Food and Agriculture Organization of the United Nations

AFRICA SUSTAINABLE LIVESTOCK 2050

The future of livestock in ETHIOPIA

Opportunities and challenges in the face of uncertainty

USAID FROM THE AMERICAN PEOPLE

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Food and Agriculture Organization of the United Nations
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Preface

Ethiopian decision makers have to grapple with so many uncertainties from multiple directions that prioritizing interventions and holding a straight course prove a daunting task. In the next decades, population growth, urbanization, smart technological innovations and adoptions, increased movements of people and goods, not to mention climate change, will thoroughly transform Ethiopian society, in ways that are often unpredictable.

Take the livestock sector: its development is fundamental to support the transformation of the country in a sustainable way socially, environmentally and from a public health perspective. In these circumstances, a robust analysis of livestock production systems and value chains, an understanding of trends in consumption of animal source foods, and an assessment of returns to different investments are essential to formulate and prioritize policy actions. However, this alone does not ensure that policies will support a sustainable growth of livestock into a future that, to a large extent, is uncertain. Take a moment and ponder over these questions: in the next three decades, how will technology uptake affect livestock productivity? How will the feed-food competition unfold? How will livestock value chains transform to satisfy the demand of an increasingly affluent and urbanized population? We must humbly admit that we can neither easily predict nor plan the long-term future of livestock in Ethiopia.

The government of Ethiopia, with support from FAO and USAID, engaged a multitude of stakeholders in a conversation around the knowns and unknowns of the future of the cattle sector in the country. They discussed past and projected trends of societal and livestock dynamics, current policy priorities, technology uptake and institutional changes and other. Stakeholders did not predict or forecast with accuracy the future of the cattle sector in Ethiopia, but generated evidence on alternative, yet all plausible futures.

The report "The future of livestock in Ethiopia: Opportunities and challenges in the face of uncertainty" looks out to 2050 and presents alternative scenarios, or plausible portrays, of the future of the cattle sector in Ethiopia. It provides invaluable insights to decision-makers on actions to take today to make the Ethiopian cattle systems more robust and resilient to an uncertain future, and sustainable from a social, environmental and public health perspective. It makes a strong case to broaden our perspective and take a forward-looking approach when designing policies and investments in dynamic and rapidly changing societies, such as that of Ethiopia.

FAO is grateful to the various stakeholders from across Ethiopia who provided the invaluable expertise and knowledge that underpin this report and to USAID for its continued generous support.

FATOUMA SEID
FAO Representative to Ethiopia
Addis Ababa

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- ABATE GETNET, Director, Development Institution Environment Law Compliance Monitoring and Regulating Directorate, Environment Forest and Climate Change Commission (EFCCC)
- ASEFA DERESSA, ASL 2050 Steering Committee member, Ethiopia Public Health Institute, Ministry of Health (MoH)
- BAHRU ZEWDIE, Expert, Food, Medicine and Health Care Administration & Control Authority MoH
- BEMNET TESHOME, ASL 2050 Steering Committee member, EFCCC
- BEREKET AKELE, Advisor to the State Minister, Ministry of Education
- CLAUDIA CIARLANTINI, Information Management Officer, FAO, Italy
- CRISTIANA GIOVANNINI, Graphic Designer, FAO, Italy
- DARSEMA GULIMA, National One Health Technical Advisor, P&R
- DOMINIK WISSER, Consultant, FAO, Italy
- ELIAS WALELIGN, MERS-CoV Project Coordinator, FAO-ECTAD, Ethiopia
- FASIL AWOL, General Manager, Ethiopian Veterinary Association
- FELESETA KASSAYE, Communication Coordinator, FAO-ECTAD, Ethiopia
- FEYESA REGASSA, Director, Ethiopian Public Health Institute, MoH
- GEDION YILMA, Export Abattoir Inspection and Certification Directorate Director, Ministry of Agriculture (MoA)
- GETACHEW GARI, Epidemiologist, FAO-ECTAD, Ethiopia
- GIJS VAN 'T KLOOSTER, Team Leader, FAO-ECTAD, Ethiopia
- HAYAT SEID, Expert, Veterinary Drug and Animal Feed Administration and Control Authority, MoA
- HIVER BOUSSINI, FAO-ECTAD, Nigeria
- KASSAHUN ASMARE, Deputy Director, Ohio State University – Global One Health Initiative
- KASSAHUN TSEGAYE, Expert, EFCCC
- MESERET BEKELE, Director, Veterinary Public Health Directorate, MoA
- MUSTAFA ABU, Coordinator, MoA
- SHIFERAW NEGASH, Expert, Environmental and Social Impact Assessment and Licensing, EFCCC
- SOLOMON GEBREMARIAM, Meat Inspector, MoA
- SYLVIA MURPHEY, Veterinary Officer, CDC
- TADESSE EGUALE, Researcher/Associate Professor, Aklilu Lemma Institute of Pathobiology, Addis Ababa University
- TAMRAT DEGEFA, Senior Researcher, Ethiopian Institute of Agricultural Research
- TANJA HICHERT, Hichert and Associates Ltd and Lecturer, Centre for Complex Systems in Transition, Stellenbosch University, South Africa
- TARIKU TEKA, Director, Dairy Resources Development Directorate, MoA
- TESHITA SHUTE, Expert, Food, Medicine and Health Care Administration & Control Authority, MoH
- THOMAS CHERENET, Project Coordinator and ASL2050 Steering Committee Chairperson, MoA
- WONDWOSEN ASFAW, Deputy Team Leader, FAO-ECTAD, Ethiopia
- YIRGALEM GEBREMESKEL, Livestock Program Management Specialist and Technical Advisor, USAID

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Executive summary

The Ethiopian population will grow from present 102 to almost 190 million in the next three decades, out of which 76 million people will live in cities and towns *vis-à-vis* 19 million today. Per capita national income, currently at USD 767 per year, will almost double by 2050. These changes will trigger consumption for all livestock products to increase tremendously: between 2015 and 2050 demand for milk and beef is estimated to grow by about 5.5 million tonnes and 0.9 million tonnes or 145 and 257 percent increase, respectively, with similar or higher growth rates for demand of other animal source foods.

The livestock sector will radically transform to respond to the increasing demands. The major policies and strategies that guide the transformation of the country and of its livestock sector include the Growth and Transformation Plan-II (2015–2020), the Agricultural Development Led Industrialization (since 1995), the Livestock Master Plan (2015–2020), and the Climate Resilient Green Economy Strategy (2015–2030). The transformation of the livestock sector, however, is anticipated to be so rapid and, to some extent, unpredictable that existing policies and strategies might become inadequate in few years' time to steer a long-term sustainable growth of livestock.

The government of Ethiopia, represented by the Ministries in charge of Agriculture, Health and Environment, and the Food and Agriculture Organization of the United Nations (FAO) have thus engaged stakeholders to articulate long-term livestock scenarios for 2050 to explore emerging livestock-related opportunities and challenges for society and inform the policy debate. Representatives from the three Ministries, the academia, research institutions, the civil society, the private sector, international organizations and other actors have jointly articulated four different cattle scenarios for 2050. These scenarios are plausible stories about the future: they build on information on past trends and long-term projections on societal and livestock dynamics to describe alternative possible structures of the cattle sector and their likely impacts on public health, the environment and livelihoods.

In 2050, the cattle sector will be dramatically different than today. In two scenarios, thanks to an active government, cattle production increases tremendously with moderate to high level of intensification, with Ethiopia becoming an increasingly important player in livestock trade. In the other two scenarios, with limited resources and policy support, extensive production systems dominate, production level remains low and Ethiopia derives little benefits from its cattle resources. Depending on the scenario, cattle population may increase to 90 million heads from 56 million today or it may decline to about 40 million. The decline in heads of cattle is favourable in a scenario with improved productivity but limits supply of animal source foods in a scenario with an inefficient cattle sector. In all futures, the radical transformation of the cattle sector will result in a multitude of opportunities and challenges for stakeholders, including livestock farmers, other value chain actors and consumers.

In 2050, the cattle sector will be dramatically different than today

BUSINESS OPPORTUNITIES

The growing demand for animal source foods will provide major business opportunities for cattle farmers, who will invest to increase herd sizes and improve productivity. This, in turn, will generate business opportunities for input suppliers such as feed producers, breeding animal suppliers and veterinary service providers, as well for all other actors downstream the value chain, such as traders, processors, wholesalers and retailers. Last but not least, consumers may benefit from the availability of affordably priced animal source foods in the market. However, these opportunities come with some major challenges that, if not properly

addressed, risk jeopardising the development of the sector itself and having negative impacts on public health, environment and livelihoods.

ZOONOSES AND (RE-)EMERGING DISEASES

Due to growth in animal and human population, there will be increased risk of spread of zoonotic diseases (EIDs), including infectious emerging and re-merging diseases. Increased interaction with wildlife will further exacerbate this risk. Even in the best-case scenario, EID outbreaks have devastating consequences within and outside the livestock sector. Besides resulting in animal loss, production loss and human infections, outbreaks of emerging and re-emerging diseases can result in restriction of people's movements, closure of businesses and public offices, trade bans, decrease in tourism, social unrest, and political instability.

ANTIMICROBIAL RESISTANCE (AMR)

Even in the best scenario, AMR has severe consequences. Already today, specific infectious diseases cannot be treated or are difficult to treat in both animals and humans as the pathogens have developed resistance to antibiotics. For example, *Salmonella* strains isolated from milk and meat samples and tuberculosis-causing bacteria are confirmed resistant to first- and second-line antimicrobials available on the market. In the future scenarios, the risk of large improper use of antimicrobials in animals will increase because farmers will have to deal with the increased risk of zoonotic diseases while at the same time attempting to tap fully into the growing business opportunities provided by the expanded market for animal source foods.

NATURAL RESOURCES DEPLETION AND CLIMATE CHANGE

In all scenarios, the competition for land, feed and water is fierce. In the favourable scenarios, increased consumption of animal source foods and high level of production pose an immense environmental challenge, while in less appealing scenarios bad management and lack of regulations result in high greenhouse gas emission levels, land degradation, soil and water pollution and biodiversity loss. Impact of droughts is expected to worsen as are climate change associated problems such as reduced precipitation, rising temperature, desertification and flooding, further increasing the pressure on natural resources.

LIVELIHOODS AND EMPLOYMENT

The transformation of the cattle sector might result in less direct livelihoods opportunities from livestock. Because of increased competition to access productive inputs, starting with land and water, smallholders might in fact decide or be forced to exit the livestock sector altogether. This will be the case also in good scenarios, because of major shift towards capital intensive and labour saving production systems. The creation of alternative employment opportunities will be thus essential for avoiding increased levels of poverty and food insecurity in the future. It will largely depend on how the overall economy of Ethiopia will be in 2050.

MIDDLE-SCALE FARMERS IN URBAN AND PERI-URBAN AREAS

A high level of urbanization occurs in all scenarios, leading to the emergence and concentration of middle-scale commercial farms in and around urban centres to satisfy the growing demand for animal source foods. This is anticipated to pose major public health and environmental threats. On the one hand, high density of and frequent interactions between humans and animals are major determinants of outbreaks and spread of emerging and re-emerging infectious diseases. On the other hand, concentration of animals and processing of livestock products in urban areas, especially slaughtering, can result in water and soil contamination, leading to further health threats.

NEXT STEPS

Cognizant of the above, the government of Ethiopia may wish to prioritize certain investments within the existing policy framework. It might also appreciate what additional actions, if any, should be taken today to ensure a sustainable livestock in the long term, which provides affordable animal source foods to the growing population while having marginal or no negative impact on the environment and public health.

Introduction

The Ethiopian society and economy will grow fast and transform extensively in the next three decades: the country's population is anticipated to reach 190 million in 2050, *vis-à-vis* 102 million today, with more than 76 million people living in urban areas, while the size of the economy is expected to more than triple. Such a pace of change is unparalleled in the country's history.

Along this transformative process, the demand for animal source foods will exponentially increase and livestock will likely become the most important sector of agriculture. The growth and transformation of the livestock sector will be unprecedented. It will pose immense puzzles to society, livestock being a cornerstone for livelihoods and food security, environmental sustainability and public health. These include emerging challenges, which escalate as years pass and in the medium to long-term risk to undermine sustainable development, and uncertain one-off events with great disruptive impacts not only on the livestock sector but also, and more broadly, on society as a whole.

How can Ethiopia be prepared for and take action to ensure sustainable livestock production and value chains in 2050?

This is the question at the basis of this report. In the last two years, the Ministry of Agriculture, Ministry of Health and the Environment, Forest and Climate Change Commission have joined forces with the FAO Africa Sustainable Livestock 2050 (ASL2050) to engage a multitude of stakeholders in an evidence-based conversation around the long-term future of Ethiopia and of its cattle sector in particular. The consensus stakeholders reached is presented here.

This report portrays the country's possible cattle futures: it sheds light on emerging challenges and uncertain disruptive events associated with a transformed cattle sector, and identifies priority areas of action to take today for a sustainable livestock in the long-term.

What are scenarios?

Scenarios are plausible snapshots of the future that help focus thinking on key factors driving long-term changes and identify emerging opportunities, challenges and threats. They are constructed by engaging stakeholders in a conversation on available information on anticipated trends, such as population growth and climate change, and unpredictable dimensions of the future, such as the level of market integration and technology development and adoption.

There are multiple scenario building methods. Stakeholders used the double uncertainty matrix to formulate four plausible scenarios for 2050: they agreed upon two key uncertainties that will shape the future and explored how their interactions with known trends result in significantly different futures.

Scenarios build on the premise that the future is still in the making and can be actively shaped by anticipating emerging opportunities, challenges and threats, and by taking strategic action today that supports resilience and sustainability in the long-term.

Ethiopia today: a fast-growing economy

With a population of about 102 million people, Ethiopia is the second most populous nation in Africa (after Nigeria). It is a low income country, with a per capita income of USD 767 per year. Ethiopia is also one of the fastest growing economies in Africa, with GDP growth averaging over 10 percent in the last 10 years. It aims to reach lower-middle-income status by 2025.

Ethiopia today

Ethiopia is a low-income country with a population of 102 million and a GDP per capita of USD 767. Roughly, 20 percent of the population dwells in urban areas. Estimates by The Economist (2015) revealed middle class society represents a mere 2 percent of Ethiopians.

Agriculture is the mainstay of the economy, contributing about 35 percent to GDP and 68.2 percent to employment, and 90 percent of export value. Industry and services contribute around 23 and 42 percent to GDP, respectively, the two sectors employing about 9.4 and 22.4 percent of the labour force, in that order (FDRE, 2016).

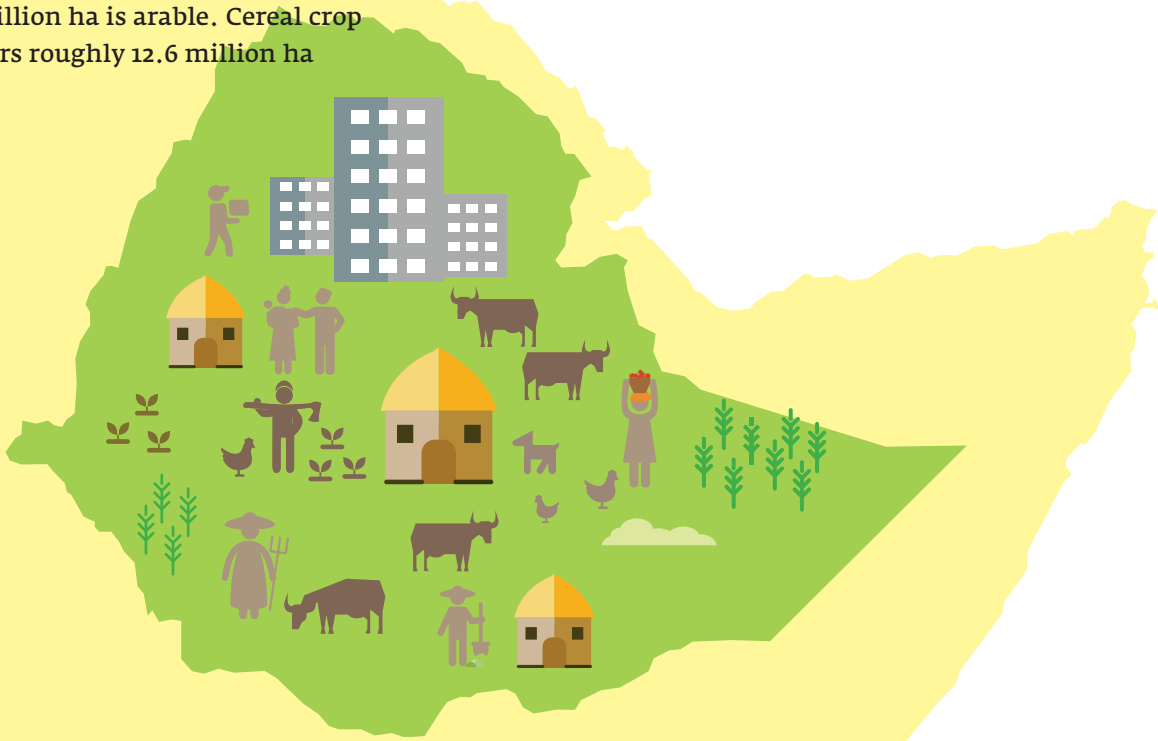
The country's agricultural sector is heterogeneous, comprising small through medium to large farmers and farms with different levels of efficiency. Smallholders, however, dominate the agricultural and livestock production landscape. Smallholder farmers mainly cultivate wheat, barley, teff, maize, sorghum, and keep cattle, small ruminants, equine and poultry.

Agricultural productivity is constrained by a variety of institutional and economic bottlenecks, as well as by agro-ecological factors since 44 percent of the total land area is arid or semi-arid. Ethiopia has 35.7 million ha of agricultural land (36.3 percent of total land area) in total and of this 15.2 million ha is arable. Cereal crop production currently covers roughly 12.6 million ha (WB, 2018).

Out of 102 million people, 26.7 million people (26.2 percent) live under the poverty line. Most of the poor are in rural areas. Undernourishment affects 28.8 percent of the total population, with stunting and severe wasting in children under five being at 38.4 and 2.9 percent, respectively.

Life expectancy is 64.7 and 66.5 years for males and females, respectively. Major causes of death are diarrheal diseases, usually symptoms of an infection of the intestine, lower respiratory infections, such as pneumonia, ischemic heart diseases and tuberculosis. On average, the government spends USD 24.27 per person per year or 4.04 percent of GDP on health (WB, 2018).

The Ethiopian highlands are densely populated and experience heavy environmental degradation. The lowland areas are extremely fragile. Between 1990 and 2015, Ethiopia's forest area decreased by 25 percent, from 167 to 125 thousand square kilometres. During this same period, the forest area of Sub-Saharan Africa decreased by 12 percent. A number of species (32 mammal, 33 bird, 14 fish, and 47 higher plant species) are already either threatened or endangered. Recurrent droughts and occasional flooding highly affect livelihoods (WB WDI, 2018). There is high degree of vulnerability to climate change.



GDP per capita

767 *USD*
or **1 729** *USD*
PPP per year

URBANIZATION

Roughly, **20%**
of the population
dwells in urban areas

POPULATION

102 *million*

AGRICULTURE

Dominated by smallholders, it contributes about

35%
to ***GDP***

68%
to ***employment***

90%
of ***export value***

LIVESTOCK

Smallholders grow
cattle, **small ruminants**, **equine** *and* **poultry**

CROPS

The country's agricultural sector is heterogeneous:
wheat, barley, teff, maize, sorghum

Livelihoods

26.2%
live under poverty line.
Most of the **poor**
are in rural areas

4 of 10 children
under age 5
are **stunted**

Public health

Life expectancy *is* **64.7** *(male) and* **66.5** *(female)* **years**

Infectious diseases are the major cause of death: *main ones include diarrheal diseases, lower respiratory infections and tuberculosis*

Environment

The **highlands** *experience heavy* **environmental degradation**

The forest area decreased by 25%, *between 1990 and 2015*

The **lowlands** *are extremely vulnerable to* **droughts** *and severely affected by* **climate change**

Livestock today

Livestock is an integral part of agriculture, accounting for about 45 percent to the total value of agricultural production and supporting the livelihoods of a large share of the population. More than 14 million households – or 70 percent of the population – keep livestock, including many poor. The typical herd is small, and is made of 3 cattle, 3 goats/sheep and few chickens.

The national herd comprises 57 million cattle, 30 million sheep and 23 million goats, and 57 million chicken, as well as camels, equines and a small number of pigs. Most animals are raised in the highlands, where also most of the population live. Due to technical, economic and institutional constraints, livestock productivity is generally low. Total production of milk, meat and eggs amounts to 5.6 billion litres, 1.1 million tonnes and 419 million eggs per year. Statistics on total production level, depending on the source, can however vary significantly. Statistics on the value of production, which also are highly varied, do not account for the value of organic fertilizers (68 million tons) and that of draft power provided by animals (617 million days per year).

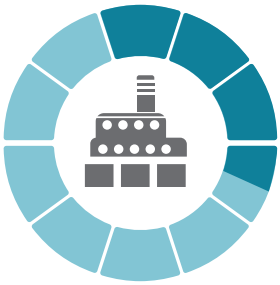
Beyond providing foods and other goods and services to the population, the livestock sector is a major contributor to export earnings, mainly through the export of live cattle and small ruminants. It is estimated that Ethiopian livestock contribute about 10 percent to total export earnings, of which 69 percent accounted for by live animal exports.

The total supply of animal source foods in the country, including of net trade, translates in a per capita consumption of 9 kg meat, 56.2 litres of milk and about 4 eggs per year. Cattle products, beef and cow milk, contribute for almost 80 percent of all meat and milk consumption. Market transactions are largely in urban areas as self-consumption dominates in rural areas.

14 million households own livestock

70%
of population

Agriculture value added



35%
of gross domestic product

Livestock value added

45%
of agricultural gross domestic product

Cattle
57
million

Chicken
57
million

Sheep
30
million

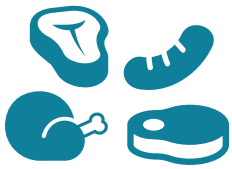
Goats
23
million

Equines
9
million

Camels
4.8
million

Pigs
28
thousand

Meat production (all kind)

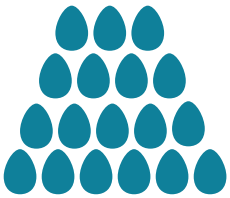


1.1
million tonnes

Milk production (all animals)

5.6
billion litres

Egg production



419
million

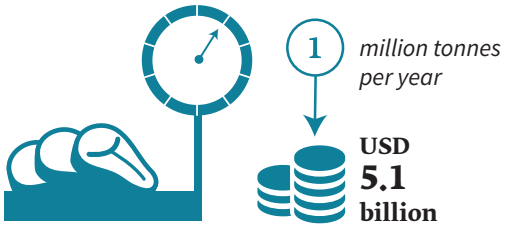
Per capita consumption
per year

Meat	**Milk**	**Eggs**
9	**56.2**	**4.1**
(kg)	(lit)	(pieces)

Cattle today

Cattle contribute about 80 percent of the livestock value added. Ethiopia produces over 3.8 billion litres of cow milk and about 1 million tonnes of beef per year, valued at USD 2.5 billion and USD 5.1 billion, respectively.

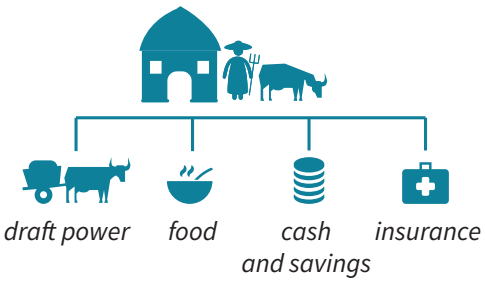
Beef production



Cow milk production

Out of the 14 million households keeping livestock, more than 12 million own at least one cattle, which support livelihoods through the provision of meat, milk, cash, draft power, hauling services, insurance and social capital.

More than **12 million households**
own at least **one cattle**



The cattle sector is highly heterogeneous. Five major production systems are identifiable in the country.

Dairy Commercial

Market-oriented dairy farms are capital intensive and concentrated in the central highland plateau. The average herd size varies between less than 30 (small-scale) and to above 100 (large-scale) heads, mainly consisting of exotic and high-grade animals.

Feedlots

There are more than 300 feedlots operating in Ethiopia, predominantly in East Shoa (Oromia). Animals are entirely confined in a yard fitted with watering and feeding facilities for a finishing duration of 3–6 months. The average number of animals kept per batch varies between 100 and 1 500 heads, mainly consisting of the Borana native breed.

Urban/Peri-urban

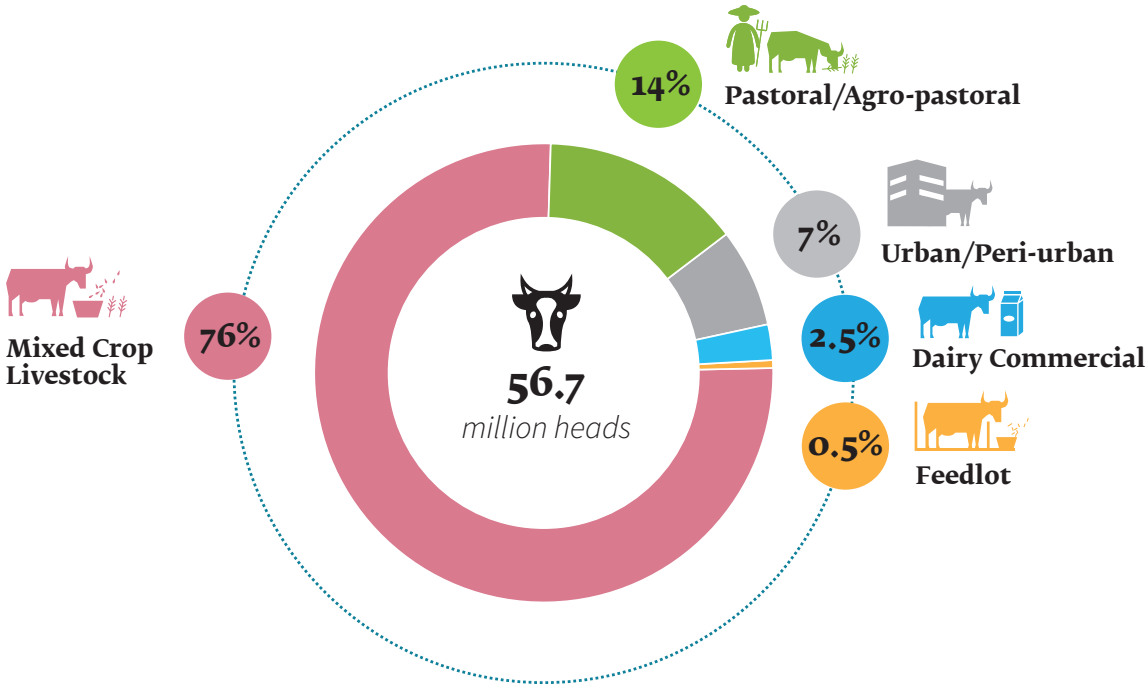
It is an expanding production system mostly found in the highlands. It is concentrated in the Addis Ababa milk shed area and around the regional capital cities. Peri-urban farmers and landless households also fatten few animals for slaughtering. The average herd size is around 5-10 heads, including indigenous Zebu, crossbred and high-grade animals.

Mixed Crop Livestock

It is a subsistence-oriented farming system concentrated in the mid- and high-altitude agro-ecological zones, where cereals and cash crops are the prevailing farm activities. Cattle are primarily kept to supply draft power and for milk production. The average herd size is around four heads, typically of indigenous breeds.

Pastoral/Agro-pastoral

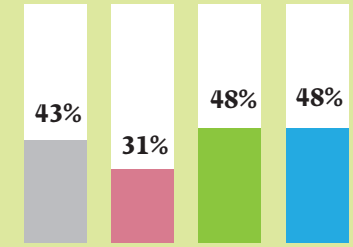
Pastoral and agro-pastoral production systems are mainly found in the lowlands and largely rely on natural or semi-natural vegetation. Production is subsistence-oriented and milk is the main product. Pastoralists and agro-pastoralists also sell excess young bulls to highlanders and feedlot operators. The typical herd comprises 10–20 indigenous cattle, though herds of over 200 heads are common.



Livelihoods

About **12.5 million households keep cattle**, which contribute from 31 to 48 percent to total household income

Cattle income as % of total household income



- mixed crop-livestock systems
- pastoral/agro-pastoral systems
- dairy commercial systems
- urban/peri-urban systems

Cattle contribute to **food security** and **nutrition** through the provision of beef and milk to the population

Per capita consumption of beef and cow milk is **6.5 kg** and **43.3 kg** per year, respectively

Public health

Cattle can negatively impact on public health through **zoonotic diseases**, which jump from animals to humans

USD 4.65 billion

The total cattle and human health cost of **brucellosis, bovine tuberculosis, salmonellosis and anthrax** amount to 24.2 percent of the livestock value added

Inappropriate use of **antibiotics** in cattle farms can result in **antimicrobial resistance in humans.** The fight against infectious diseases, the major cause of death in Ethiopia, might become a daunting challenge

Environment

Cattle is a major user of land and water in Ethiopia, which can result in **land degradation and soil and water pollution**. Cattle can also contribute to **loss of biodiversity** and emissions of **greenhouse gases**

Cattle water consumption

amounts **687 million m³** or **7 percent of the total water** withdrawal in the country

Greenhouse Gas Emissions from cattle (CO_2e)

million tonnes

Systems:

- mixed crop-livestock = **138**
- pastoral/agro-pastoral = **33**
- dairy commercial = **8**
- urban/peri-urban = **13**
- feedlots = **0.35**

Ethiopia in 2050: knowns and unknowns

The way Ethiopia and its livestock sector will be in 2050 depends on the interactions between known factors, including existing long-term policies and strategies and megatrends, and uncertain factors, such as consumers' behaviour and government accountability.

Knowns

Long-term policies and strategies

The **Growth and Transformation Plans** (GTP I, 2010/11 – 2014/15 and GTP II, 2015/16 – 2019/20) "serve as a spring board towards realizing the national vision of becoming a low middle-income country by 2025, through sustaining the rapid, broad based and inclusive economic growth, which accelerates economic transformation and the journey towards the country's Renascence".

The **Agriculture Development Led Industrialization** and the **Agriculture Sector Policy** and **Investment Framework** 2010-20 guide Ethiopia's agricultural growth and transformation, with the ultimate objective to sustainably enhance agricultural productivity for food security and nutrition.

The **Livestock Master Plan** is a series of five-year development plans (2015/16 – 2019/20) for priority livestock value chains and production systems. It supports a development of the livestock sector that improves the livelihoods of smallholder farmers, reduces poverty and increases food security in both rural and urban areas, and sustains industrialization and inclusive economic growth.

Megatrends, 2015-2050

POPULATION

+86%

from **99** to **190** *million*

The demand for livestock products will increase and by 2050 most of livestock products will be marketed and consumed in urban areas

URBANIZATION

+300%

from **19** *to* **76** *million*

CLIMATE CHANGE

Temperatures will be much warmer

Changed rainfall pattern and frequent extreme weather events will make livestock production increasingly challenging

TECHNOLOGY

Big data and automation technologies will improve productivity in all sectors

Livestock production and husbandry practices, livestock products and livestock value chains will be markedly different than today

Consumption of livestock products } 2015-2050

in thousand tonnes

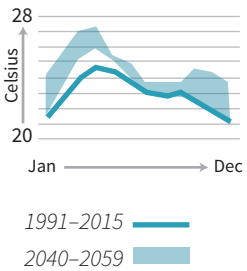
beef +200%
from 445 to 1 300

poultry meat +200%
from 72 to 217

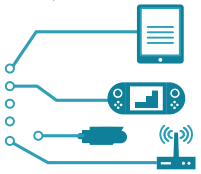
milk +100%
from 4 458 to 9 586

eggs +200%
from 38 to 94

Past and projected average monthly **temperature**



Technology development *will change the way individuals and organizations, including the government, will behave, work and interact*



Unknowns

Peace and stability, the role of Regional Economic Communities, the market size of artificial meat, the use of drones for the provision of livestock services are examples of unpredictable factors that will shape the future.

However, there are two bottom line uncertainties that will largely shape how Ethiopia will be in 2050: the governance system and the economic system

GOVERNANCE SYSTEM

Governance is the manner in which the government guides – through policies, institutions, investments and rules and regulations – social behaviour and economic activities. At the extremes, the governance system can be either good or bad.

Good governance
"Highly stable, open democracy"

Bad governance
"Highly unstable, heavily corrupt"

ECONOMIC SYSTEM

The economic system is the manner in which resources are allocated to produce, distribute and trade goods and services. At the extremes, the economic system could be either good or bad.

Good economic system
"Booming and resilient economy"

Bad economic system
"Collapsed and fragile economy"

Pairing the good and bad governance and the good and bad economic system uncertainties allows constructing four possible scenarios for Ethiopia in 2050.

The four scenarios shed light on how the known and unknown factors of the future might differently interact to result in alternative, yet all plausible futures for Ethiopia and its livestock sector.

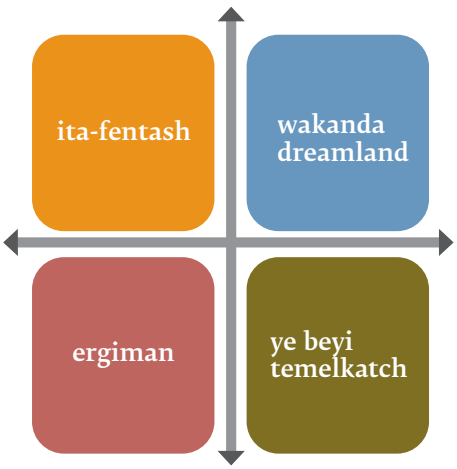
SCENARIO NAMES

WAKANDA DREAMLAND – the good-governance-good-economy scenario. Wakanda is a fictional African nation depicted in the Hollywood blockbuster Black Panther movie and portrayed to command the heights of technological advancement while retaining an ancient and rich culture. It represents a prosperous, technologically advanced, politically stable, democratic, and culturally intact Ethiopia.

ITA-FENTASH – the good-governance-bad-economy scenario. Ita-Fentash is an interjection that in this context means "it is your luck that trapped you in such desperate situation despite your good intentions and efforts". It represents an economically struggling Ethiopia despite good intentions by the government.

YE BEYI TEMELKACH – the bad-governance-good-economy scenario. Ye Beyi Temelkach portrays a situation where majority of Ethiopians sit and desperately watch the handful wealthy minority enjoy life. The economy grows as few cartels exploit the country's resources unfettered conjointly with heavily corrupt politicians.

ERGIMAN – the bad-governance-bad-economy scenario – literally means living under curse. It represents the worst scenario corresponding to a failed state. A failed and corrupted government is unable to sustain any type of socio-economic development.

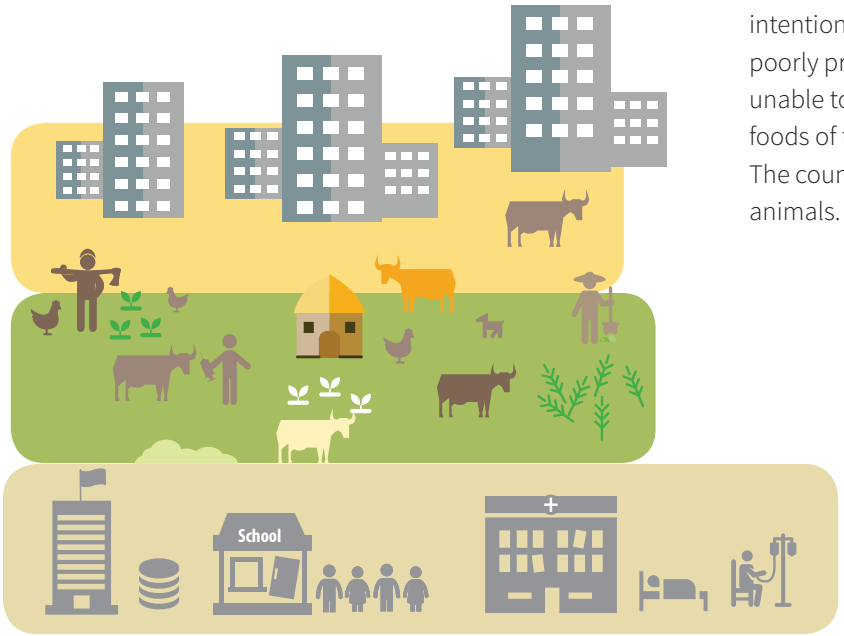


Ethiopia 2050 scenarios

Governance system

ITA-FENTASH

Ethiopians struggle to thrive, as economic growth and development are unstable in spite of all good intentions of the government. The livestock sector, poorly productive because of lack of finance, is unable to satisfy the demand for animal source foods of the population of 190 million people. The country is no longer a major exporter of live animals.



Economic system

ERGIMAN

Many Ethiopians are poor: an inefficient government is unable to provide good services to the population and there is little private sector investment. Livestock contribute to grassland degradation and biodiversity loss; make inefficient use of water; negatively affect public health because of zoonoses and livestock-driven anti-microbial resistance; and marginally support people's livelihoods.

Governance system

Governance system

WAKANDA DREAMLAND

Ethiopians are well-off and live in a prosperous, technologically advanced, politically stable, democratic, and culturally intact country. The country's livestock sector is an exemplary model of sustainability, providing affordably- priced and healthy food to the population while at the same time having minimum negative effects on the environment and public health.

Economic system

YE BEYI TEMELKACH

Most Ethiopians sit and desperately watch a handful wealthy minority enjoying life, as the government is unable to provide public goods and services to the citizens. Population is in excess of 190 million. There is a dual livestock sector, comprising few large corporations, which tend to overexploit natural resources, and millions of poor smallholders who survive tending a few poorly productive animals.

Governance system

Ethiopia in 2050: cattle scenarios

The alternative futures of Ethiopia will shape the development of the cattle sector, and consequently result in different production system distributions and characteristics and value chains and diverse impacts on livelihoods, the environment and public health.

Cattle in Ita-Fentash

CONSUMPTION

In comparison with today, there is no any significant change in per capita consumption of cow milk and beef. Many people consume more white meat, a cheaper source of protein. The aggregate demand for cattle products is however much higher because of the doubling of the population.

PRODUCTION

Trade

Production levels are not able to meet consumers' demand: the country produces 8.6 million tonnes of milk and 1.1 million tonnes of beef, which provide 45.2 litres of milk (per capita consumption is ~48 litres, the balance being covered through imports) and 5.8 kg of beef per person to the about 190 million people living in the country.

Per capita consumption
per year

	Today	2050
beef (kg)	6.5	5.8 ↓
milk (lit)	43.4	45.2 ↑

Since demand is higher than production, importation of milk continues, while beef and live animals exports decrease.

CATTLE POPULATION AND PRODUCTION SYSTEMS

Since 2016, the cattle population has grown by 8.5 million heads, to reach nearly 65 million, with reduced relevance of the crop-livestock production system both in terms of number of animals raised (from 43 to 39 million) and share (from 76 to 60 percent of all cattle). Conversely, pastoral and agro-pastoral systems and more so urban/peri-urban systems have gained importance. Due to challenges in getting finance, there is no any expansion of the commercial dairy and feedlot systems.

PRODUCTIVITY

The weak economy does not allow significant improvements in cattle productivity. However, in mixed crop-livestock systems the share of cross-bred animals increases, as less animals are used for draft power due to shrinking land area and because farmers attempt to satisfy the growing demand of animal source foods. The bulk of milk is produced in the urban/peri-urban and mixed crop-livestock systems whereas beef is primarily produced in mixed crop-livestock systems.

Livelihoods

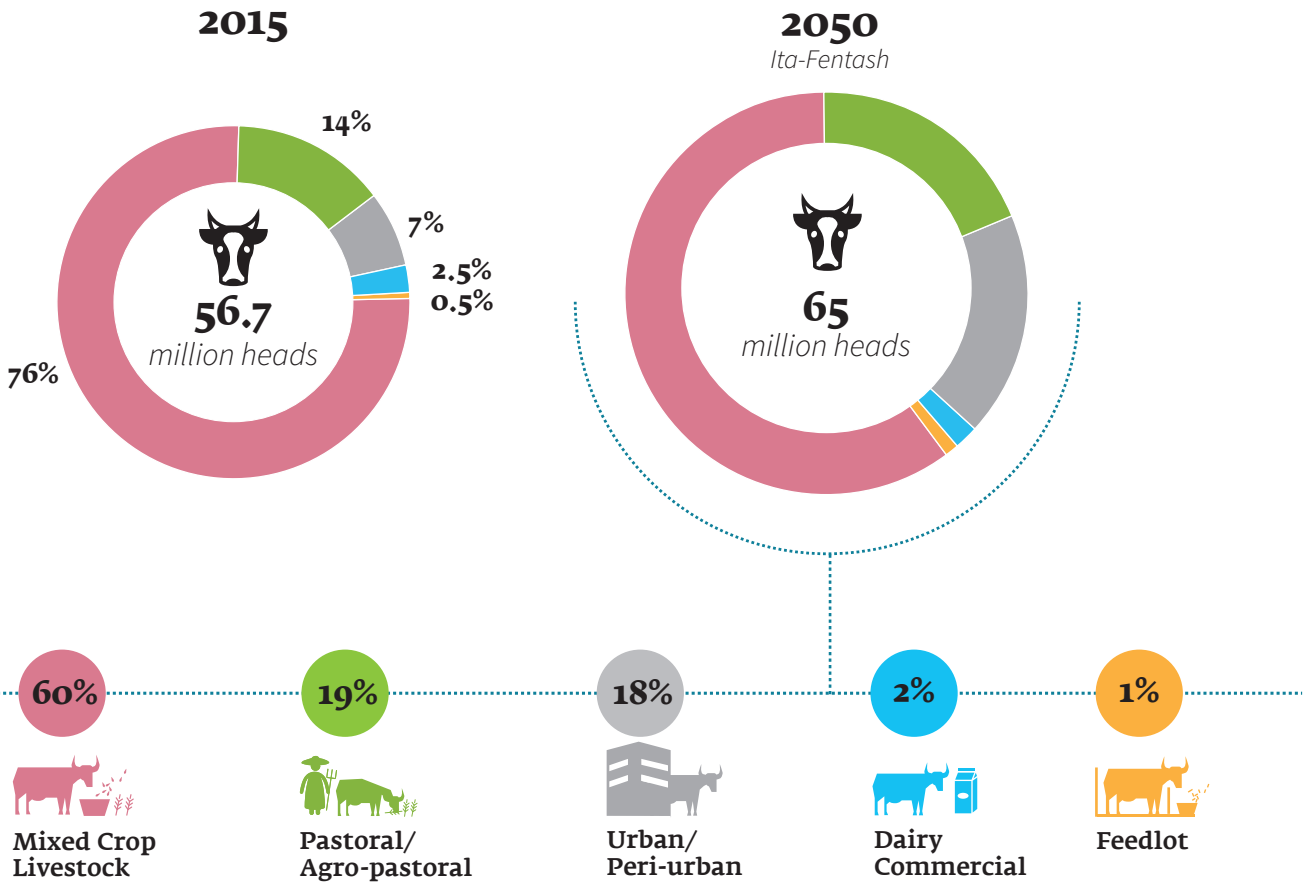
Though more numerous than today, the share of population keeping cattle has decreased. The mixed crop-livestock system still dominates. **Household income from livestock activities has not changed notably with respect to today** for smallholders, agro-pastoralists and pastoralists, because of the weak economy and significant challenges in accessing productive inputs. **There are**, however, **more people employed in livestock value chains** (including urban/peri-urban cattle keepers) serving urban areas.

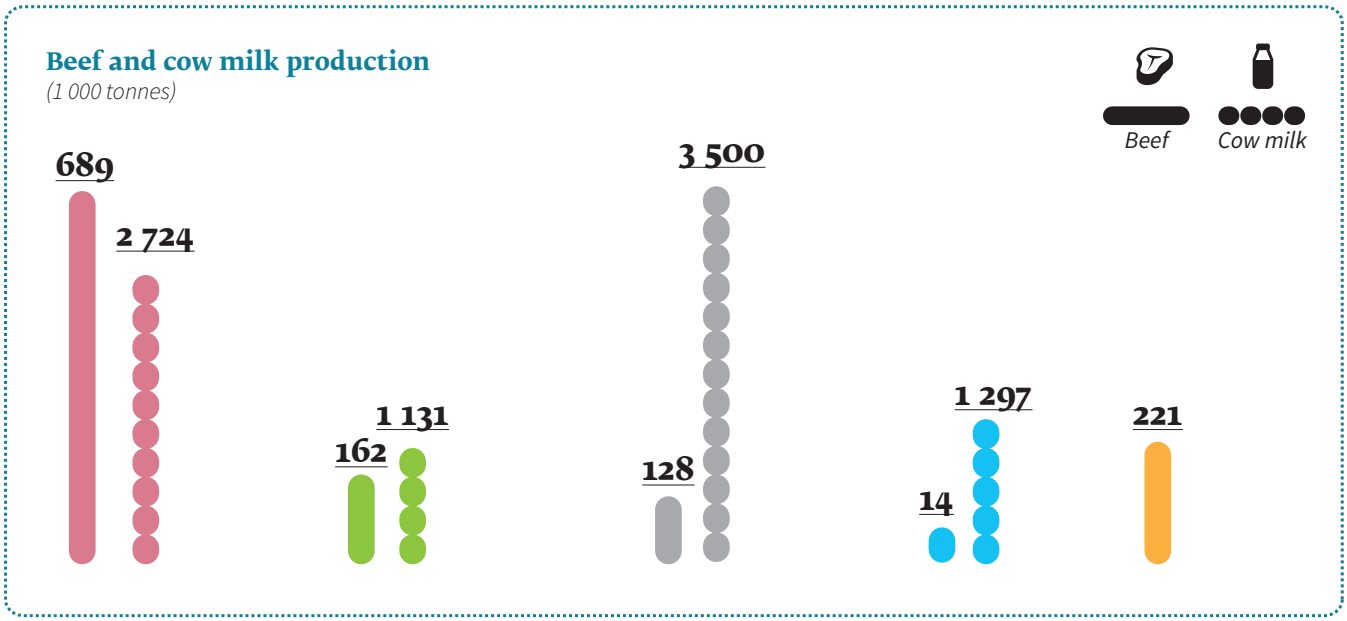
Public health

The **increased number of cattle**, cattle keepers and a larger human population **increases the risk of zoonotic disease** outbreaks in animals with farmers having incentives to **use antibiotics** for disease prevention. This is particularly true in peri-urban farms around densely populated cities. However, as there is no significant rise in the share of people consuming cattle products due to the weak economy, **the risk of food-borne diseases increases slightly** and is also mitigated by a good governance system.

Environment

The **cattle population is higher** than today **and exerts increased pressure on land and water** resources, also threatening biodiversity. In addition, as productivity is relatively low, with most of animals raised in mixed-crop livestock systems, the cattle sector **contribution to greenhouse gas emissions is higher than today.** There are some improvements in terms of GHG emissions per unit of output in an increased number of efficient farms, both in mixed and peri-urban systems.





Challenges

A growing cattle population in a weak economic system, with little finance available, makes it challenging even for an efficient government to ensure sustainability in livestock production systems. In particular, the fast expansion of urban/peri-urban farms around increasingly populated cities will result in fierce competition for natural resources, such as land and water, increased risks of pollution, inappropriate use of antibiotics, and outbreaks and spread of zoonotic diseases. However, due to the good governance, foreign aid continues to be available for development initiatives as well as in case of environmental and public-health related crises.

Cattle in Wakanda-Dreamland

CONSUMPTION

With respect to today there is tremendous **improvement in annual per capita consumption of milk and meat**, which has already reached 100 kg and 12 kg, respectively. In terms of aggregate demand, this means a total of 15 million tonnes of milk and 1.8 million tonnes of beef for the population. More than 50 percent of households regularly consume foods of animal origin.

Per capita consumption
per year

	Today	2050
beef (kg)	6.5	12 ↑
milk (lit)	43.4	100 ↑

PRODUCTION

Trade

Cattle systems generate 21 million tonnes of milk and 1.6 million tonnes of beef. The country has nearly reached self-sufficiency in meat, and exports fresh milk and dairy products to Central and Western African countries. It continues exporting cold carcasses and live animals to its traditional customers in the Gulf, North and Southern African countries and to some new market destinations, such as China.

CATTLE POPULATION AND PRODUCTION SYSTEMS

The cattle population has decreased from 56 million to 40 million heads, accompanied by the expansion of the intensive sector: 22 and 5 percent of the cattle population is raised in the commercial dairy and feedlot systems, respectively. The mixed crop-livestock system remains the most populous subsector, though its cattle population has halved from roughly 40 to 20 million heads. The pastoral/agro-pastoral and urban/peri-urban systems' population has also decreased.

PRODUCTIVITY

There is an increase in production despite the reduction in cattle population largely accounted for by increases in herd sizes and productivity in the intensive commercial systems (dairy and beef), which usually keep improved genotypes. Because of rising incomes, there is some improvement of productivity in mixed crop-livestock and pastoral systems too, where farmers mainly keep improved indigenous, crossbred as well as some unimproved breeds.

Livelihoods

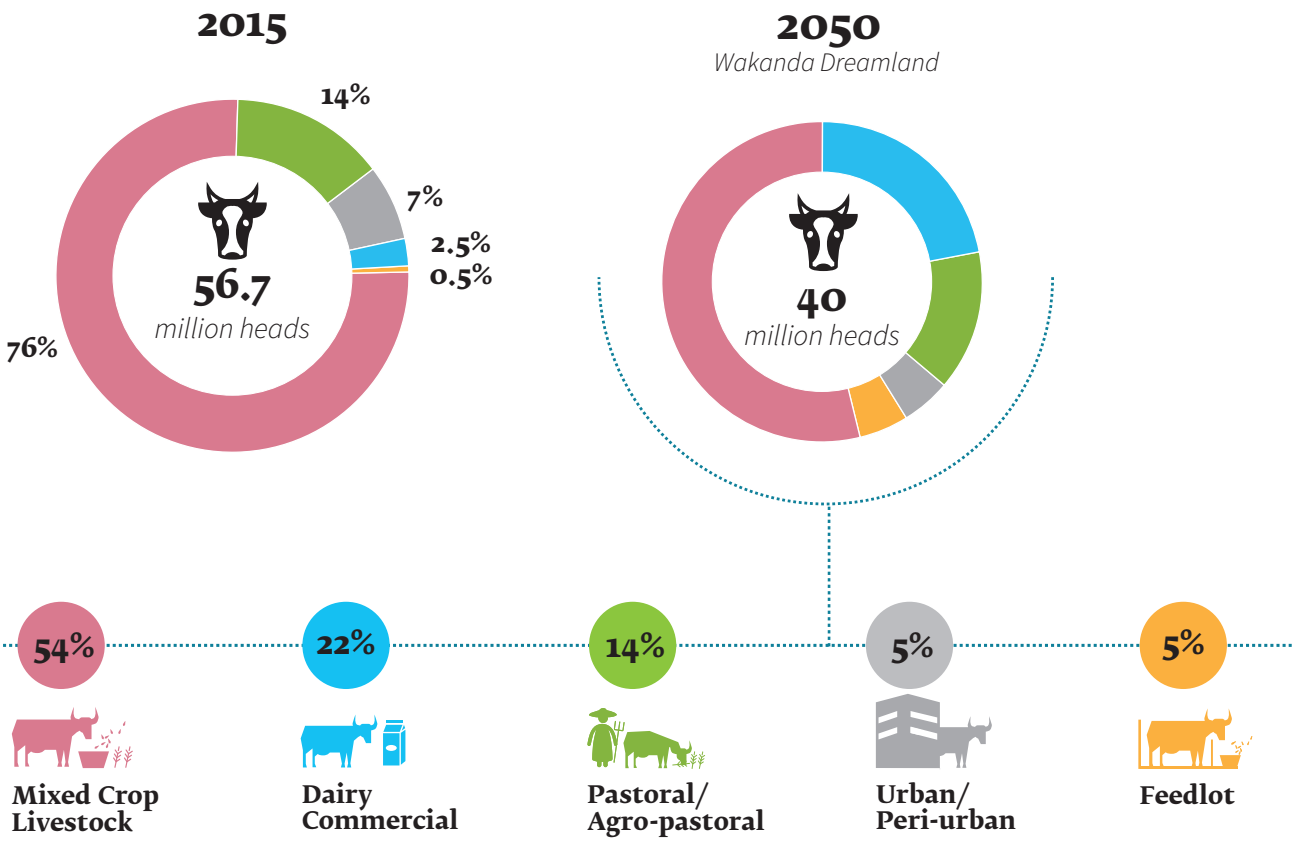
A **smaller share of the population own livestock**; many have exited agricultural self-employment to **well-paid salary jobs**. Yet, some smallholder livestock keepers and input suppliers have become uncompetitive and have lost their main source of livelihoods. Livestock, however, remain a significant contributor to livelihoods in extensive systems and provide some employment in the commercial system.

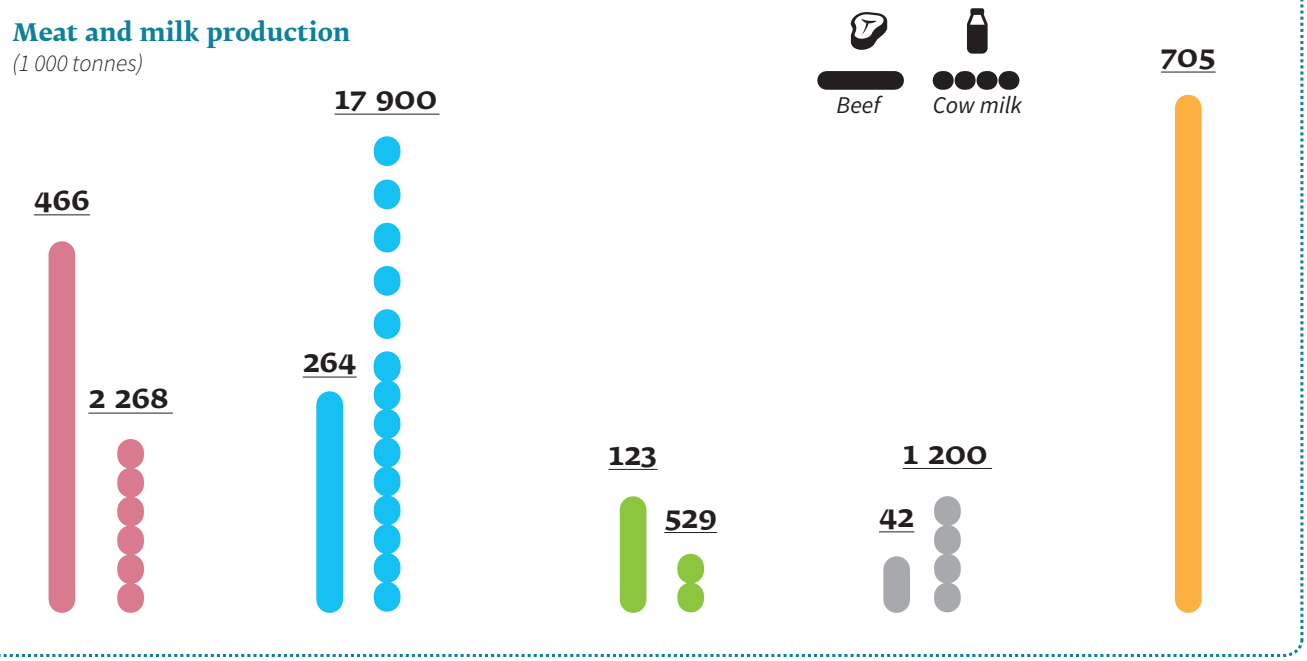
Public health

The expanded commercial cattle sector employs many workers at feedlots, abattoirs and dairy industrial plants. The share of **population interacting with cattle is still significant, but the interface is different *vis-à-vis* today**. **Zoonotic diseases and antimicrobial resistance are under control.** As the population is much better off than today, many more people consume cattle products and **food security has increased**.

Environment

The tremendous increase in production brings **large pressure on the environment**, though there have been great improvements in efficiency due to intensification: there are less cattle than in 2016, and **natural resource consumption and emission per unit of produce are lower than today on average.**





Challenges

The major challenge this scenario poses comes from the significant intensification of the cattle sector, which is dominated by large commercial farms.

The human-cattle interactions, natural resource consumption and emissions related to production all happen in a much more concentrated area than before. This vastly increases risk of emergence and spread of diseases, and poses a challenge on natural resources and emission management. Additionally, Ethiopians consume more cattle products than ever but efficient production systems as well as consumer awareness about antimicrobial resistance are likely to minimise any public health risk from livestock.

Cattle in Ye Beyi Temelkach

CONSUMPTION

Even though aggregate consumption and production have increased, per capita consumption of beef has declined, and that of cow milk has marginally increased due to increased inequality and the government's priority in allocating resources for export. The share of households regularly consuming livestock products has also decreased. The informal market has grown and awareness on food safety issues is low.

Per capita consumption *per year*

	Today	2050	
beef (kg)	6.5	5	↓
milk (lit)	43.4	45	↑

PRODUCTION

Trade

Total milk production has reached 15 million tonnes, predominantly from commercial dairy, urban/peri-urban, and mixed crop-livestock systems in order of importance. Much of the milk produced by dairy commercial and urban/peri-urban systems is exported. Total beef production is at 5 million tonnes mainly produced from feedlot animals; most of the produce is exported in line with the governmental interest and because the majority of the population cannot afford purchasing red meat. The share of livestock value added as a percentage of agricultural value added had increased, due to the high growth in beef production directed at export.

CATTLE POPULATION AND PRODUCTION SYSTEMS

The cattle population has increased to 90 million heads. The population of all production systems has increased, though in terms of shares there is a significant shift towards the intensive systems. Due to the export interests of the government, the share of animals in commercial dairy, feedlot and urban/peri-urban systems has increased to 7, 10 and 13 percent, respectively. The share of mixed-crop livestock and pastoral/agro-pastoral systems has decreased, though the former remains the most populous production system in the country in terms of cattle population.

PRODUCTIVITY

There are no significant productivity improvements as the government is unable to provide efficient services to cattle producers; the only exception is the carcass weight in feedlots (180 kg/head).

Livelihoods

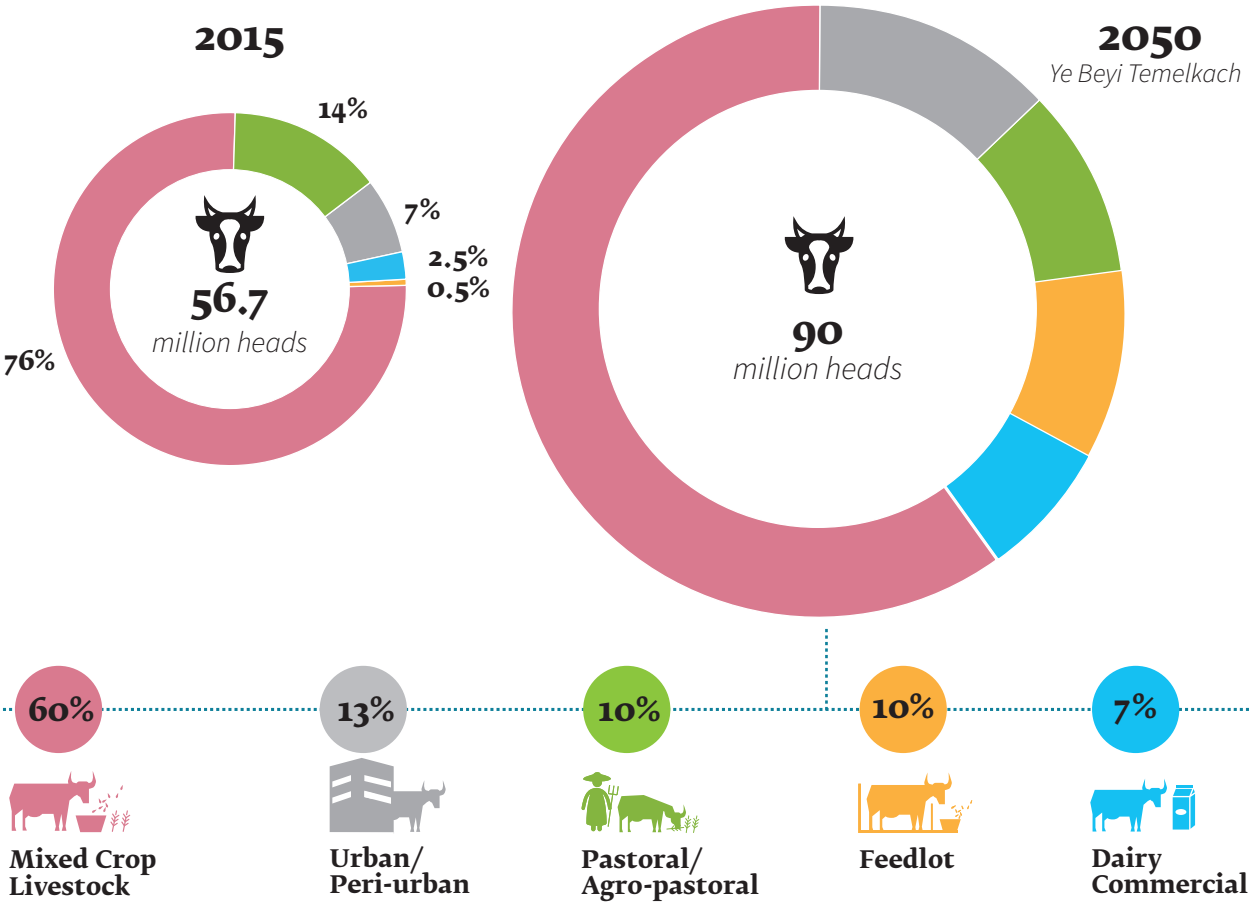
There is an **increase in the number of farms** since the cattle population nearly doubled and there are **no significant changes in herd size**. Employment opportunity and income from livestock have increased in the (semi-)intensive systems, while **the contribution of livestock to employment and household income remains moderate** in extensive systems.

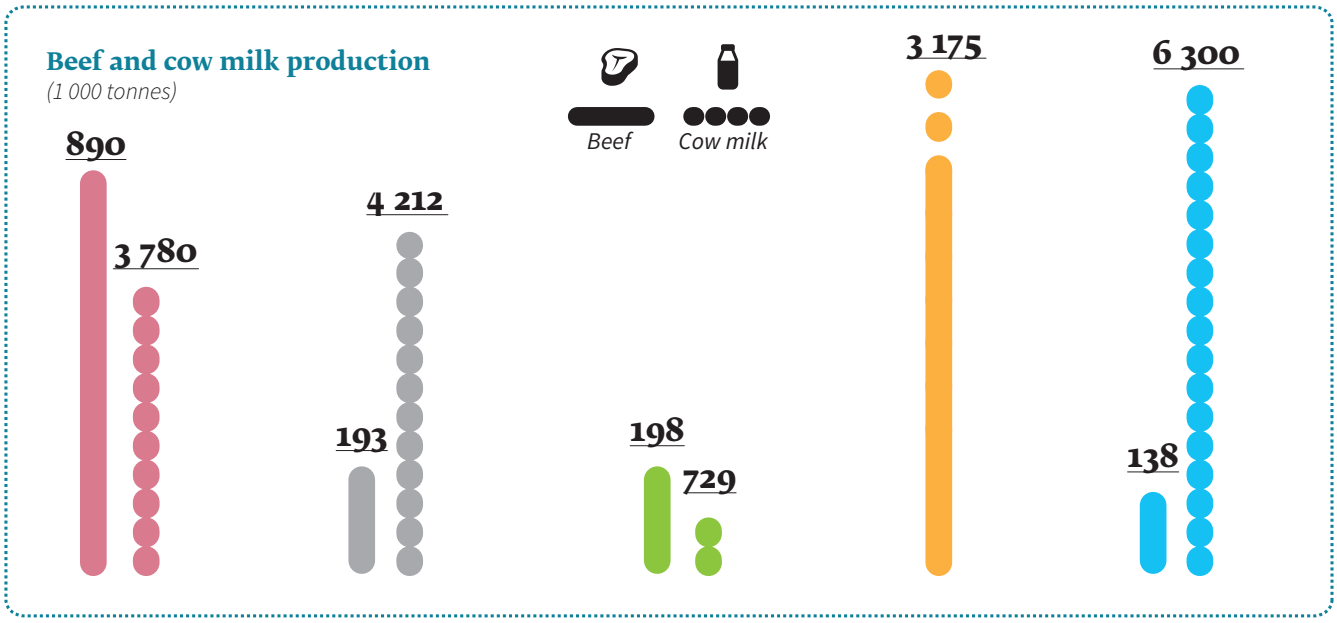
Public health

There is a **very high increase in cattle-human interaction** due to the huge rise in the animal population, especially in the dairy commercial, feedlot and urban/peri-urban systems. There are **regular outbreaks of all types of animal diseases in all production systems**, but for the commercial one. It is difficult to implement health measures due to the large expansion of the informal sector.

Environment

The huge increase in the cattle population puts **enormous pressure on environmental resources**. Through the expansion of the intensive sectors, greenhouse gas emissions per unit of produce have decreased though **pollution of soil and water is much higher** as production happens in a much smaller area.





Challenges

The major challenge in Ye Beyi Temelkach is due to the massive increase in overall cattle population coupled with expansion of feedlot operators and the urban/peri-urban dairy systems. The human-cattle interactions, natural resource consumption and greenhouse gas emissions related to production all happen in a much more concentrated area than before. This vastly increases risk of emergence and spread of animal diseases, and poses a challenge on natural resources and greenhouse gas emission management. Public and animal health services are poor due to weak governance, which risks further increasing the negative impact of cattle on the environment and public health.

Cattle in Ergiman

CONSUMPTION

Per capita consumption of beef and cow milk is very low with respect to today and only few households (< 25 percent) can afford consuming livestock products regularly. Almost all livestock products are traded in informal markets and citizens have minimum awareness of food safety issues, such as foodborne diseases and AMR.

Per capita consumption
per year

	Today	2050
beef (kg)	6.5	2
milk (lit)	43.4	11

PRODUCTION

Trade

Total cow milk and beef production has reduced to about 2 million tonnes and 0.5 million tonnes, respectively, and the mixed crop-livestock system alone generates more than 50 percent of both commodities. Livestock value added as percent of agriculture has declined significantly. Both imports and exports of livestock products have reached lowest-ever level. Similarly, imports and exports of live animals have become negligible.

CATTLE POPULATION AND PRODUCTION SYSTEMS

Total cattle population has declined to 42.5 million, mainly due to lack of resources, extremely fragmented and fragile land holdings and spread of diseases. The share of cattle raised in mixed-crop livestock systems has increased to 84 percent, while all other production systems' share has declined: 10 percent in pastoral/agro-pastoral, 5 percent in urban peri-urban, 1 percent in commercial dairy and there are only about 100 thousand cattle in feedlot systems.

PRODUCTIVITY

Productivity has generally deteriorated in all cattle systems and has worsened in the mixed crop-livestock and pastoral systems. Feed resources have been degraded and there is acute shortage of feed. Grazing is the predominant feeding system – animals browse whatever is available on degraded pastures, crop aftermath, and even roadsides. Water is not readily available from natural as well as constructed sources. Due to lack of resources and feed, milk yields, offtake rates and carcass weights are low.

Livelihoods

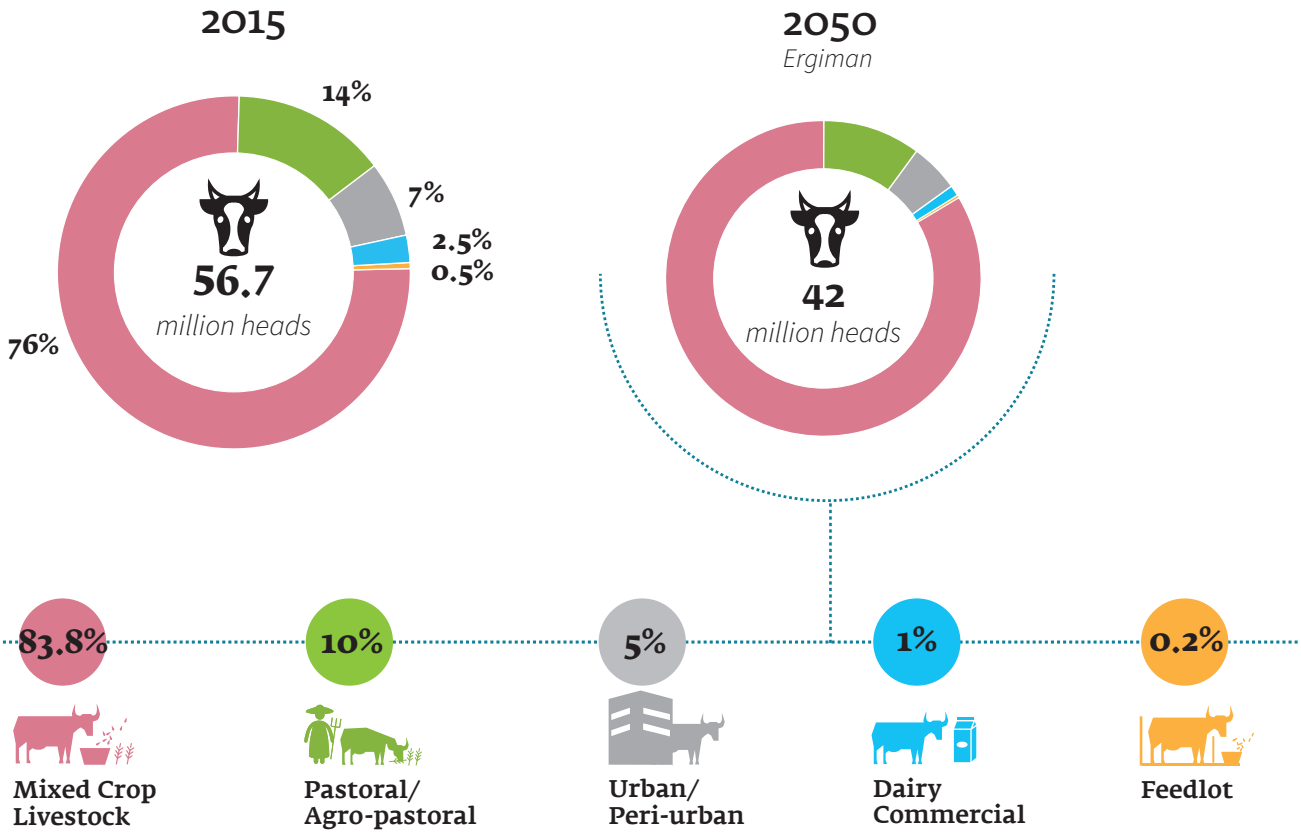
The number of cattle keeping households has decreased from 2016 levels. Commercial dairy, urban/peri-urban, and mixed crop-livestock cattle keepers have been displaced due to various reasons and are now less in number. **The role of cattle in the national as well as household economy has become marginal** though it remains one of the few livelihood options. There are limited employment opportunities along the value chain.

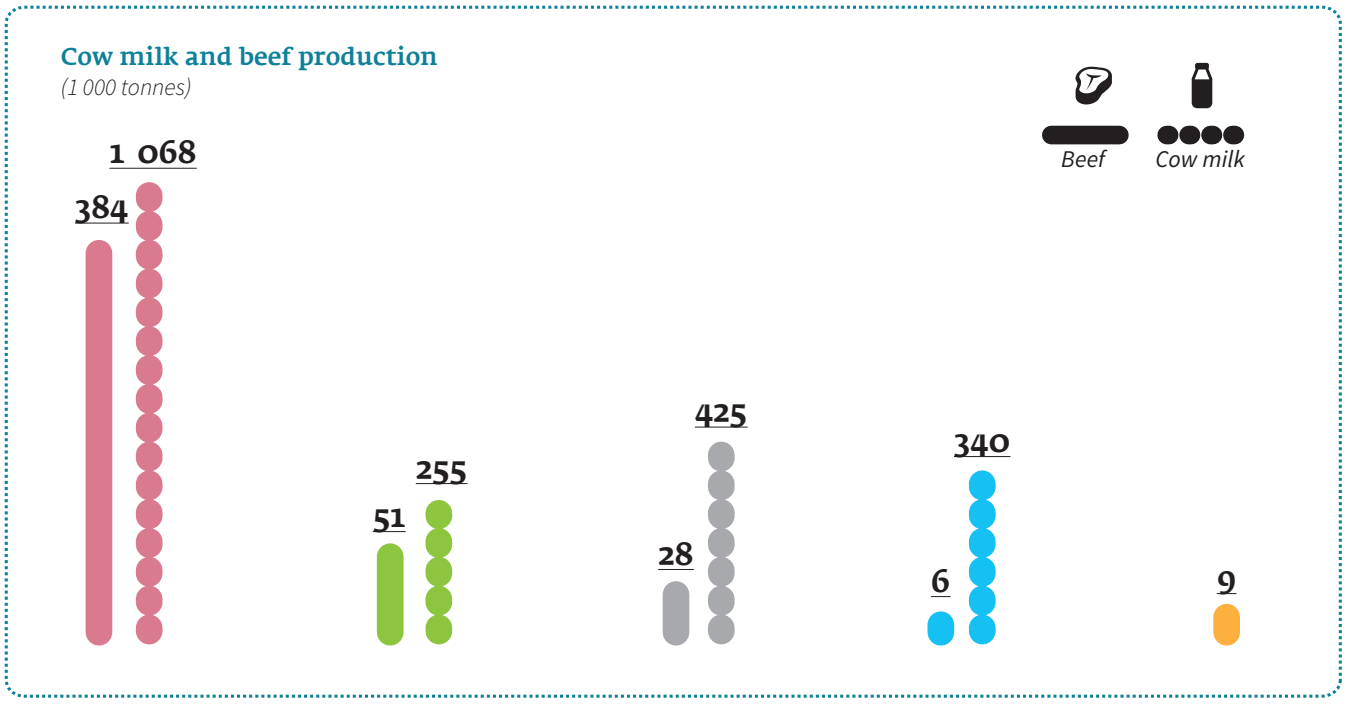
Public health

The overall cattle population has decreased; however, **risk of zoonotic disease outbreak and spread is high** due to increase in human population, the rise of informal markets, and higher levels of undernourishment, that is partially caused by the low availability of livestock products.
While there is **high risk of inappropriate use of antimicrobials in animal farming**, a badly performing economy makes them poorly available on the market.

Environment

The impact of cattle systems on land, water and biodiversity is high due to poor production practices and poor natural resource management. **Total greenhouse gas emissions from cattle systems have declined** due to contraction in cattle population but there is **high emission per unit of product** as productivity is low. Additionally, impact of cattle systems on biodiversity is high due to overgrazing and poor natural resource management plans.





Challenges

Major challenges in Ergiman include the massive increase in human population and the expansion of mixed crop-livestock systems accompanied with declining productivity; increased risks of (re)-emerging zoonotic diseases in the face of extremely weak public animal health services; fragmented land holdings; and degradation of natural resources.

Moreover, the expansion of the informal sector makes disease surveillance and control more difficult to implement. The low consumption of animal source foods increases food insecurity and decreases the resilience of the population to diseases.

Opportunities and challenges

The coming growth and transformation of the livestock sector will have major consequences on Ethiopia's society in the next decades. As part of the future remains unpredictable, however, it is difficult to anticipate how the livestock sector will eventually affect people's livelihoods, the environment and public health in 2050. Portraying alternative development pathways for Ethiopia and its livestock sector sheds light on the multitude of future opportunities, challenges and threats. It assists in strategically designing policies that are more resilient to an uncertain future.

Livelihoods

- In the future, livestock farmers and other actors along the livestock value chains will face expanding business opportunities, because of the growing demand for animal source foods.
- Smallholder farmers will find it increasingly challenging to derive a livelihood from livestock, because of increased competition to access scarce natural resources and inability to meet food safety standards.
- Many smallholders will exit the livestock sector and, in many cases, will move from rural to urban areas in search for employment opportunities.
- If the livestock sector develops sustainably, consumers will be better nourished and food secure because of the increased availability of affordably-priced animal source foods in the market.

Public health

- The future will be characterized by an increased risk of outbreaks of zoonotic diseases, including emerging and re-emerging infectious diseases (EIDs). The growing animal and human populations, in fact, will result in novel interactions between humans, animals and wildlife. This holds particularly true along value chains serving expanding urban and peri-urban areas.
- There will be increased risk of livestock-driven antimicrobial resistance in humans, with the associated negative impact on society. Either because of stiffer competition or because of the increased risk of zoonotic diseases, farmers will be tempted to imprudently use antibiotics not only to treat sick animals but also as growth promoter and/or for prophylaxis.

Environment

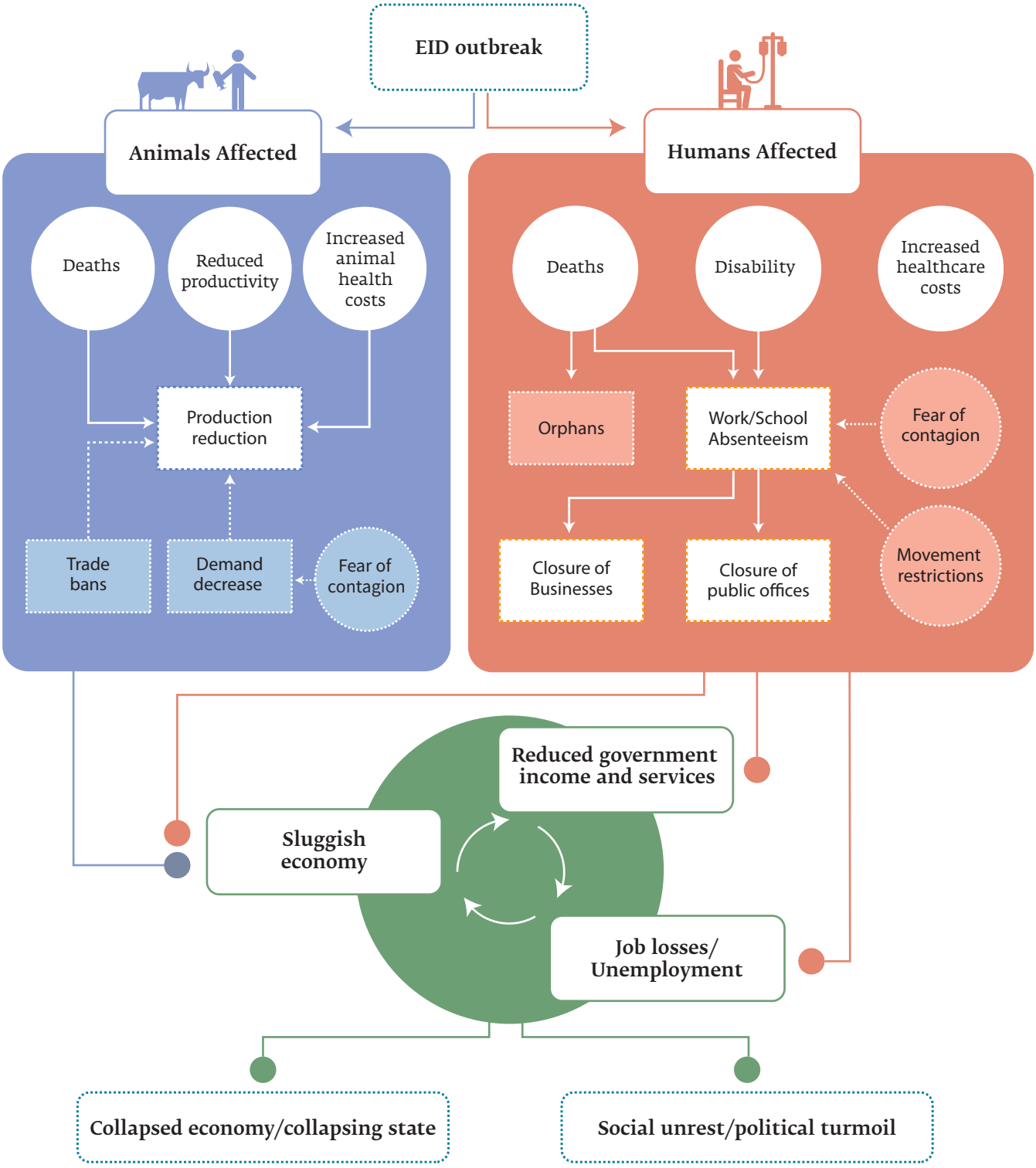
- Expansion of the livestock herd will result in growing demand for and pressure on land for pastures and feed, and increased demand for water at farm level and in industries along the value chain.
- Pressure on natural resources will be particularly high in peri-urban areas, where the ever-growing animal and human populations will compete for scarce natural resources.
- Livestock intensification and concentration might result in increased risk of point source pollution of soil and water and in biodiversity losses.
- A larger herd size, if unproductive, will result in increased greenhouse gas emissions from livestock, exacerbating the negative impacts of livestock on climate change

The magnitude of the future livestock-related livelihoods, environment and public health challenges will vary in each of the different 2050 scenarios.

However, two elements deserve closer scrutiny, including the increased risk of outbreaks of emerging and re-emerging infectious diseases and the ongoing rapid urbanization.

EMERGING AND RE-EMERGING INFECTIOUS DISEASES (EIDs)

An outbreak of an EID originating in wild and/or domesticated animals and that jumps to humans might not only significantly impact the livestock sub-sector, but also result in a high human death toll with broader disruptive impact on society, such as through reduced people's movement, work absenteeism, closure of businesses and schools, children losing parents, trade bans, reduction in foreign direct investments, etc. Eventually, EIDs might trigger social unrest and destabilize governments by eroding public trust and confidence and, when spreading rapidly across countries, regions and continents, they can also result in worldwide pandemics.



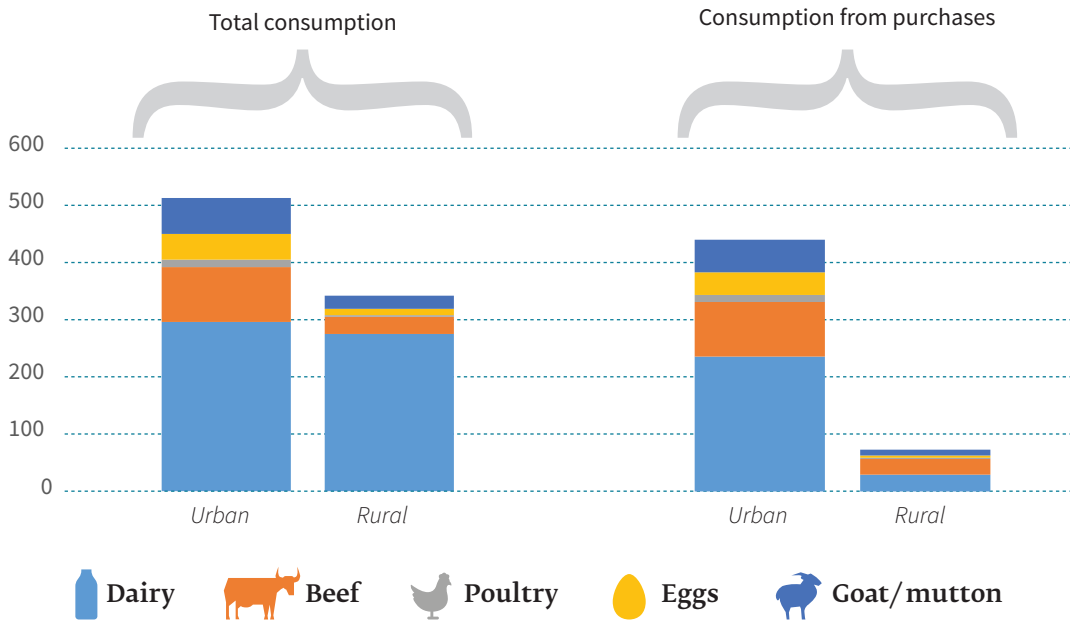
URBANIZATION

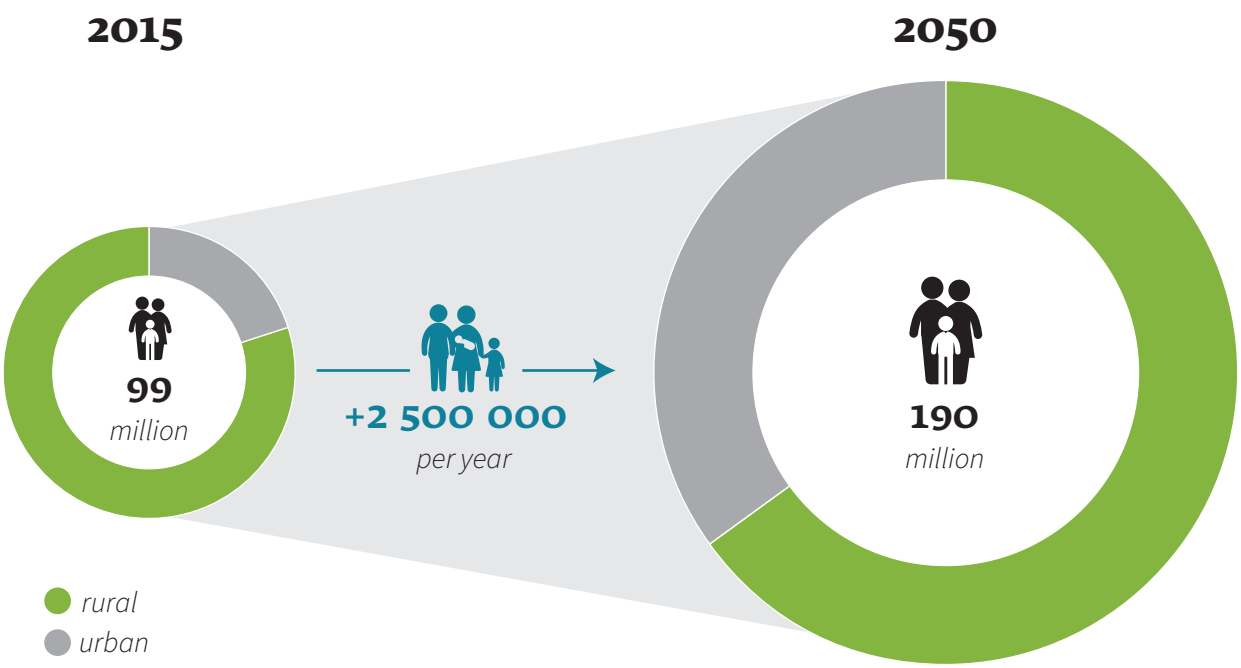
The coming transformation of livestock will largely aim at satisfying the demand for animal source foods of a growing urban population.

Between 2015 and 2050, 65 percent of the anticipated increase in population will occur in urban areas *vis-à-vis* 35 percent in rural areas, and the average per capita consumption of animal source foods is higher in urban than rural areas.

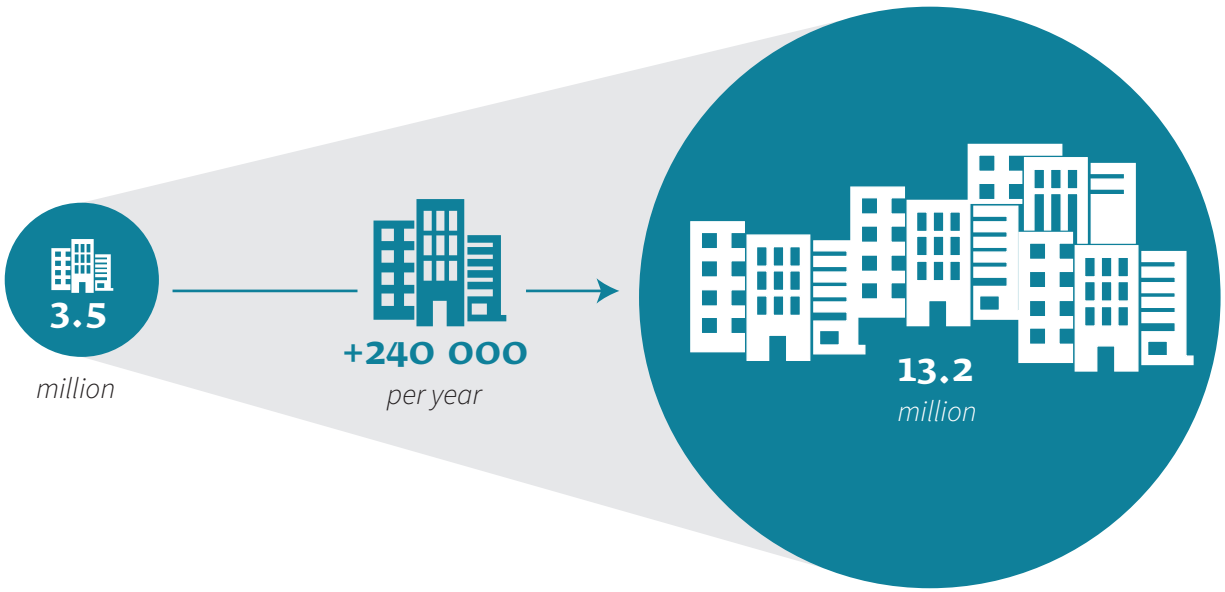
Livestock farms and value chains in peri-urban and urban areas are thus expected to transform more rapidly and hastily than anywhere else in the country, exacerbating exponentially the risk of negative impacts of livestock farming on the environment and public health in densely populated areas.

Per capita weekly consumption (g) of livestock products by rural and urban area





Ethiopia population by rural and urban area, 2015 – 2050



Addis Ababa population, 2010 – 2050

Conclusion

Towards resilient policies

Multiple plausible futures await Ethiopia and its cattle sector, each of them having highly different impacts on society. The future will eventually depend on the interactions between known megatrends – from population growth to technology development – and unpredictable factors of which governance and the economic system are extremely critical.

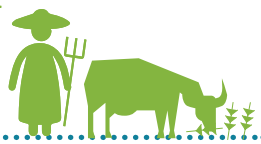
This report presented four internally consistent views of what Ethiopia and its cattle sector might turn out to be in 2050. None of the alternative scenarios will likely materialise and the future will comprise elements from all of them. They do, however, point to expanding business opportunities for actors along the value chain as well as to numerous common social, public health and environmental challenges.

The scenarios convincingly show the escalation of many known challenges such as fierce competition for environmental resources, particularly land and water, structural changes in employment opportunities and the increased risks of emergence and spread of zoonotic diseases and livestock-driven antimicrobial resistance. These risks will be better managed in some scenarios than in others; however, unpredictable outbreaks of an emerging or re-emerging infectious disease(s) will not only drastically affect the livestock sector, or one of its subsectors, but also have such negative spillover effects on society to jeopardize years of growth and development.

The scenarios point to an issue that is often overlooked in livestock sector policies and strategies: the increased relevance of urban, peri-urban middle-scale and commercial livestock operations. These entities operate closely to fast expanding and densely populated urban areas, and they will become more important as the urban population grows and is better off, demanding increasingly larger quantities of livestock products, especially beef and dairy products. It is critical that these hotspots of human-animal interaction are properly regulated, as any disease outbreak could escalate rapidly in such densely populated areas.

Stakeholders should adopt a One Health approach to appreciate the relevance and efficiency of current policies dealing with priority zoonotic diseases, emerging infectious diseases, antimicrobial use and farming systems in urban and peri-urban areas. Making the current policy framework resilient to these anticipated changes is a pre-condition to ensure an expansion of the Ethiopian cattle sector that provides affordable and healthy milk and meat to the population while having minimal negative impact on the environment and public health.

Urban, peri-urban middle scale commercial livestock operations… will become increasingly important in the future



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Data sources

Data and statistics in this report originate from a multitude of sources, including the Central Statistical Agency; the Ministry of Agriculture; Environment, Forest and Climate Change Commission; and the Ministry of Health. When national statistics were not readily available, data was sourced from FAOSTAT, the World Development Indicators dataset of the World Bank, the Health Statistics and Information Systems of the World Health Organization, and the Institute for Health Metrics and Evaluation.

An expert elicitation protocol was designed and implemented to gather data on variables for which information was not available from any source, such as the incidence of selected zoonoses among the human population.

The FAO's Global Perspective Studies, the United Nations Population Divisions and Hoornweg and Pope* (2016) provided long-term projections for social, economic and livestock-related variables. When data portraying the current situation of country and its livestock sector differed markedly by source, stakeholders jointly agreed on the statistics to utilize in the report.

Stakeholders, however, never considered conflicting statistics on the current situation a critical issue, as the focus of the scenario exercise was on portraying long-term, alternative development pathways, around which they reached broad consensus.

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Appendix

A1. Description of scenarios for Ethiopia

ITA-FENTASH

Governance of *Ita-Fentash* is highly stable and an open democracy. The rule of law is respected. Citizens contribute to policy making process much more than today. However, quality of infrastructure is poor (same level as today) due to the struggling economy. Access to basic services is better, though not highly developed due to the weak economy.

Overall, economic growth and development is unstable due to fragile situation even if the government has good intentions. Although economy is fragile, there is good governance that leads Ethiopia to a lower middle-income country status by 2050. Urban-rural migration driven by the struggling economy and land scarcity contributes to urbanization growth. Middle class society does not expand and the poor get significant support from the government.

The industry sector expands due to increasing urbanization, growing population, vulnerability of the agricultural sector to climate change and hence the government makes effort to shift its economy to industry and services. Agriculture contributes less to GDP but remains the biggest sector. Employment in agriculture has decreased in terms of share but absolute numbers increase due to population growth. The country imports many commodities, mainly food items.

Public health situation is better because of availability and improved access to health facilities. Ethiopians have better awareness due to globalization and since public health is a global good. There is a global influence in all aspects of health. However, diarrheal diseases remain significant due to lack of basic sanitation services and clean water.

Household income is the same or slightly worse as the economy is weak but the government supports the people. Poverty rate is higher than today. Proportion of malnourished people has not declined.

Cities are more polluted. Arid and semi-arid lands have become less productive. The government has good intentions but the economy does not allow significant change. The government wishes to focus on creating jobs and poverty alleviation; however, there is resource limitation. Ability to cope with climate change has hence not been improved.

WAKANDA DREAMLAND

Government of the *Wakanda Dreamland* is highly stable and open democracy. Safety of the citizens is protected and rule of law is defended. Authorities respect human rights and there is high participation of the citizens in policy formulation and in ensuring respect of human rights. Human development is highest as the country is free of conflict, safety of citizens is protected and rule of law is upheld providing necessary conditions for the pursuit of economic opportunities.

The country has already joined the group of lower middle-income countries. Human population has stabilized at about 150 million due to better family planning. Roughly 45 percent of the population lives in urban areas. GDP per capita is ~4 000 USD. Middle class society has reached 10 percent of the population from a mere 2 percent in 2015; however, there remains a remarkable divide between the rich and the poor.

Share of agriculture in GDP remains important but declines to 30 percent whereas share of industry and services in GDP each grows to 35 percent. Agriculture employs lower proportion of the labour force compared to 2015. Industry and service sectors each employs 15 percent and 30 percent, respectively, of the active labour force. There is more diversified economy in all major sectors. The country transitions to more value addition through development, operationalization, and maintenance of several agro-industrial parks. Access and use of technology has much more improved. Literacy rate increases (above 87 percent) and the capacity to adopt technology has gone up. About 80 percent of the population have access to services such as electricity. The country's openness to trade has improved very much as revealed from contribution of trade to GDP (~70 percent compared to 31.4 percent in 2017). Overall efficiency or competitiveness has much improved (reached 5.5 from 3.78 in 2017).

Average life expectancy has significantly improved and reached 75 and 76 years for males and females, respectively. Disability Adjusted Life Years (DALYs) remain the same as that registered in 2016 (48 million) due to growing population despite improvements in health services. Major causes of deaths are non-communicable diseases. Physician density per 10 000 population has dramatically improved and reached 10. Fifteen hospital beds are available per 1 000 people. At least 80 percent of the population accesses sanitation services. Access to drinking water has improved to more than 90 percent.

Poverty rate reduces to under 10 percent. Prevalence of undernourishment (percentage of population) is 13 percent and number of severely food insecure people is about 15 percent.

Environmental protection has greatly improved and afforestation has increased. Rate of deforestation has declined. There is effective and good policy in place to protect biodiversity but due to population pressure, habitat reduction may occur. Rate of drought recurrence persists but ability to cope with challenges of climate change has much improved.

YE BEYI TEMELKACH

Rule of law worsens and lawlessness increases. Participation of citizens in decision-making and the situation of human rights is at lowest level. Infrastructure however is in much better shape than in 2015, due to the booming economy. Public services in general have worsened though, and there is high instability and level of corruption.

Ethiopia in *Ye Beyi Temelkach* is a middle-income country, due to the booming economy GDP per capita increases, however, so does inequality. There is a large gap between the rich and poor. Up to 50 percent of the population lives in urban areas.

The share of agriculture in GDP decreases while that of both services and industry grow. The contribution of agriculture to employment also decreases.

There are increased health services provided by the private sector that many people could not afford. Due to awareness raising, diseases associated with hygiene and sanitation decrease. There is an increase in non-communicable diseases.

Household income on average increases, though the income distribution is very unequal. The poverty rate decreases slightly.

Due to urbanization, increased industry and population growth, environmental pollution increases.

ERGIMAN

The government is highly unstable and heavily corrupt and the country's economy is fragile and collapsed. Safety of citizens is much worse and rule of law is not respected. Ethiopians hardly participate in or contribute to policy making processes and human rights. Authorities are corrupt and have little respect for human rights. Infrastructure is at its worst, public services are not readily available, those that are available are inaccessible, and human development is stagnant (declining human development index).

The country has remained among the low-income category countries, per capita income further deteriorating. Effective family planning is lacking and population is above 200 million. Fewer citizens live in urban areas due to higher emigration since the economy is degrading. There is much smaller middle class citizen compared to 2015, and the gap between the rich and the poor has become bigger.

Contribution of agriculture to GDP is much less in real terms because of instability though it remains the only means of subsistence. Agriculture also contributes less to employment as farmlands have become severely degraded and unproductive. The other sectors (e.g. industry and services) also provide less employment opportunities. Hence, unemployment rate is very high. Level of economic diversification is extremely low and technology mood is absent. Illiteracy is very high and there is no efficiency or competitiveness in any one of the economic sectors.

Life expectancy in *Ergiman* is low. Access to public health services has deteriorated. Communicable diseases such as tuberculosis, diarrheal diseases and respiratory diseases are major causes of death. Physician density per 10 000 population is only 0.2. Only 10 hospital beds are available per 10 000. About 90 percent of the population do not have access to basic sanitation services including drinking water.

Poverty is rampant and household income is much lower than 2015 levels. Poverty rate is also much higher (more than 50 percent of the population lives below poverty line). Prevalence of undernourishment among the population is nearly 60 percent and proportion of severely food insecure people is about 75 percent.

Ergiman is heavily polluted owing to lack of effective policy to protect the environment. There is increased desertification and deforestation. Arid/semiarid lands have become much less productive. Coping mechanism (resilience) is much worse. Rate of drought recurrence has worsened, ability to cope with challenges of climate change has very much deteriorated, and people live under state of persistent vulnerability.

A2. Description of cattle production systems

Dairy commercial – characterized by market-oriented dairy farms concentrated in the central highland plateau involving higher levels of investment. These are either small-, medium or large-scale farms. They specifically target urban consumers. This production system comprises only 2.5 percent of the total cattle population.
The average herd size varies between less than 30 (small-scale) and above 100 (large-scale) heads, mainly consisting of exotic and high-grade animals. Feed is based on hay, concentrated dairy mix and industrial by-products. Milk yield per cow is around 15-20 litres per day.

Feedlot – there are more than 300 feedlots operating in Ethiopia, predominantly in East Shoa (Oromia). Animals are entirely confined in a yard fitted with watering and feeding facilities for a finishing duration of 3-6 months. This production system comprises a minor share (<1 percent) of the cattle population. The average number of animals kept per batch varies between 100 and 1 500 heads, mainly consisting of Borana breed. Feed is based on agro-industrial by-products. Carcass weight is around 110 kilograms, with a dressing percentage of 45-48 percent.

Urban/Peri-urban (dairy and beef) – is an expanding production system mostly found in the highlands. It is largely concentrated in the Addis Ababa milk shed area as well as around the regional capital cities where there is an adequate market for fresh milk. Smallholder farmers and landless households around urban areas also fatten few animals at a time. Oxen are mainly fattened when they can no longer provide farm services (e.g. ploughing) and have to be replaced with younger ones. This production system accounts for 7 percent of the total cattle population. The average herd size is around 5-10 heads. Indigenous Zebu, high-grade and crossbred animals are kept. Feed is based on crop residues, some industrial by-products and supplements. Milk yield per cow is around 10-15 litres per day, and the average carcass weight is around 110 kilograms.

Mixed crop-livestock – a subsistence oriented farming concentrated in the mid- and high-altitude agro-ecological zones where cereals and cash crops are the dominant farm activities. Cattle are primarily kept to supply draft power, however milk is an integral part of production. Old oxen that retire from ploughing are commonly sold to fatteners or conditioned and finished on-farm. This production system accounts for 77 percent of the total cattle population. The average herd size is around four heads, typically indigenous breeds. Feed types include natural pasture, crop residues and weeds and crop thinning. Milk yield per cow is below 2 litres per day, and carcass weight is roughly 110 kilograms per slaughtered animal on average.

Pastoral/agro-pastoral system – rangeland based livestock production system that relies on natural or semi-natural vegetation. The main product is milk, the main function of livestock is subsistence; however, social and cultural functions are also important. Usually, pastoralists sell excess young bulls to highlanders (used as draught oxen) or to feedlot operators. This production system comprises 13.5 percent of the total cattle population. The average herd size is around 10–20 heads but herds of over 200 heads are common too. Only indigenous breeds/ecotypes are kept. Feeding is on communal pastures; crop residues are used to a limited extent in agro-pastoral areas. Milk yield per cow is around 1.5 litres per day. Households usually do not slaughter cattle for home consumption.

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