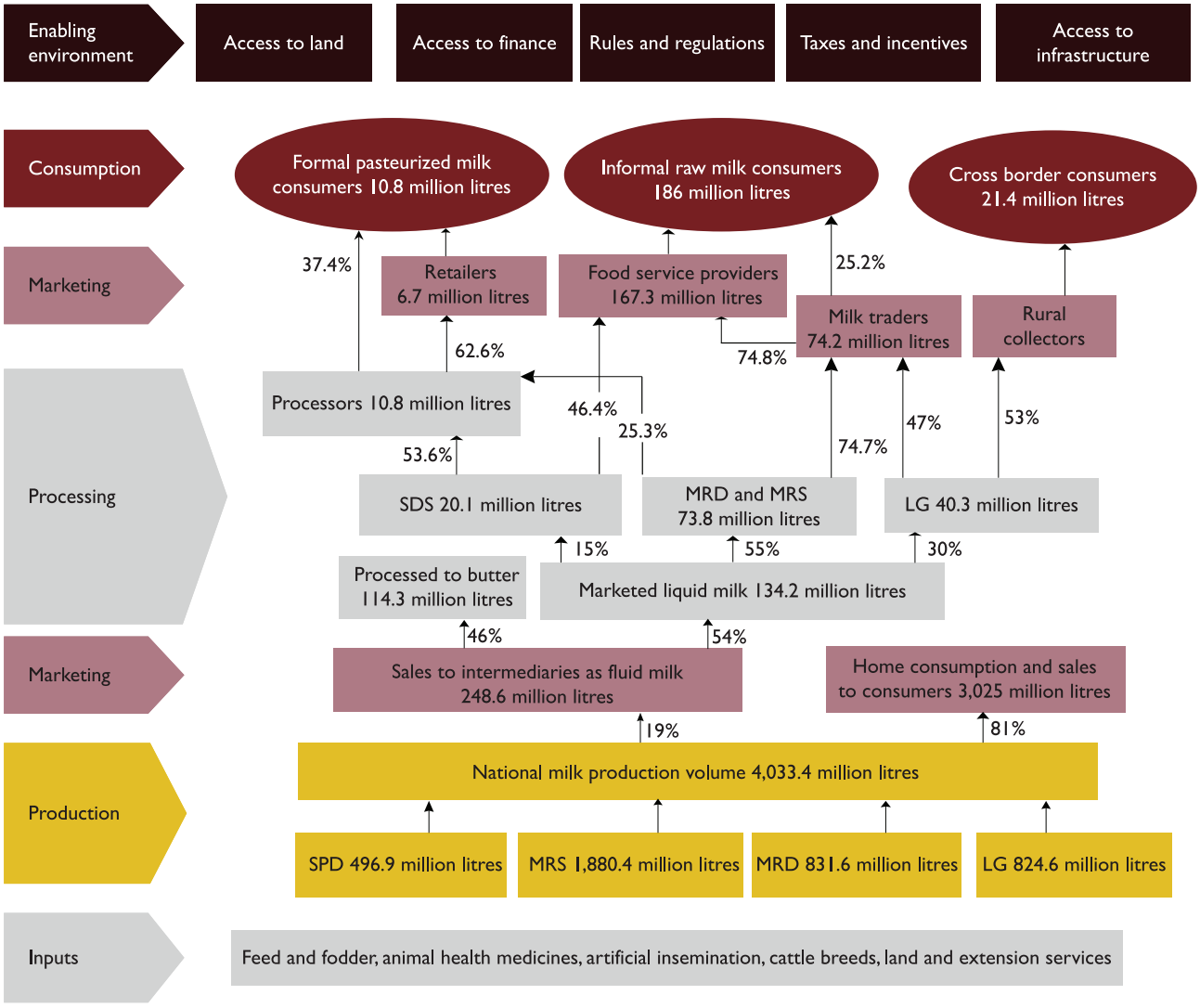


Figure 25: Camel value chain map

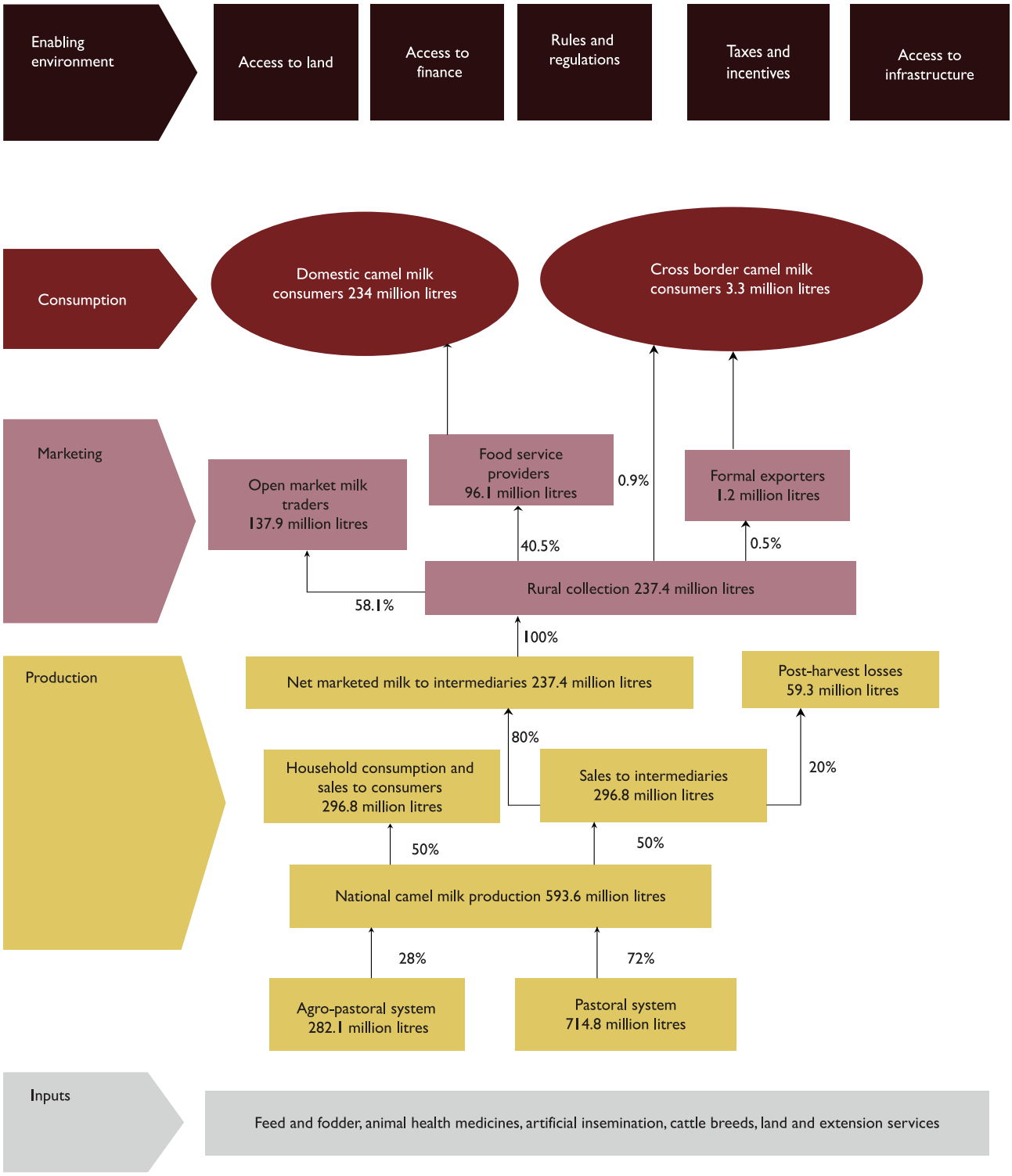
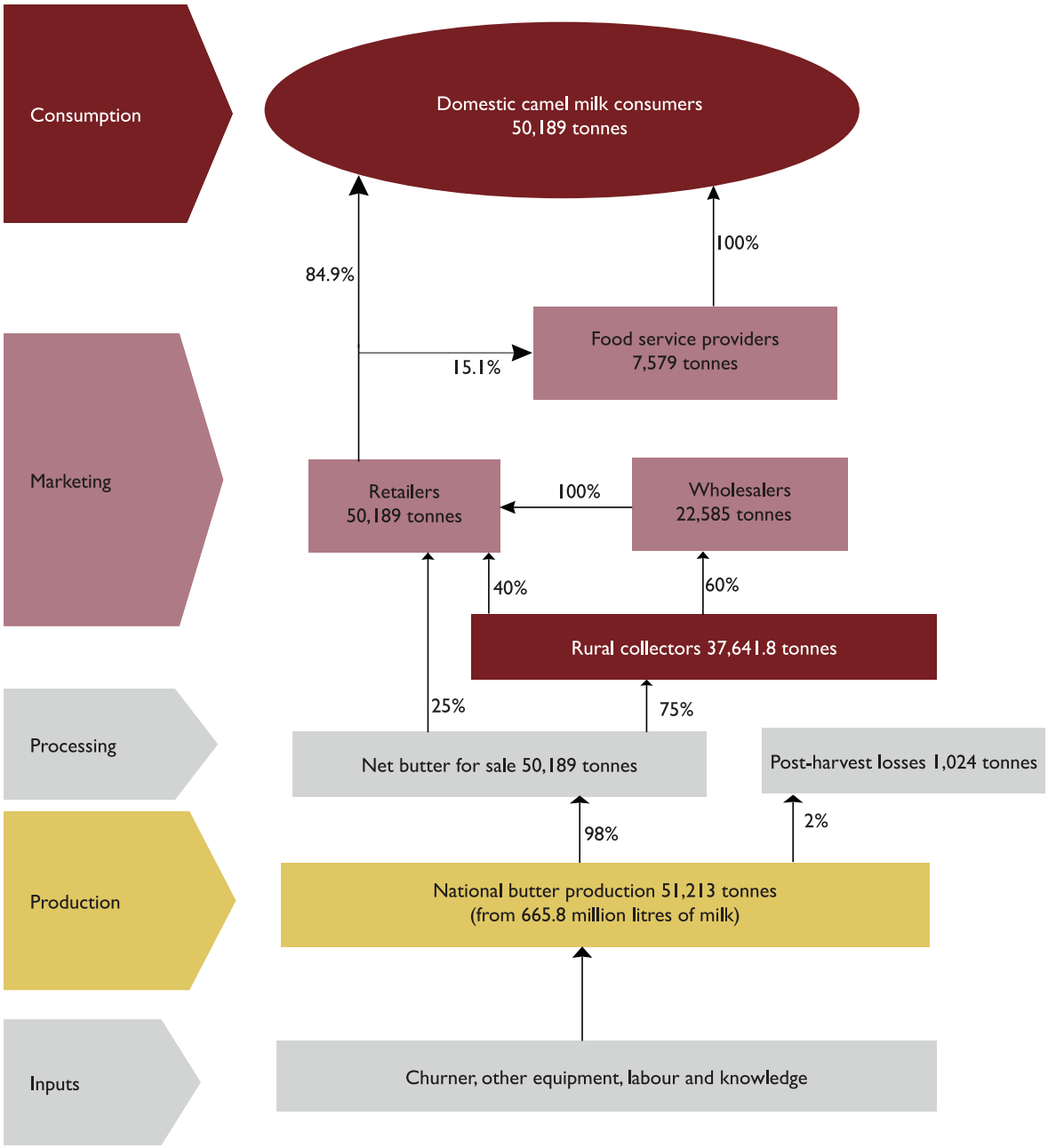


Figure 26: Butter value chain map



Assessment of the live cattle and beef value chains and sub-chains

Live cattle and beef, live camels and camel meat, live sheep and goats, mutton and goat meat, are the main commodities in the live animals and meat value chains.

The live cattle and beef value chains and sub-chains are described in Annex 2, Figure 27 and Table 55. The live sheep and goats, and mutton and goat meat value chains and sub-chains, and live camels and camel meat value chains and sub-chains are described in Annex 2, Figure 28–29 and Table 55. The hides and skins value chains and sub-chains are described in Annex 2, Figure 30 and Table 56. As well, the poultry meat and eggs value chain and sub-chains are also described in Annex 2, Figures 31–32 and Table 51.

Cattle and beef chain and sub-chains

As described in Annex 2, Figure 27 about 85% (758,795 metric tonnes or MT) of the total cattle volume entering the cattle value chain pass through the beef sub-chain and this reaches both domestic and foreign consumers through five sub-chains. Two of the five sub-chains serve domestic consumers through beef slaughtered in formal slaughterhouses (one sub-chain in the mixed system and one in the grassland system). About 3% and 25% of the meat in the chain are supplied to individual consumers though formal slaughterhouses in the grassland and mixed systems, respectively. The other two sub-chains in the beef value chain serve the domestic market through backyard slaughter. About 13% and 59% of the beef supplied to domestic consumers is processed through backyard slaughter in grassland and mixed systems, respectively. The fifth beef sub-chain is the export value chain where only 0.4% of the total beef entering the chain is exported to different African and Arab countries. Ethiopia beef exports are not competitive internationally—domestically consumed beef can sell at twice the export price, but exporters benefit from foreign exchange advantages.

The live cattle value chain is also divided into formal and informal sub-chains. In the formal live cattle value chain exporters follow government rules and regulations when exporting animals. One of the basic requirements is quarantine where animals are vaccinated against major transboundary diseases and inspected for 21 days in order to get export documentation. About 29% and 8% of the live cattle from the grassland and mixed systems, respectively, are exported through the formal channel. Meanwhile, about 58% and 5% of the live animals come from the grassland and mixed systems, respectively, and are exported through informal channels. Informal exports are more than double the formal exports, which has a very significant impact on the national economy, in terms of both lost revenue and high domestic prices.

Price analysis for the live cattle and beef value chains

Annex 2, Table 55, shows the price structure (% increases along the value chain) and gross margins for the live animal and meat various value chains. Table 55 shows the following:

Formal and informal live cattle export sub-chains

- For all value chain actors except the live animal exporters, a 1% increase in the price of animals yields less than a 1% increase in the gross margin.
- In the formal market, the highest percentage increase in price of animals (82%) is obtained by feedlot operators and 74% of the gross margin generated in the sub-chain is taken by feedlots, but they have also the highest cost in concentrate feed and other inputs, and face a greater price risk if they cannot sell their animals in time.
- The informal cattle exporters get 89% of the gross margin generated in the sub-chain mainly because they are doing opportunistic transactions without having to feed the animals or fulfilling any bureaucratic requirements, thus buying and selling whenever they get attractive prices. Their short chains also contribute to the high proportion of their total margin.

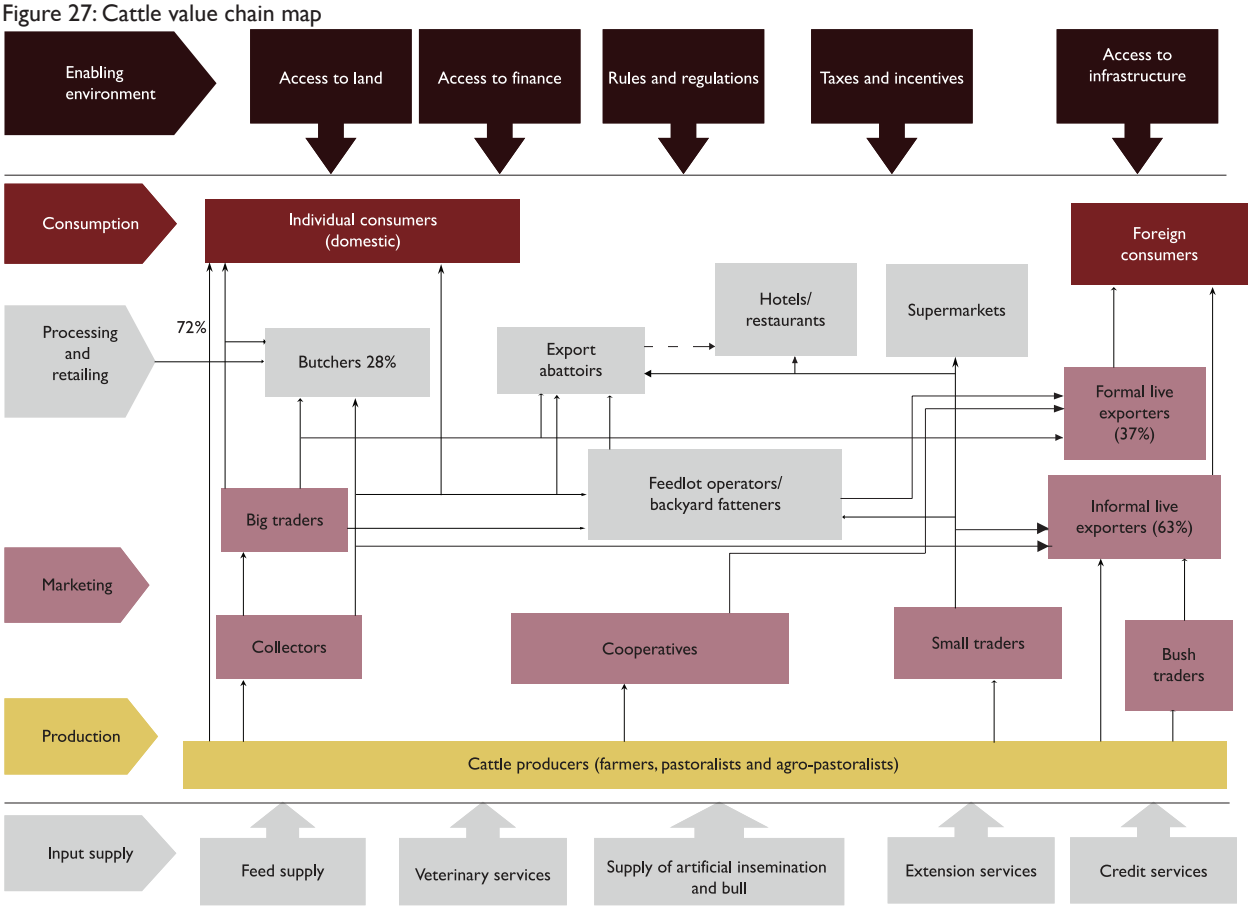
Beef sub-chain

- For collectors and small traders, a 1% increase in price paid to the actors' yields almost a similar percentage increase in the gross margin for the actors. This is slightly higher for big traders than for small traders, where a 1% increase in price paid to a big trader yields more than 1% increase in gross returns.
- For butchers, a 1% increase in price relative to what has been paid to the big trader increases their gross margin by more than 2% making their gross returns more than double. Moreover, about 84% of the total gross margin generated in the beef value chain is obtained by butchers, with 14% for the other actors. This is mainly because of the collusion among the butchers enabling them to control the beef market and impose artificially high prices onto the consumers. Once the price of beef is raised for any reason, including increases in the price of slaughter animals, it never goes down.

Table 55: Average price increases and gross margins along the live animals and meat sub-chains: average increases (%) captured by value chain actors and gross margins (ETB/kg), with gross margin in per cent (%)

Market actors	Cattle			Sheep				Goat				Camel
	Beef	Live export		Mutton		Live export		Meat		Live export		
		Formal	Informal	Grass land	Mixed	Formal	Informal	Grass land	Mixed	Formal	Informal	
Producers	96	41	41	62	63	62	62	75	70	75	75	60
Collectors	+0.5% (0.6%)	+8%	+9%	+16% (25%)	+11% (13%)	+16% (15%)	+16% (15%)	+10% (21%)	+7% (6%)	+10% (14%)	+15% (20%)	+5% (9%)
Small traders	+4% (5%)	(6%)	(5%)	+9% (38%)	+19% (25)	+21% (22%)	+21% (22%)	+7% (17%)	+9% (8%)	+7% (11%)	+3% (5%)	+14% (24%)
Big traders	+7% (10%)	+9% (7%)	+9% (6%)	+15% (34%)		+15% (20%)	+15% (28%)	+8% (21%)		+8% (13%)	+8% (14%)	+6% (11%)
Butchers	+36% (84%)											
Live animal retailers					+13% (20%)			+15% (41%)				
Hotels					+23% (41%)				+95% (87%)			
Feedlot operators		+82% (74%)										
Export abattoirs				+1% (3%)								
Formal live exporters		+8% (13%)				+28% (13%)				+34% (61%)		+26% (56%)
Informal live exporters			+116% (89%)				+28% (42%)				+34% (61%)	+26% (56%)
Traditional tanners												
Tanners												
Consumers	166	94	103	102	114	129	129	110	160	129	129	96
Total margin	70	53	63	39	52	66	66	35	90	54	54	36

Figure 27: Cattle value chain map



The value chain maps include only the verified percentages or shares of products for each sub-chain for which we were able to obtain reliable data.

Analyses of other live animals and meat, and hides and skins **value chains**

Description of the goat and sheep value chains and sub-chains

The goat value chain and sub-chains are depicted in Annex 2, Figure 28. The LSA analysis showed that there are about 64,426 TECs of goat meat entering the value chain per annum. This is supplied through six sub-chains. Two of these sub-chains are supplying live goats to individual consumers for slaughter at home (backyard slaughter). About 47,997 TECs of goat meat are consumed by individual consumers in this sub-chain out of which 43,810 TECs are supplied from the mixed system. The remaining balance is supplied by the grassland system.

The significant recent development in the goat value chain is a very high export demand for goat meat from Ethiopia. About 80% of meat exported to the Middle East countries is goat meat. About 12% of the goat meat that enters the value chain from lowlands (7,924 TECs) is exported to these countries per annum. Two of the six sub-chains supply live goats to the export market (one formal and one informal). Only 0.3% (193 TEC) of the goat meat entering the value chain is formally exported and 9.1% (5,992 TEC) of the total goat meat is exported through informal sub-chain. This indicates the amount of foreign exchange earnings the country is losing due to the informal livestock trade. This could be captured in the formal sub-chain through government facilitation of marketing for the pastoral community living close to borders.

The sheep value chain and sub-chains are also depicted in Annex 2, Figure 28. A total of 60,464 TECs of mutton are estimated to enter the sheep value chain. There are six sub-chains out of which three are the sub-chains serving domestic consumers while the rest serve the export market (one for mutton and two for live export sub-chains). The most important market segment for sheep is domestic highland consumers, due to the high and growing population and incomes of highland consumers, and their strong preference for highland mutton rather than goat meat. About 56% (27,247 TECs in volume) of sheep entering the value chain is consumed by the highland market segment and is supplied by the highland sub-chain.

The first important domestic sub-chain supplies slaughter sheep to individual consumers. About 5,514 TECs of mutton are traded through this sub-chain. Demand for animals in this sub-chain follows festivals such as Easter, Christmas, New Year and Ramadan and is thus seasonal in nature. Individuals prefer well-conditioned (fattened) sheep so producers and traders target these festivals. Hotels are the other important domestic buyers of mutton. Demand for dishes made from mutton is also very high in hotels in the highlands, the second sub-chain. About 24% (or about 14,511 TECs in volume) of the mutton entering the value chain is absorbed by hotels. Hotels and restaurants usually buy mature ewes not kept for breeding purposes.

The other three sub-chains supply male, intact yearlings of good body condition to export abattoirs. The highest numbers of animals slaughtered by the export abattoirs are goats and sheep, but this makes up only 10–20% of their total slaughter operation. As a result, this channel consumes only 2% of the mutton that enters the value chain. Live sheep are also exported from Ethiopia mainly during the Hajj season to Saudi Arabia for sacrifice at the ceremony. Thus, about 6% (3% each through formal and informal channels) of the mutton entering the value chain are exported during this time. Male, intact sheep from grasslands are needed for this purpose since highland sheep cannot tolerate the high temperature during shipment.

Description of the camel and camel meat value chain and sub-chains

The camel and camel meat value chain and sub-chains are also depicted in Annex 2, Figure 29. About 73,554 TECs of camel meat are estimated to enter the camel value chain per annum in Ethiopia. However, unlike ruminant animals, consumption of camel meat is not that common. Thus, the camel value chain is mainly the live camel value chain wherein camels are exported. The two major live camel sub-chains exporting camels to Middle East and North African countries are the formal and informal live camel export sub-chains. The formal camel sub-chain is the one in which animals are mainly exported through Metema to Sudan. Animals are transported from the other end of the country, as far as Moyale, on the border with Kenya (and sometimes from Kenya) to Metema with a stopover at Adama to fulfil the quarantine requirements in order to get export permits. About 36% of the total volume of animals entering the camel value chain passes through this sub-chain. The other 64% of camels entering the value chain are exported informally. The main reason for this informal export business is the inconvenience of fulfilling formal export requirements. Analysis of the costs and margins along the camel value chain shows the two sub-chains are similar in terms of margins obtained by the different actors. Efforts to properly identify the root causes of the informal trade are needed to take appropriate action to lower transactions costs.

Description of the hides and skins value chain and sub-chains

The hides and skins value chain and sub-chains are also depicted in Annex 2, Figure 30. The hides and skins value chain includes hides of cattle, and skins of sheep and goats. It is estimated that 80% of cattle and 90% of shoats are slaughtered in backyards. Thus, the bulk of hides and skins in the value chain are collected from backyard slaughter and a strong network of value chain actors is required to recover all the hides and skins produced in every corner of the country. The hides and skins value chain is then composed of a network of different actors including collectors, small and big regional traders, and tanners. About 105,714 tonnes of hides and skins are collected annually in this value chain.

Five sub-chains were identified in the hides and skins value chain. The first two sub-chains are those in which hides are collected from formal slaughterhouses and backyards and then sold to traditional and modern tanners. About 26% (16,292 tonnes) of the hides in the value chain are collected in the first sub-chain and sold to traditional tanners. About 32% of the total hides in the value chain are sold to modern tanneries through the second sub-chain. This sub-chain is composed of the hides collected from backyard slaughter, slaughter slabs, municipal slaughterhouses and export abattoirs. The other important sub-chain is the one in which sheep skins are collected from different sources and sold to modern tanneries. Sheep skin is mainly collected from the mixed system because of quality issues associated from these areas. The traditional tanners do not process sheep skin. They process hides and goat skin into different products. The remaining two sub-chains are the goat skin sub-chains that collect skins from backyard slaughter for traditional tanneries (2.5%) and modern tanneries (9%). The traditional tanneries usually collect dried

and poor quality goat skins that do not fit the quality criteria of modern tanneries and their price is relatively lower than that of the formal tanneries. Goat skins slaughtered in the export abattoirs usually reach the tanneries in their green state without any salting.

Price structure and gross margins for the mutton, goat meat, and live camels and camel meat value chains and sub-chains

Annex 2, Table 55 shows the price structure (% increases along the value chain) and the gross margins for the various live animal and meat value chains. In each cell, the first figure with a positive (+) sign indicates the average increase in price (in percentage terms) paid to the relevant actor in the value chain and the figure in the parenthesis indicates the gross margin. It shows the incremental price paid to the actor. Analysis of the incremental prices and gross margin in Annex 2, Table 55 shows the following:

Mutton value chains and sub-chains

- Small traders supplying slaughter animals to big traders and export abattoirs get the highest proportion of the gross margins (38%) generated in the grassland mutton sub-chain. This is mainly because they are the major collectors of animals from primary and secondary markets and use their network of collectors to bring them the types of animals required by the market.
- Hotels get 41% of the total margins in the mixed system mutton sub-chain because they process the meat into different dishes according to consumer tastes and preferences and add the greatest value to the product. The margin actually varies according to the size and standard of the hotel. Bigger hotels prepare better quality food and charge higher prices, thus increasing their margin per unit of mutton sold.
    - Similar to that of live cattle exporters, informal live sheep exporters get the highest proportion (42%) of the gross margin the in sub-chain since they do this business during a high demand season (Hajj ceremony).

Live goat and camel value chains and sub-chains

Annex 2, Table 55 also shows the following:

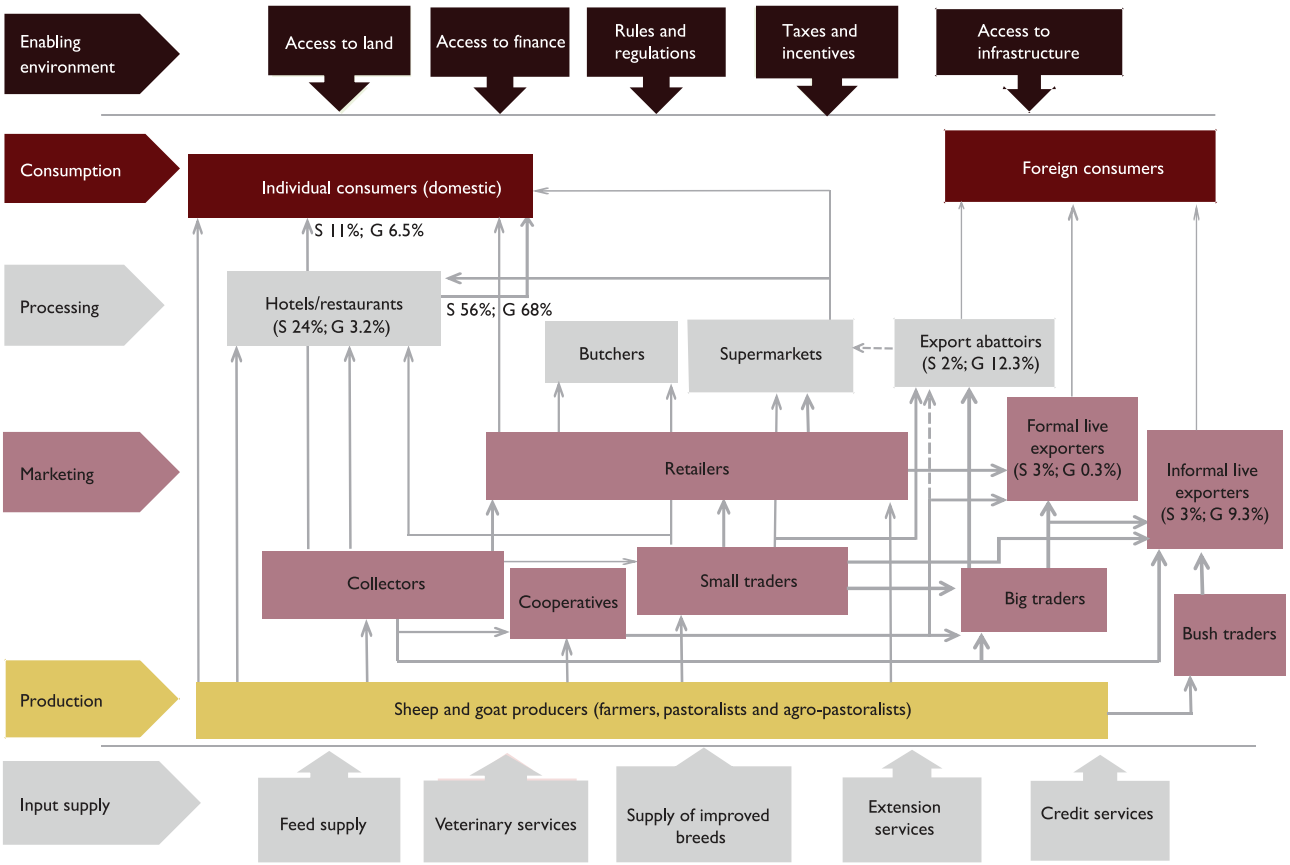
- Similar to mutton, the highest proportion of gross margin (87%) generated in the mixed system goat meat sub-chain is obtained by hotels since they are processing meat to the final consumable products. The percentage increase in price of meat is also the highest for this sub-chain.
- Regarding the live exports of goats and camels, there is no noticeable difference in the margin obtained by formal and informal exporters. Though the two sub-chains vary in terms of the marketing costs, the driving factor behind the informal trade is not only the attractive margin, but also the convenience for marketing actors.

Hides and skins value chains and sub-chains

Annex 2, Table 56 indicates the following:

- The price analysis of the dairy sub-chains shows that producers are paid the same prices per kg, whether the hides and skins go to modern or traditional tanneries. Sheep skin prices paid to producers (ETB 20/kg) are twice as high as goat skin prices (ETB 10/kg.), and almost seven times higher than hide prices (ETB 20/kg). Prices to consumers are basically the same, as well, whether they buy from modern or traditional tanners.
- Most of the gross margins are captured by the tanneries since they process the hides and skins, with traditional tanners getting 100% since they buy directly from producers, and modern tanners getting from 33% to 75% since there are more collectors and traders in the chain. In any case, processing hides and skins is a lucrative business in Ethiopia.

Figure 28: Sheep and goats value chain map



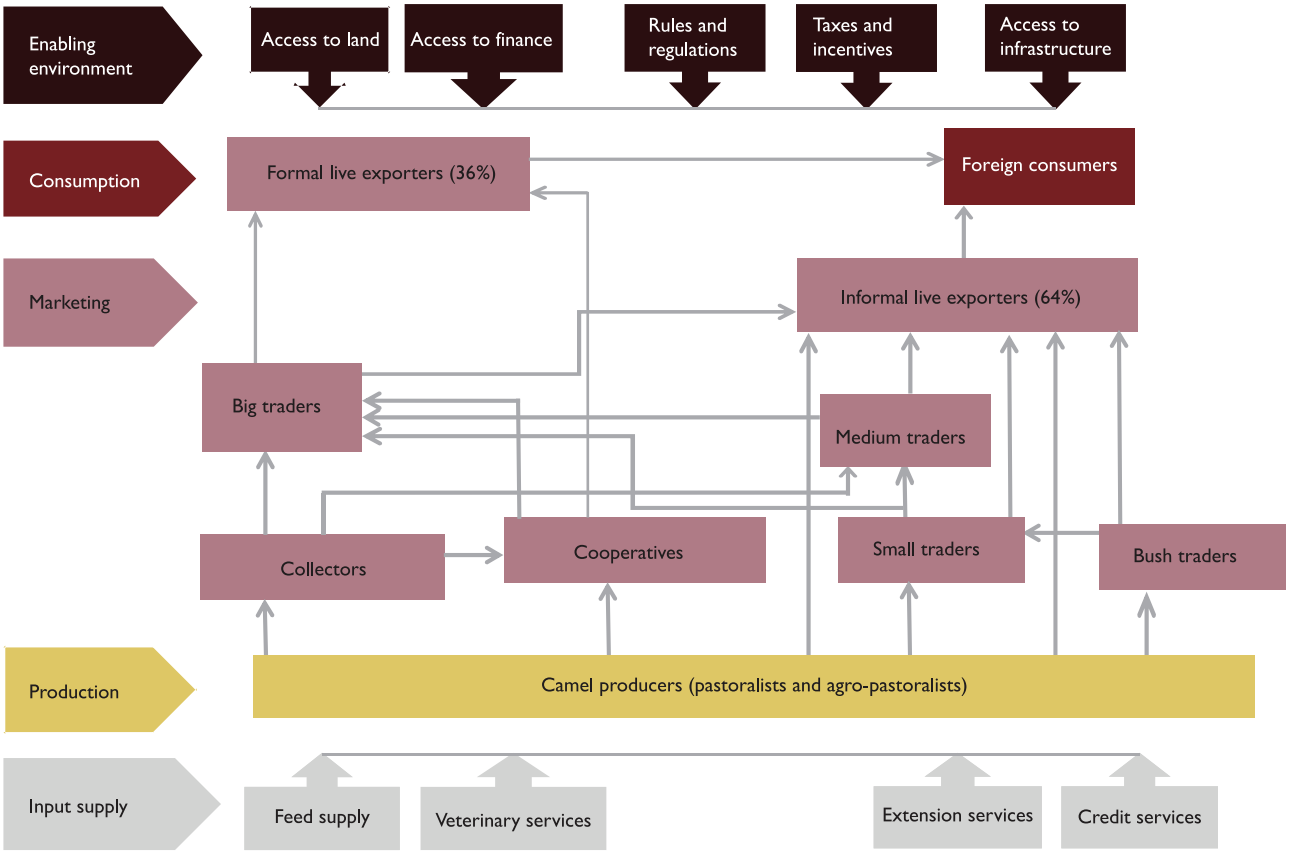
G=Goat S=Sheep

The value chain maps include only the verified percentages or shares of products for each sub-chain for which we were able to obtain reliable data.

Table 56: Average price increases and gross margins along the hides and skins sub-chains: average increases (%) captured by value chain actors and gross margins (ETB/kg), with gross margin in per cent (%)

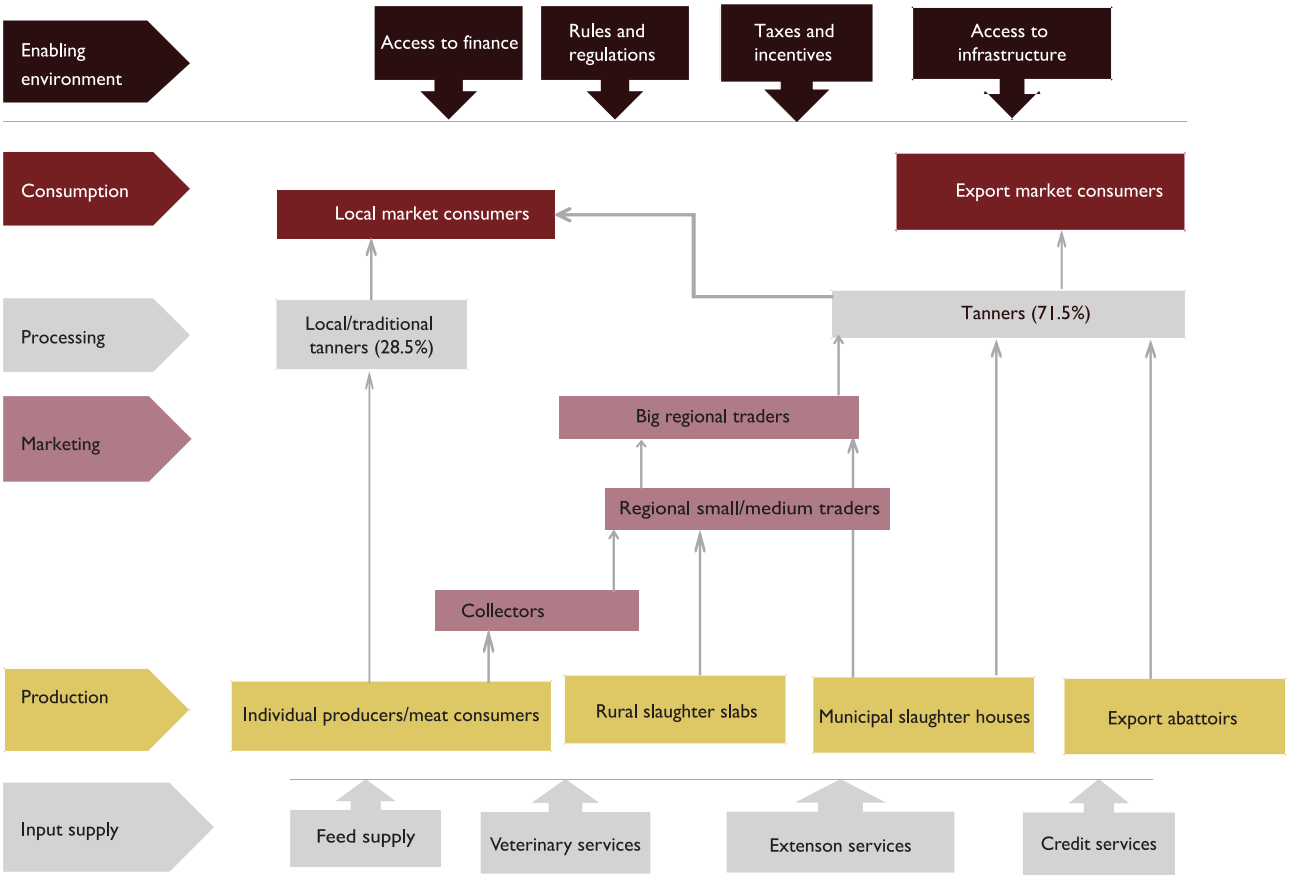
Market actors	Skins and hides				
	Goat skin		Sheep skin		Hides
	Modern tanneries	Traditional tanneries	Modern tanneries	Modern tanneries	Traditional tanneries
Producers	10	10	20	3	3
Collectors	+75% (22%)		+17% (7%)	+33% (9%)	
Small traders	+43% (22%)		+14% (7%)	+25% (9%)	
Big traders	+30% (22%)		+25% (15%)	+20% (9%)	
Traditional tanners		+200% (100%)			+344% (100%)
Tanners	+34% (33%)		+94% (70%)	+146% (75%)	
Consumers	44	30	65	15	13
Total margin	34	34	45	12	10

Figure 29: Live camel value chain map



The value chain maps include only the verified percentages or shares of products for each sub-chain for which we were able to obtain reliable data.

Figure 30: Hides and skins value chain map



The value chain maps include only the verified percentages or shares of products for each sub-chain for which we were able to obtain reliable data.

Price analysis of the poultry meat and egg value chain and sub-chains

Please see the poultry meat value chain map in Annex 2, Figure 31. The EcoRum analysis revealed that the total production of poultry meat is 47.7 thousand tonnes, out of which 99% is from village backyard traditional system and 1% from commercial poultry farms (0.4% from layers and 0.6% from broilers). Village producers consume or direct sell 49% of the total production and the volume that enters the value chain is 51%. Almost 100% of broiler meat and 96% of layers' meat enter the value chain. The supermarket sub-chain absorbs only 7.6% of the total meat, which comes exclusively from commercial farms. About 92.4% of the backyard chicken meat is channelled to consumers through traders.

Annex 2, Figure 32 shows, meanwhile, that the total egg production estimate is 138.6 million from the traditional backyard (79%) and commercial farms, (21%). Of the total volume of eggs in the value chain, 57% come from the traditional systems and 43% from commercial farms. The supermarket sub-chain absorbs about 50% of the eggs entering the value chain, of which 73% comes from backyard village producers and 27 % from commercial poultry farms. The traders-direct-to-consumers sub-chain accounts for the remaining 50% of eggs, of which 40% comes from village backyard producers and 60% comes from small-scale poultry farms.

Price structure and gross margins in poultry systems

Although six major poultry meat sub-chains were identified in the value chain analysis, for the analysis of prices and margins, due to similarities in value chain structure and prices, these six sub-chains were consolidated into four channels which are aligned with the backyard and commercial production systems, or two for poultry meat and two for eggs, as is shown in Annex 2, Table 57.

Annex 2, Table 57 shows that consumers pay a higher price for commercially-produced chicken meat in supermarkets. Moreover, the margin gained by the supermarkets is more than three times higher in the commercial system than the backyard system. Meanwhile, the poultry meat price gained by producers in the commercial system is ETB 10 higher than that of the backyard system, and they gain more of the total gross margin (74%), as opposed to 71% in backyard systems.

For eggs, the price to consumers is the same (ETB 2.5 per egg), but the price received by commercial producers is 22% higher. Furthermore, commercial producers gain more of the total gross margins (78%), as opposed to 64% in backyard systems. The demand for both backyard and commercially-produced meat and eggs is high. The higher gross margin realized by supermarkets and producers in commercial systems is likely due to the extra inputs costs (feed for commercial producers) and extra handling, packaging, and advertisement they do.

Table 57: Average price increases and gross margins along the poultry sub value chains: per cent of weighted average price increase (%), the per cent of the total gross margin (gross margins in per cent shown in parenthesis) captured by each value chain actors

Actors	Poultry meat		Egg	
	Backyard	Commercial	Backyard	Commercial
Producer	77.5	87.5	1.6	1.95
Village collector	+15.5% (38.7%)		+15.6% (27.7%)	
Trader	+13.4% (38.7%)		+16.2% (33.3%)	+7.7% (27.3%)
Broiler processor		+8.57% (24.2%)		
Shops				+4.8% (18.2%)
Supermarket	+6.9% (22.6%)	+24.7% (75.8%)	+16.3% (39%)	+13.6% (54.5%)
Consumer	108.5	118.5	2.5	2.5

Figure 31: Poultry meat chain map.

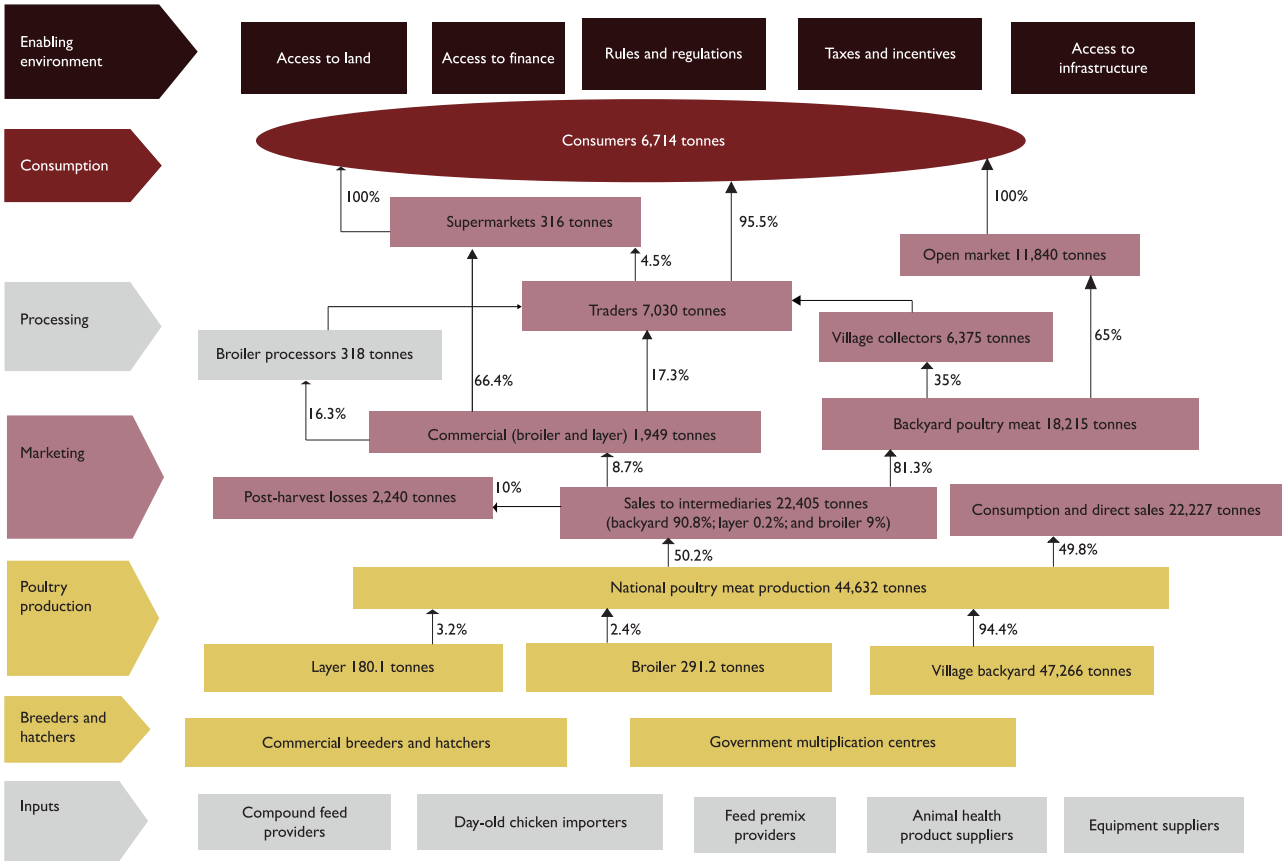
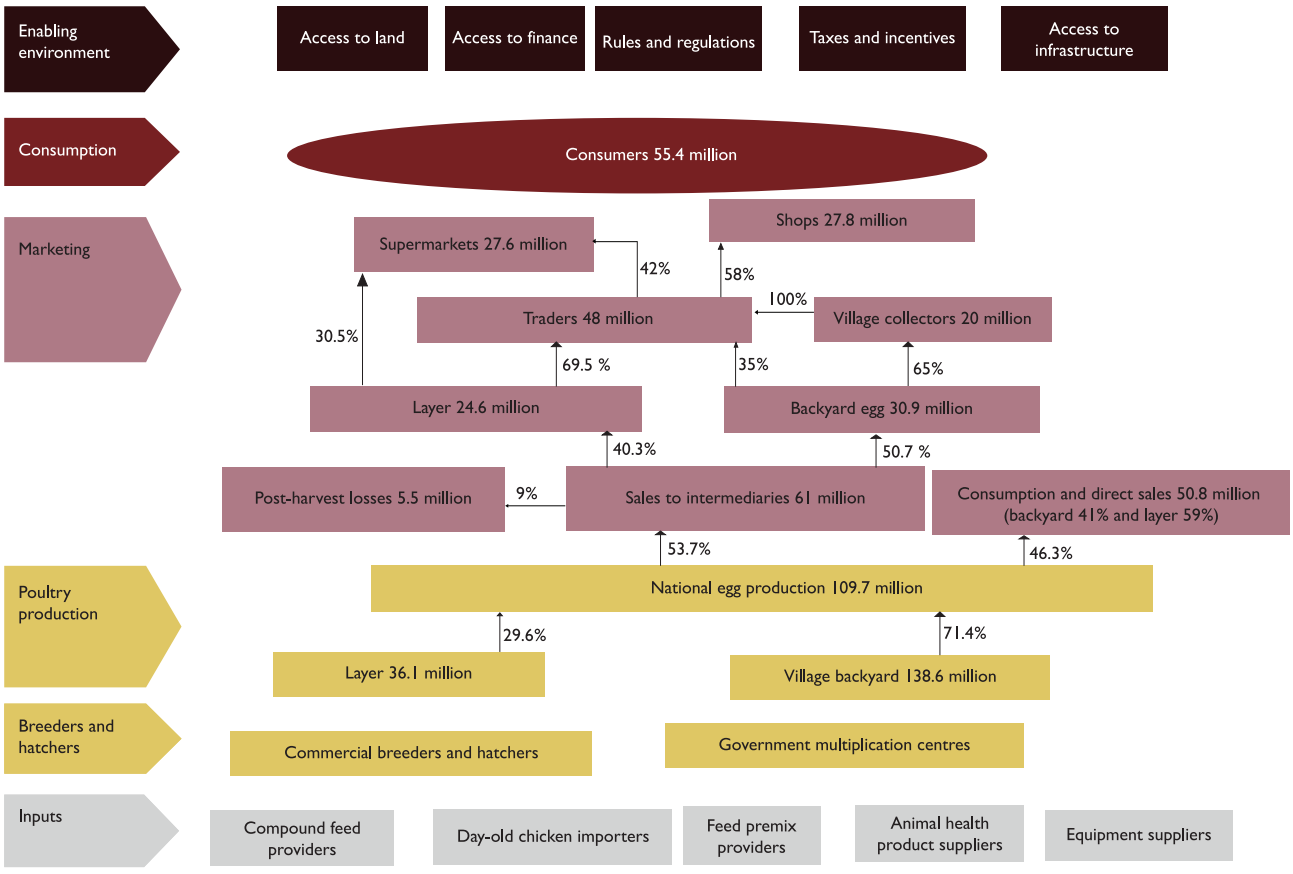


Figure 32: Poultry egg value chain map.



Annex 3 Institutional and policy constraints and opportunities supporting section 8: policies

Table 58: Review of current policy constraints and proposed actions in animal health services[34]

Priority policy or institutional constraint/gap 12	Evidence, group affected and rationale for change	Required policy action
1. Unclear roles of public and private animal health service providers, constraining an efficient deployment of available human and financial resources	Low (30%) coverage of clinical services, in particular for poor livestock keepers, because:	Delineate the roles of the public and private sector in animal health services based on the nature of the goods, with the following as main elements:
	Most clinical services are provided by the government	Preparation of a policy statement which clearly defines public and private tasks
	Public services are constrained by shortage of operational budget	Full cost recovery by the public sector of private good tasks (such as clinical services) to avoid competition with the private sector
	Weak enabling environment for private sector development	Gradual withdrawal of the public sector from clinical services
	Limited employment opportunities for new graduates	Establishment of sanitary mandate – delegation of certain public good activities to the private sector
		Provision of loans for interested private service providers
2. Absence of animal identification and traceability system	Absence of traceability system:	Establish a legal framework that will support the introduction and operation of a traceability system:
	Restricts exports to more remunerative markets	Test on a pilot basis the acceptability of the system, and establish appropriate and identify its key characteristics, such a cost effectiveness and acceptability by trading partners
	Constraints effective disease control, and	
	Complicates backward tracing of disease	Decide on scaling up the system
		Establish a national livestock registry and traceability databank
3. Lack of emergency preparedness and harmonized plan and strategy to prevent and control major transboundary animal diseases	Delay in detection of emerging animal diseases such as highly pathogenic avian influenza, and Rift Valley fever have significantly increased their impact and control costs	Strengthen epidemiological survey capacity, and provide incentives and enforcement for regional states comply with national disease reporting and execute national disease control programs in their respective areas in line with set strategies
	Limited impact of ongoing disease control efforts, affecting above all the poor livestock keepers	Confirm prioritization of major livestock diseases for prevention and control based on their trade, livelihood and zoonotic importance proposed under LSIPT (see page 72)
		Develop, for priority diseases, specific control and prevention strategies which are feasible and cost effective
		Ensure a clear, legislated chain of command involving singular decision-making authority and accountability during a declared animal health emergency
		Strengthen coordination mechanisms, with other agencies including from an 'One Health' perspective
		Establish sustainable financing mechanism for rapidly mobilization in response to disease outbreaks

34. Based on the review of Wondwosen Asfaw Awoke

Priority policy or institutional constraint/gap 12	Evidence, group affected and rationale for change	Required policy action
		Include animal disease emergencies as a component of the national disaster response plan; and Create a National Veterinary Committee, where the national chief veterinary officer (CVO) and regional heads of animal health meet together formally and regularly to discuss and agree on policy and programs, and to monitor their consistent implementation across the country.
4. Absence of clear policy for ensuring quality of veterinary education	Poorly trained graduates Eleven faculties created without considering the demand in the job market Unemployed young graduates	Limit the entry of new students in veterinary faculties to match the job market Harmonize veterinary education in current faculties Improve quality of education Create job opportunities for young graduates in the private sector
5. Lack of a livestock movement control system	Disease transmitted through unregulated movement of livestock	Establish an animal movement control system Ensure the system is supported by adequate legal provisions through legislation

Table 59: Current dairy policy and institutional constraints[35]

Priority policy or institutional constraint/gap	Evidence, group affected and rationale for change	Recommended policy action
1. Absence of a cattle breeding policy	Slow rate of genetic improvement of dairy cattle; and Limited access of smallholders to improved genetics	Finalize and implement the existing draft breeding policy, ensuring that adequate attention is given to remote and poor smallholders
2. Lack of PPP and leadership of the dairy sector development	Lack of agreement under the different partners regarding desirable dairy development strategy, affecting in particular the producers	Implement the draft dairy board establishment document, ensuring that all stakeholders are participating, and develop with the dairy board, the national dairy development strategy
3. Absence of appropriate regulatory and incentive framework for the production of high-quality milk	Limited shelf life of dairy products with important pathogen loads, although in part attenuated by consumer habits to boil milk before consumption. Changing consumer preferences will increase the demand for safe milk over the next decade. Increasing standards without incentives at producer level will affect producer's income	Revise the standards and develop a regulatory and incentive (differential prices for hygienic milk) framework as a pilot for the Addis Ababa milk shed
4. Absence of dairy recording scheme	On-farm selection and centres of genetic improvement (AI, bull stations) constrained by lack of reliable production records	Formulate a milk-recording scheme for voluntary participation

35. Based on a review prepared by Desalegn Gebremedhin

Table 60: Current poultry policy constraints and proposed actions in the poultry sector

Priority policy or institutional constraint/gap	Evidence, group affected and rationale for change	Recommended policy action
1. Absence of clear policy that defines the role of private and government institutions in poultry production, processing and marketing	Unclear roles and unfair competition from public sector constrains new entry producers and risks crowding out existing commercial producers, with spill-over effects on the entire chain	Clear policy that defines the role of private and government interventions.
2. Inefficient and low quality service and input delivery systems (vaccination, treatment, extension, consultancy, feed, replacement stocks, credit, land, etc.)	LISPT data shows technical parameters and broiler meat competitiveness at the low side of international average standards, affecting in particular, small- and medium-scale producers	Promote PPPs, based on the strategy under 1) to: Enhance service delivery Establish grandparent farms for distribution of parents to multipliers of commercial replacement stocks Improve feed quality by strengthening feed quality control and enhance accessibility by reducing VAT on raw materials/ ingredients and vitamin, amino acids and mineral premixes Revise rules to facilitate allocation of land for establishment of poultry farms
3. Inadequate poultry disease prevention and control systems	High disease incidence affects all producers and ripples through the rest of the chain.	Strengthen the poultry disease control system: Strengthen the diagnostic capacity for poultry diseases Establish a policy on compensation and contingency plan in the case of forced stamping out of a contagious disease Enforce stricter disease control on importations of commercial replacement stock Strengthen the epidemiological service (see also Animal Health Policy)

Table 61: Current policy constraints in the hides and skins sector

Priority policy or institutional constraint/gap	Evidence, group affected and rationale for change	Recommended policy action
1. Absence of clear and applicable hide and skin and leather industry value chain development policies	Producers feel they are not earning fair prices for their products. Tanners are not able to collect and process high-quality raw material	Develop, refine and launch a clear and applicable hides and skins /leather sector / regulation Develop an objective grading system for hides and skins Consistent incentives for producers to improve the quality of their outputs Offer financial incentives for quality13 throughout the supply chain from producers to traders and processors Agreements or contracts to follow specific practices and protocols at producer or abattoir level which allow for quality premiums
2. Poor quality of hides and skins, ineffective collection and lack of incentives for quality	Producers and traders lose income due to high rejection rate resulting from poor handling of skin and hides Price based on averaging rather than quality Adequate skill for managing hides and skins lacking among producers and in slaughterhouses	Establish regulations to encourage private/ public urban/urban slaughter slabs with necessary priority for land lease access and sanitary regulations Visit to abattoirs by technicians to advice correct flying and skinning procedures without reducing slaughterhouse productivity Monitor and assist producers to gain access to appropriate chemicals to control ectoparasites, and disease-driven skin quality deterioration Promotion for flawless hides
3. Lack of institutional linkages and no clear cut responsibility within sector ministries	Weak extension and thus poor quality of skin and hides at producer level Impediment on timely information flow Loose integration amongst the various actors Weak implementation of regulations	Regulations to encourage government and industry organizations to continue with development efforts and programs aimed at achieving reductions in the level of waste/ tannery effluent. Develop an information flow mechanism on price of hides and skins to producers and traders Establish a stakeholder consultation platform that brings together public and private sector actors to raise and discuss policy issues needing to be addressed
4. Hide and skin trade and regulations	The existing proclamation No. 457/97 is lacks an enforcement appendage and is not being adequately applied	Awareness raising on the regulations and how it benefits producers and traders Institutionalizing the regulation in relevant sector bureaus nationally Regulations on the uniform and timely implementation of the proclamation in all regions and city administrations in Ethiopia

Table 62: Current policy constraints and proposed actions for live animals and meat

Priority policy or institutional constraint/ gap	Evidence, group affected and rationale for change	Recommended policy action
1. Lack of grading system for live animal and absence of qualified graders	Producers do not get fair price for produce: prices are based on eye appraisal	Enforce the use of quality grading for meat and live animal pricing, quality grading should be demand driven and
	Consumers are affected	
		Train and certify graders and legal empowerment of same
2. Lack of enforcement for use of designated live animals and meat transport system	Animals lose significant weight during trucking/ trekking	Enforce use of designated live animals transport and transport measures need to be costed.
	Inhumane transport of live animals	Enforce use of refrigerated trucks in meat transport
	High transaction cost on producers and traders due to loss of animals en route to abattoirs	Regulations to monitor movement of animals
	Deterioration in quality of meat by not using cold chain	
3. Absence of standards for feedlot management and incentive mechanism	Significant variability in the quality of meat produced	Develop and/or enforce the standards
	Limited knowledge by feedlot operators on cost-effective fattening rations	Build capacity of feedlot operators, including feedlot design, management and operation of feedlots, best cost fattening ration formulation and feeding management, livestock trade and requirements
	Little incentive for quality	
4. Lack of policy and enforcement of regulations to formalize informal cross-border trade	Reduced revenue to central and regional governments	Develop guidelines and directives within the framework of the regional initiatives like the AU Policy Framework for Pastoralism (2012)
	Bureaucratic hurdles	
	Producers not getting fair price for produce	Make policy decisions based on cost and return to cross-border trade in livestock
	Many actors involved thus making the transactions complex	

Table 63: Current policy constraints and proposed actions for apiculture

Priority policy or institutional constraint/gap	Evidence, group affected and rationale for change	Recommended policy action
1. Lack of regulation on development and protection of apiculture (still in draft stage)	Difficulty preventing the importation of live bees, and used beekeeping equipment Bee colonies affected because of use of pesticides in bee habitats is not controlled No guidelines and procedures for carrying out stringent test on imported honey for honeybee pests and diseases Could not impose mandatory quality and safety testing on honey and beeswax	Finalize and the draft standards and regulation document and enforce it Define and map the natural bee habitats as well as the honey-shade areas for protection against use of pesticides
2. Standards and procedures missing for defining scale of commercial beekeeping operations	Entrepreneurs affected as lack of standards hampers the opportunity of duty-free benefits Disincentive to commercial beekeepers Difficulty to achieve the GTP projections Enhanced introduction and distribution of damaging bees, pests and diseases Gene dilution which affects the merits of the bees in the new environment	Develop the standards and procedures and create awareness on this
3. Lack of mandatory act on quality testing of honey and beeswax for export and local market	Customers and exporters affected Beeswax and honey are intensely exposed to adulteration[1] Producers do not adopt the procedures for quality product production. There is no incentive for producing quality products	In collaboration with the quality standards authority establish the act and create modalities of enforcing it; and incentives for producing quality products
4. Pesticide registration and control legislation	Mishandling and application of different brands of pesticides Residual effects on honey and beeswax Free and indiscriminate application of pesticide causes adverse effects on non-targeted animals-specifically honey bees Loss of income and complimentary livelihoods for communities engaged in beekeeping Disincentive to commercial operators	Legislation must be put in place to regulate the transport, storage, distribution, sale and use of pesticides
5. Lack of guidelines on Honey bee breeding	Private commercial queen raisers (breeders) who want to breed high-performing bee's strains for sale are affected Government cannot earn foreign income through exporting genetically improved queens	Develop honey bee breeding policy with clearly defined blood scales for honey bee breeding

[1]The International Livestock Research Institute (ILRI) works to improve food and nutritional security and reduce poverty in developing countries through research for efficient, safe and sustainable use of livestock. Co-hosted by Kenya and Ethiopia, it has regional or country offices and projects in East, South and Southeast Asia as well as Central, East, Southern and West Africa. ilri.org

Table 64: Current policy constraints and proposed actions for lowland areas of Ethiopia (pastoral and agro-pastoral systems)

Priority policy or institutional constraint/gap	Evidence, group affected and rationale for change	Recommended policy action
1. Lack of policy, legal and institutional frameworks to support sustainable pastoral and agro-pastoral production	Low commercialization and limited number of micro and small enterprises	Market policies to support timely and reliable market information
	Producers vertical linkages to markets is poor	Modalities of supporting cross-border livestock marketing
	Weakening of customary institutions and poor linkage between them and formal government structure	Assist pastoralists in understanding marketing trends
		Provide a substantially extended role to customary institutions
2. Most of the policies, strategies and programs are agrarian oriented with less attention to pastoral development	Conflict over resources between herders and cultivators	Address risks related to drought/flood and resource conflict
		Further work on access rights to pastoral land administration and use
	Livestock keepers' capacity to respond constrained	Participatory pastoral land use mapping and directives to enforce it
3. Lack of policies and adequate implementation to support effective functioning of livestock trade corridors to mitigate effects of drought	Migratory routes compromised, especially in times of drought and famine	Regulations and enforcement of protected corridors
		Allocation of adequate resources to build infrastructure needed to make corridors effective (water points, feed storage facilities, etc.)
		Empowerment and active involvement of communities in governance of protected corridors
4. Lack of information to analyse current practices, identify key constraints, and predict how producers will respond to policy initiatives15	Difficult to estimate the economic performance of a sector	Better information on production practices, marketing decisions, and linkages of the pastoral sector to the larger economy
	Unreliable statistics which obscure the factors which drive changes in livestock population numbers, such as climatic fluctuations	Recognize the resilience and adaptive capacity of dry lands

Table 65: Current policy constraints and proposed actions for breed improvement

Priority policy or institutional constraint/gap	Evidence, group affected and rationale for change	Recommended policy action
1.Need to improve genetic potential and productivity of national herd	Inefficiency of the production system including low fertility, poor off-take, high mortality	Use of AI and hormone synchronization to improve national herd through cross breeding and/or local selection
	Agro-ecological and production system zonation does not prescribe appropriate productivity improvement	Established a system of progeny testing and selection of AI bulls
	Lack of understanding on where local breed improvement works, and where crossbreeding with exotics merits	Develop an efficient and effective supply of quality semen and other inputs and strengthen established operating systems
		Monitoring and evaluation to avoid indiscriminate crossbreeding
		Promoting local breed improvement via selection within the herd
2. Privatization of AI	Delineation of public/private sector roles recommended but has not yet taken place	Gradual development of private AI services where it is profitable for private sector with incentives (subsidized and/or guaranteed loans to build clinics)
	Limited progress in privatization	
	The national AI service is chronically understaffed and under-budgeted and is unable to contribute to the sector at expected level	Encourage private sector involvement in the AI service delivery, importation of genetic germplasm
	Lack of awareness about the potential of AI in the rural areas, along with initiative of improving semen quality, specially blood-level supply of different variety of bull semen	Continuing public services in remote areas where private AI will not go
		Technical and financial incentives to rural AI workers
	Lack of coordination between the public and private sector	Increase coverage with quality, efficiency and cost-effective service to the small farmers
3. Need to meet the requirement of buyers, weak sector organization and inconsistency in supply (chain)	Old-age animals for beef, meat coloration and packaging	Facilitate linkages of producers and buyers
	Producers not meeting the market requirements and unable to sell animals	Put in place a modality for reaching the big herd in pastoral areas, and use hormone synchronization and AI with local breeds to get more calf crop
	Animals take longer to reach market age	

Annex 4 Assumptions for section 9—assessment of strategic investment options

- Combined animal health, feeding and management investment interventions to reduce YASM
  - The adoption rate for interventions is assumed to progress slowly over 20 years. The adoption rate is expected to reach 20% by the fifth year of the intervention; 40% by the tenth year; 80% by the fifteenth year; then to remain the same through the twentieth year.
  - Health services improved through the delivery of vaccinations (once–twice/year) for major diseases like FMD, CBPP, anthrax, pasteurellosis, with control/treatment for external and internal parasites twice per year.
  - Recurrent costs associated with health investment grows to ETB 53, 52, 25 and 25/per head for cattle, camel, sheep and goats, respectively; Table 66.

Table 66: Assumptions on annual recurrent costs associated with the investment to reduce young stock mortality (ETB/head)

Animal health intervention recurrent cost item	Costs (ETB/head)			
	Cattle	Camel	Sheep	Goats
FMD	20	20	10	10
Costs of other vaccines (package)	13	13	7	7
Anti-parasitic drugs (dipping or spraying)	14	14	6	6
Improved extension services (feed, housing, and sanitation)	1	1	0.5	0.5
Annual disease surveillance (additional cost)	1	1	0.5	0.5
Additional cost for improved veterinary services	4	3	1	1
Total annual recurrent costs (ETB/head)	53	52	25	25

Source: Based on expert consultation, including ministry experts.

- Feed improvement:
  - Improved feed through better rangeland and pasture management—over-sowing with grass and legumes and control of invasive species.
  - Water development and rangeland improvement by clearing shrubs, application of fertilizers and herbicide treatment where major shrub encroachment takes place. In later years, additional fertilizer and herbicide treatment is needed particularly for poor and fair-condition rangelands.
  - Feed availability improved due to pasture improvement and soil and water conservation practices on communal grazing lands (gully prevention and rehabilitation).
  - Timely harvesting of grass, and storage and conservation of hay from communal grazing lands. Increased efficiency of crop residue use (proper storage, supplementation, treatment including physical treatment-chopping; and urea)
  - Over-sowing and rotational grazing of pasture
  - The adequate feeding of pregnant animals at the late stage of pregnancy and early stage of lactation is realized by providing more concentrates. The assumed average cost for animal feed is ETB 3/kg.

The details of the proposed animal feeding management interventions for different livestock species are presented in Table 67. The supplementary feed given cows just before giving birth and for one or two months after birth is expected to increase milk production so that the kid/calf will be fed well and become stronger and resist disease. It is thus assumed there may not be an increase in weight due to this feed supplementation of cows.

Table 67: Supplementary concentrate fed to pregnant/lactating cow/ewe/dam and expected increase in milk that could be suckled by calf/kid (increased mothering ability of the cow/ewe/dam)

Livestock species	Proposed feeding practices	Expected outcome
Cattle	0.5 kg concentrate provided to the dam for 3 months over 2 years	Milk yield increased by 1 kg
		Half goes to the calf which will result in incremental weight gain of 22 grams/day
		The remaining half is sold to increase income for the livestock keeper
Goats	0.275 kg of improved feed per day will be provided	Milk yield increased by 0.55 kg
		Half goes to the kids which will result in incremental weight gain of 23 g/day
		The remaining half is sold to increase income for the livestock keeper
Sheep	No feed is purchased but it is assumed that improved feed will be available	Incremental weight gain of 12 g per day
Camels	0.5 kg of concentrate will be provided to the dam for 3 months in 2 years	Milk yield increased by 1 kg
		Half goes to the calf to result in incremental weight gain of 22 g/day
		The remaining half is sold to generate income for the household

Source: Based on expert consultation, including ministry experts.

- Add header for section below
  - The combined investment intervention is expected to reduce young stock mortality by 20% over the 20-year investment time horizon, as well as in the reduction of older stock mortality by 10% over the same period.
  - In cattle: a 10% increase in live weight, a 3 percentage point increase in dressing percentage and parturition rate over 20 years.
  - For sheep and goats: a 20% live weight gain, a 3 percentage point increase in dressing percentage, a 4 percentage point increase in parturition rate over 20 years.
  - Camels: a 10% increase in live weight, 3 percentage point increase in dressing percentage, 2.5 percentage point increase in parturition rate over 20 years.
  - The time horizon for the investment is 20 years and for all scenarios the annual discount rate is 10%,
  - The baseline livestock growth rate was maintained constant.
- Dairy breeding improvement intervention
  - A complementary feeding intervention is required and included, but it is assumed dairy farmers have already adopted other aspects of better management, especially recommended health interventions.
  - 70% of the households in MRS will be reached via the hormone synchronization and AI investment intervention.
  - In the first and second year, it is expected that about 400,000 cows (which is a 10% adoption rate) will have taken advantage of the AI and hormone synchronization program.
  - In the case of MRS, it is expected that starting from year two the adoption rate increases gradually from 10–80% in the fifteenth year of the project life and remains the same thereafter to the twentieth year.
  - The expected impacts of the breeding investment interventions are in terms of changes in animal weight (see Table 68).

Table 68: Assumptions on weight change as a result of artificial insemination and synchronized cattle breeding in MRS and MRD systems

Sex	Age group	Small herd size		Medium herd size	
		Local baseline weight (kg)	Crossbred weight (kg)	Local baseline weight (kg)	Crossbred weight (kg)
MRS					
Female	Juvenile	90	100	90	110
	Subadult	160	200	160	220
	Adult	230	350	230	375
Male	Juvenile	90	100	90	110
	Subadult	180	220	180	220
	Adult	280	400	280	400
Female	Juvenile	85	95	90	100
	Subadult	160	200	160	200
	Adult	230	350	230	350
Male	Juvenile	90	100	90	100
	Subadult	180	220	180	220
	Adult	280	400	280	400

- Current lactation length of local breeds increased from 200 days on average to 270 days for crossbreed in IFD (a 35% increase).
- Current average milk production per year of local breed cattle increases from 247 litres/year to 1,053 litres/year for crossbreeds in IFD (a 326% increase).
- As a result of the synchronized AI (crossbreeding) intervention, it is expected that the milk yield will increase from 1.8 litres/animal per day to 6 litres/animal per day.
- The feed provided per animal is 1.5 kg for the small herd size systems in MRS and 2 kg/animal for the medium herd size MRS systems.
- In addition, a recurrent feeding cost of ETB 4.2/kg/adult female was assumed
- The annual recurrent cost for AI and hormone synchronization is estimated at ETB 340/animal.

    - The total investment required for hormone synchronization and AI is estimated to be ETB 677 million (about USD 33.9 million), an initial ETB 16 million spent over the first two years and then again, the same investment in year five and ETB 30 million spent in year 10 of the project.
- Poultry improvement
    - Land for poultry feed production, especially for maize and soya bean farming will be facilitated and supported.
    - Establishment of feed processing plants will be supported and incentivized.
    - Infrastructure like grandparent farms and DOC multiplication and distribution centres established by the government, privet sector and PPP.
    - One national and four regional grandparent farms
    - 10 regional multiplication centres strengthened/established including 25 new day-old-chicks and 250 new three-week-old chicks' multiplication and distribution centres.
- Exotic chicken meat and egg consumption improved due to continuous promotion work
- The private sector is incentivized and motivated to get involved in building of poultry meat and egg processing plants.
    - Medium-scale poultry slaughterhouses with a capacity of around processing 1,000 birds/hour in the major cities around the country.
    - Two large poultry slaughterhouses with a capacity of processing 100,000 birds/hour around big cities.
    - One egg processing plant with a capacity to handle 200–500 thousand/hour to produce processed eggs products such as egg powder.
    - One large or a number of smaller chicken meat and egg cold storage facilities to store surplus produce till marketed.
- Newcastle disease vaccine will be readily available.
- Mortality in TFP will reduce from 50–10% in IFP
- Coverage of conversion of TFP to IFP will be 58% by 2028 starting from 0.7% in year two, 2016/17.
- Grandparent foundation stock suitable for IFP system produced as soon as possible.
- The number of poultry in IFP system is expected to grow from 51,000 by 2013 (base year) to 42.7 million by 2028.
- The number of poultry in TFP is expected to reduce from the current 47 million to 16 million by 2028. This is a 65% decrease. At the same time the number of poultry in IFP system will be increasing replacing the poultries that were in TFP.
- Mini hatcheries established.

Improving feed quality and quantity through promotion of fodder trade, forage outsourcing and contract enforcement:

- Targeted subsystems are the specialized cattle dairy and cattle fattening systems
- Recurrent costs are paid by the users.
- In small cattle system (B1OM)
    - Recurrent costs such as costs of improved forage seed increases from ETB 50–200/kg; cost of access to water increases from ETB 20 to 54; cost of fertilizer is ETB 14/kg and 200 kg/ha is applied; labour (workers per year) changes from 1.1 to 1.25
    - Cost of improved feed increases from ETB 2.5–3/kg
    - Milk production per day increases from 10–12 litre/day (20%), starting in year two
- In medium cattle system (B2OM)
    - For outsourcing land on rental basis to grow forage, the rental price is ETB 15,300/ha, including contract enforcement
    - Milk production per cow increases from 16–19.2 litre gross margin /day (a 20% increase), starting from year two

  - Parturition rate increases by 6% (from 0.9–0.954)
  - Feed purchase decreases from 85 to 82%
  - Areas for improved forage cultivation increases from 4 ha through outsourcing
  - Cost of improved forage seed increases from ETB 50 to 200
  - Cost of improved feed increases from ETB 2.5 to 3/kg
- In cattle fattening
  - Average weight increases from 342.2 to 385 kg/animal
  - Cost of feed purchased at fattening stage increased from ETB 3.5 to 4/kg
  - Selling price increases from ETB 13,500 to 15,153
  - Selling price of fattened animal increases from ETB 13,000 to 14,013
  - Per cent of feed offered per live body weight at fattening stage increases from 3 to 3.5

3. Improving export market access

- Targeted subsystem is B3LG, piloting.
- Associated technology: implantation of appropriate identity (ear tags) at ETB 5/piece
- Ear tagging will be done starting from secondary markets
- Adoption is fast and reaches 100% at the year 3
- Selling price of adult males increases from ETB 6,500 to 7,800, a projected increase of 20%

4. Reducing concentrate feed prices by eliminating 15% VAT

- Targeted subsystems are the specialized cattle dairy systems
- Faster adoption rate and 100% adoption expected from year 1
- Removal of 15% VAT from concentrates and introduction of feed quality control
- Policy intervention to remove VAT from dairy concentrate feed purchased and establishment of feed quality control laboratory
- 15% reduction in government revenue from sales of concentrate for cattle dairy
- High adoption rate
- Producers will use the 15% reduction in concentrate feed prices to buy additional feed-concentrate
- Milk yield (or production per cow) increases from 16 to 18.4 litres per day i.e. a 15% increase
- Reduction of government revenue from concentrate sold is equal to 15% reduction in VAT

Table 69: Herd growth rates

Production zone	Species/herd size	Growth rate
Lowland grazing system (LG)	Cattle agro-pastoral	0.20%
	Cattle pastoral small	0.20%
	Cattle pastoral medium	1.50%
Mixed rain-fed system (MRS)	Cattle small	0.00%
	Cattle medium	1.00%
Mixed rainfed system (MRD)	Cattle small	1.90%
	Cattle medium	3.90%
Peri-urban dairy system (SPD)	Cattle small	8.40%
	Cattle medium	6.00%
Grassland system (LG)	Sheep agro-pastoral	1.60%
	Sheep pastoral small	2.90%
	Sheep pastoral medium	3.30%
Mixed rain-fed system (MRD)	Sheep small	4.30%
	Sheep medium	5.20%
Mixed rainfed system (MRS)	Sheep small	3.60%
Grassland system (LG)	Goats agro-pastoral	2.70%
	Goats pastoral small	1.10%
	Goats pastoral medium	4.80%
Mixed rain-fed system (MRD)	Goats small	4.20%
	Goats medium	5.90%
Mixed irrigated systems (MRS)	Goats small	3.00%
Grassland system (LG)	Camel agro-pastoral	0.30%
	Camel pastoral small	0.30%
	Camel pastoral medium	0.30%
Grassland system (LG)	Cattle agro-pastoral	0.20%
	Cattle pastoral small	0.20%
	Cattle pastoral medium–large	1.50%
Mixed rain-fed system (MRD)	Cattle small	0.00%

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