# Sentinel

Social and Environmental Trade-Offs in African Agriculture

Country Report
July 2022

# What are the social and environmental trade-offs in Ethiopian agriculture?

A contextual analysis report

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This contextual analysis has been carried out as part of the Social and Environmental Trade-offs in African Agriculture (Sentinel) project. This is a four-year research project that addresses the challenges of achieving Sustainable Development Goal (SDG) 2 (zero hunger), SDG 10 (reduced inequalities), and SDG 15 (ecosystem conservation) in sub-Saharan Africa.

This report was produced by the Environment and Climate Research Center (ECRC) at the Ethiopian Development Research Institute (EDRI), now the Policy Studies Institute (PSI). The report was compiled by Tagel Gebrehiwot (PhD), Hailemariam Teklewold (PhD), Yitatek Yitbarek, Robel Seifemichael and Sahleselassie Amare.

## Disclaimer

The opinions and interpretations expressed in this report are those of the Sentinel Ethiopia research team and do not necessarily reflect the views of the ECRC or PSI.

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# Acronyms and abbreviations

| | |
|---|---|
| ADLI | Agricultural Development-Led Industrialisation |
| AGP | Agricultural Growth Programme |
| CBD | United Nations Convention on Biological Diversity |
| CRGE | Climate-Resilient Green Economy |
| CSA | Central Statistical Agency |
| DHS | Demographic and Health Survey |
| ECRC | Environment and Climate Research Center |
| EDRI | Ethiopian Development Research Institute |
| FAO | Food and Agriculture Organization of the United Nations |
| FAOSTAT | Food and Agriculture Organization Corporate Statistical Database |
| FDRE | Federal Democratic Republic of Ethiopia |
| FEED | Feed Enhancement for Ethiopian Development project |
| FTC | Farmer training centre |
| GDP | Gross domestic product |
| GHG | Greenhouse gas |
| GNI | Gross national income |
| GTP I | Growth and Transformation Plan I (2010–2015) |
| GTP II | Growth and Transformation Plan II (2016–2020) |
| HICE | Household income, consumption and expenditure |
| ISFM | Integrated soil fertility management |
| IVR/SMS | Interactive voice response/short messaging service |
| LSI | Large-scale irrigation |
| LSLA | Large-scale land acquisition |
| MEFCC | Ministry of Environment, Forest and Climate Change |
| MoANR | Ministry of Agriculture and Natural Resources |
| MoFEC | Ministry of Finance and Economic Cooperation |
| MoWR | Ministry of Water Resource |
| NARS | National Agricultural Research System |
| NBSAP | National Biodiversity Strategy and Action Plan |
| NGO | Non-governmental organisation |
| PADETES | Participatory demonstration and training extension system |
| PASDEP | Plan for Accelerated and Sustained Development to End Poverty |
| PES | Participatory extension system |
| PIF | Policy and investment framework |
| PSNP | Productive Safety Net Programme |
| REDD+ | Reducing emissions from deforestation and forest degradation |
| Sentinel | Social and Environmental Trade-offs in African Agriculture |
| SLMP | Sustainable Land Management Project |
| SNNPR | Southern Nations, Nationalities and People's Region |
| SSI | Small-scale irrigation |
| TLU | Tropical livestock unit |
| UNCCD | United Nations Convention to Combat Desertification |
| UNCED | United Nations Conference on Environment and Development |
| UNFCCC | United Nations Framework Convention on Climate Change |

# Summary

Ethiopia is fundamentally an agrarian country. Although efforts to orient the economy towards manufacturing and industry are well underway, the agriculture sector continues to dominate Ethiopia's economy. It accounts for nearly 36% of gross domestic product (GDP), 73% of employment and 76% of export earnings (FDRE, 2016). The main objective of the agricultural sector in Ethiopia is to meet the ever-increasing demand for food, and create food reserves for emergency purposes as the country faces recurrent drought. However, agricultural production has failed to keep pace with the fast-growing population. Subsistence agriculture is renowned for its low productivity and for being prone to environmental tribulations. Production is highly dependent on rainfed agriculture yet farmers have little capacity to cope with climate-driven shocks which can have devastating impacts on household food security and poverty levels.

Ethiopia has long recognised the importance of transforming its agriculture sector for stability and long-term growth. Over two decades ago, Ethiopia put agriculture at the forefront of its economic development by launching its Agricultural Development-Led Industrialisation (ADLI) strategy. ADLI provides an overarching plan for economic development on the basis of agricultural transformation through increased productivity, production and product quality.

Ethiopia's economic development vision is now encapsulated in the government's Growth and Transformation Plan (GTP). GTP is an advanced strategy founded on the experience and practices of its Plan for Accelerated and Sustained Development to End Poverty (PASDEP) and is intended to sustain rapid and broad-based growth. Maintaining agriculture as a major source of economic growth is one of the fundamental principles of the GTP. The first GTP (GTP I) was developed in 2010–2011 and implemented between 2011 and 2015. It aimed to enhance smallholder farmers' productivity, improve input and output marketing systems, upgrade the participation of the private sector, increase the volume of irrigated land, and reduce the number of households with inadequate food. In 2015, the objectives of the GTP were revised for 2016–2020. GTP II laid out a plan for dramatic structural transformation, shifting from an agrarian economy to one more geared towards manufacturing and services. GTP II envisaged 11% average annual economic growth with an improved trade balance and higher foreign reserves. The aim was for the agriculture sector to contribute to the overarching goal of making Ethiopia a middle-income country by 2025.

Ethiopia is also a country rich in biodiversity and distinctive ecosystems. However, its biological resources are being negatively impacted by human activities. The country has undergone severe losses of forest habitat and biodiversity, especially around the long-inhabited highland areas. Assessments of this impact have indicated that forests have become depleted on a large scale as a result of the expansion of agriculture and settlement areas. However, large-scale forest destruction at the national level is not the only change: other major land-cover changes have also occurred at the local level. These changes play a pivotal role in the health and existence of forest ecosystems. There are several examples where biodiversity and forest habitats have been destroyed and much forest cover has been lost. Increased population pressure also greatly affects agriculture and ecosystems. The demand for food is increasing at an alarming speed, which consequently stresses the environment. Meeting this demand while maintaining the health and resilience of agricultural and natural ecosystems is one of the greatest challenges facing the country.

## Main findings

This contextual analysis has been carried out as part of the Social and Environmental Trade-offs in African Agriculture (Sentinel) project. It provides evidence to explain the social and environmental trade-offs, impacts and associated risks of different agricultural development pathways in Ethiopia.

- Cereals dominate Ethiopian agriculture with teff, wheat, maize, sorghum and barley accounting for more 81% of total cultivated area and 29% of agricultural GDP in 2016–2017 (14% of total GDP).
- Domestic cereal production increased by 99% between 2005 and 2016. Average cereal yield in Ethiopia reached 2.5 tonnes per hectare in 2016, indicating a 55% increase from 2005. However, average cereal yield in Ethiopia is still very low compared to other countries.
- In 2015–2016, the average landholding was about one hectare per household, showing a 10% decrease from 2007 to 2008. Sixty percent of smallholders in Ethiopia cultivate less than one hectare of land while about 40% cultivate less than half a hectare.
- There has been a rising trend in the adoption of modern agricultural inputs such as fertiliser and improved seeds. In 2015–2016, fertiliser-use intensity was found at 18.5 kilograms per hectare. But the adoption rate and intensity of modern inputs still remains low compared to other developing countries.
- Despite having a large diversity of biological resources, biodiversity in Ethiopia is being negatively impacted by human activities. Forests have become depleted at a large scale as a result of the expansion of agriculture and settlement areas.
- Agricultural expansion is the most significant economic driver of deforestation and biodiversity loss in the country. As a result, Ethiopia has been experiencing a high level of deforestation (about 163,000 hectares per year). Between 2000 and 2008 alone, agricultural land expanded by about four million ha, and 80% of this land was formerly forests, woodlands and shrublands. The annual average deforestation rate lies between 1.0 to 1.5%.
- Foreign direct investment (FDI) — particularly large-scale agricultural investments — are key economic drivers of agricultural expansion. The intensified transfer of land to large-scale commercial farms is being established in dense forest areas instead of grasslands or other lands with lower tree cover.
- Widespread poverty is also among the proximate causes of deforestation and biodiversity loss as poor communities depend on forests for sources of energy, food, timber and income.
- Increased population growth, age composition and population density are the primary underlying drivers for the increased demand for food, agricultural land and fuelwood.
- Climate change and climate variability are impacting ecosystems and biodiversity in Ethiopia. Increased heavy rainfall as a result of climate change can cause soil erosion, crop damage and waterlogging. The country loses more than 1.5 billion tonnes of fertile soil each year through heavy rain and flooding.
- Despite enhancing productivity, the increased use of agricultural technologies may be having a negative impact on ecosystem services such as soil fertility, water, biodiversity, air and climate. High-input agriculture requires increased use of fertiliser, pesticides and modern improved seeds. There are inefficiencies in fertiliser application and crop uptake, and the increase in fertiliser use has implications for soil fertility and greenhouse gas emissions. Excessive applications of pesticides also result in environmental pollution.

- The increased use of improved seed impacts on biodiversity as it threatens the maintenance of genetic diversity. Modern crop varieties have frequently displaced many local varieties and ultimately led to a loss of biodiversity.
- The rate of expansion of urban centres, industry, agriculture and agro-industries has been large and very fast. This accelerated change is occurring without adequate land-use plans or due consideration of the potential impacts. Consequently, important wetland ecosystems, high-potential arable lands, grasslands and forest areas have been converted to urban centres and industrial sites, with undesirable environmental and social consequences.

# 1. Agriculture: the heart of Ethiopia's economic development

Ethiopia is the second most populous country in Africa after Nigeria, with an estimated population of 104.9 million and a population growth rate of 2.5%, with 80% of people living in rural areas. Over 88% inhabit the highlands, where resources are exhausted and environmentally degraded. Geographically, the country is located between 33° and 48° east longitude and 3° and 15° north latitude and comprises an area of 1,104,300 square kilometres (111.5 million hectares). Of this, 74 million ha or 66% of the total area is deemed suitable for agriculture. The country has extreme climatic diversity ranging from equatorial rainforest in the southwest, to the desert-like conditions of the northeast. Ethiopia has a diverse topography, with elevations ranging from 125 metres below sea level and mountains exceeding 4,500m above sea level (Dankil depression and Ras Dashen), with diverse climatic conditions, soil types, flora and fauna.

Ethiopia is fundamentally an agrarian country. Although efforts to orient the economy towards manufacturing and industry are well underway, the agriculture sector continues to dominate. It accounts for nearly 36.3% of GDP, 73% of employment and nearly 76% of export earnings (FDRE, 2016). Major agricultural exports include coffee, sesame seeds and flowers. Furthermore, the majority of the agriculture sector is made up of smallholder farmers who live off less than one hectare of land.

Ethiopia has long recognised the importance of transforming its agriculture sector for stability and long-term growth. Over two decades ago, Ethiopia put agriculture at the forefront of its economic development by launching its Agricultural Development-Led Industrialisation (ADLI) strategy. ADLI provides an overarching plan for economic development on the basis of agricultural transformation through increased productivity, production and product quality. Over the last 17 years, ADLI has been the central pillar of Ethiopia's economic policy and each of its different strategies has had a five-year timeframe:

- Sustainable Development and Poverty Reduction Programme (SDPRP) (2000–2005)
- Plan for Accelerated and Sustained Development to End Poverty PASDEP (2005–2010)
- Growth and Transformation Plan (GTP I) (2010–2015) and GTP II (2016–2020).

Each strategy has recognised agriculture as the heart of the Ethiopian economy and has included a set of clear objectives and targets that aim to boost agricultural production, strengthen agricultural research and facilitate stronger market linkages.

The main objective of the agricultural sector in Ethiopia is to meet the ever-increasing demand for food, and create food reserves for emergency purposes as the country faces recurrent drought. However, agricultural production has failed to keep pace with the fast-growing population. Subsistence agriculture is renowned for its low productivity and for being prone to environmental tribulations. Production is highly dependent on rainfed agriculture yet farmers have little capacity to cope with climate-driven shocks which can have devastating impacts on household food security and poverty levels.

Over the past decade, the country has experienced sustained rapid and inclusive economic growth, averaging 10.4% per year since 2004 (USAID, 2017). Extreme poverty fell from 55% in 2000 to 33% in 2011. Ethiopia's rapid and sustained growth has been driven by agriculture and service sector growth, paired with massive public investment. The agriculture sector still continues to dominate the Ethiopian economy, accounting for nearly 36.3% of GDP, 73% of employment and nearly 76% of export earnings (FDRE, 2016). In 2016, the service sector accounted for about 43% of GDP while agriculture and manufacturing accounted for 41% and 4% respectively. Between 2004 and 2015, the agriculture and service sectors accounted for 3.6% and 5.4% of average annual growth, respectively. Over the same period, industry and manufacturing accounted for 1.7% of annual growth. However, over recent decades, the agricultural share of GDP has been steadily declining while the service sector's share has been growing.

Ethiopia is also a country rich in biodiversity and distinctive ecosystems. However, increases in population have greatly affected agriculture and ecosystems as the need for food has increased at an alarming rate. Ethiopia's population is expected to reach 143 million by the year 2037, which is 49% higher than the current population of the country (CSA, 2013b). However, in the face of climate change, the productivity of the agriculture sector has lagged behind the demand for food to feed the ever-growing population. The situation is greatly aggravated by natural hazards and low agricultural productivity, and farmers' coping capacity in relation to the changing environment is minimal.

In this report, we provide a contextual analysis for agriculture and environmental trade-offs in Ethiopia. We examine the agricultural system and ecosystems, historical trends, regional contexts and the current status of agricultural development and its social and environmental impacts. Furthermore, we explore key drivers (economic, demographic, cultural and religious, physical, scientific and technological, and sociopolitical) that influence ecosystems and agricultural systems. By and large, this report is meant to offer a framework in which to think about and examine long-term effects and trade-offs of policy disconnects across sectors.

The report was prepared by reviewing, analysing and synthesising the existing stock of knowledge. To complement this, data and information were gathered from official government data sources, such as the Ethiopian Central Statistical Agency (CSA) (agricultural sample survey for crop and livestock, input utilisation).

# 2. The dynamics of farming in Ethiopia

## 2.1 Types of farming systems in Ethiopia

A farming system is defined here as a group of individual farm configurations that broadly contain a similar resource base, enterprise patterns, household livelihoods and constraints; hence similar development strategies and interventions would be appropriate to enhance their growth potential (Dixon et al., 2001). Amede *et al*. (2017) classified 12 Ethiopian farming systems based on the available natural resource base and the dominant pattern of farm activities, household livelihoods and agroecology.

## 2.2 The dominance of cereal production

The agricultural sector in Ethiopia is currently composed of 12.6 million smallholder farmers (who operate on farms averaging 1.2 hectares each) and several hundred commercial farms. The combined annual crop production of these two groups of farms is 31 million tonnes, with 71% of this output comprising grains (cereals, pulses and oil crops) and the remainder being vegetables, fruits and cash crops (mainly coffee, sugarcane, chat and enset) (IFDC, 2015). Grain accounts for about 96% of the total cultivated land.

Ethiopia's crop agriculture is complex, involving substantial variation in crops grown across the country's different regions and ecologies (Taffesse et al., 2011). Cereals dominate Ethiopian crop production. The majority of farmers (95%) are involved in the production of cereals. Teff, wheat, maize, sorghum and barley are the major cereal crops in Ethiopia's agriculture and food economy, accounting for more than three-quarters of total area cultivated (81.3%) and 29% of agricultural GDP in 2016–2017 (14% of total GDP). There has been substantial growth in cereals in terms of area cultivated, yields and production over the past decade. However, yields are low by international standards and overall production is highly vulnerable to weather shocks, particularly droughts.

After cereals, the second most important crop group (in terms of acreage) is pulses. In 2016, total grain production averaged 290.4 million quintals per year, of which cereal crop production accounted for 87.4%, pulses 9.7% and oilseeds 2.9%. Table 1 shows a summary of annual cereal production, yield and land under cereal production from 2000–2016. Before cereal production started to increase, reaching a level of 25.4 million metric tonnes in 2016, it went through a trough, reaching a low of 3.81 million metric tonnes in 1975. Domestic cereal production increased by 99.1% from 2005–2016. Furthermore, the trend in crop yield has shown significant improvements over the last decades despite major food-crop yields being relatively low. In recent years, increases in yield per hectare have been more significant. Average cereal yield in Ethiopia reached 2,484 kilograms per hectare in 2016, indicating a 54.8% increase from 2005. But average cereal yield in Ethiopia is still very low compared to other countries. In a ranking of 177 countries by cereal yield, Ethiopia is 146th. On the other hand, land under cereal production has increased from 5.1 million hectares in 1980 to 10.2 million hectares in 2016, showing a 49.7% increase. By and large, strong growth in agricultural output has accrued predominantly from area expansion and intensification

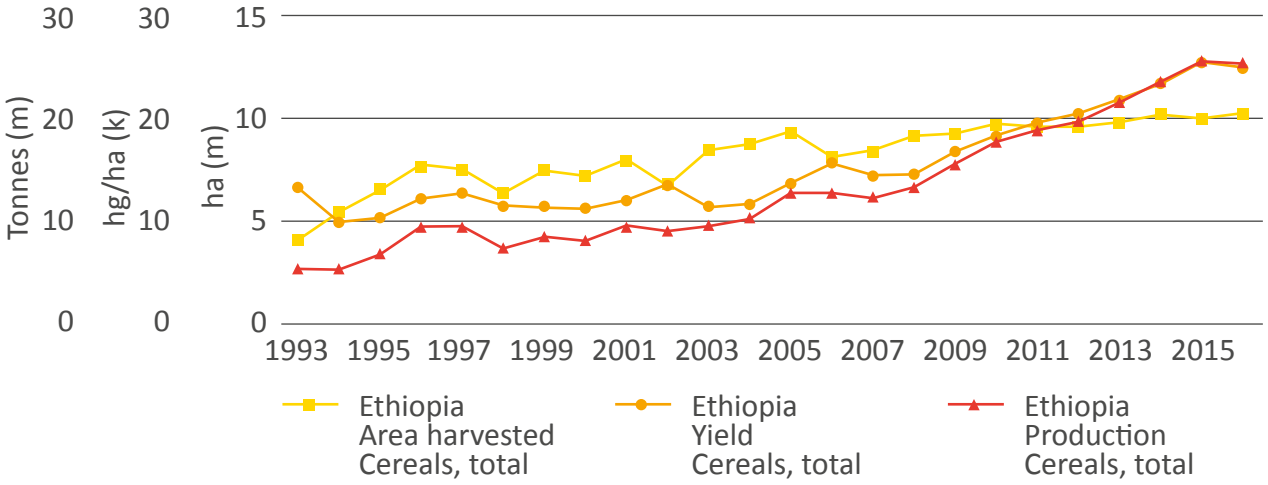
of cropping systems as opposed to large-scale improvements in productivity. Figure 1 shows cereal production from 1970–2016.

**Table 1. Cereal production, yield and land under cultivation from 2000–2016**

| Year | Production (metric tonnes) | Yield (kg/hectare) | Land under cultivation (hectares) |
|---|---|---|---|
| 2016 | 25,384,725 | 2,484 | 10,219,444 |
| 2015 | 25,495,127 | 2,556 | 9,974,316 |
| 2014 | 23,607,662 | 2,325 | 10,152,014 |
| 2013 | 21,575,457 | 2,193 | 9,835,052 |
| 2012 | 19,651,152 | 2,047 | 9,601,039 |
| 2011 | 18,809,963 | 1,962 | 9,589,012 |
| 2010 | 17,761,202 | 1,833 | 9,690,734 |
| 2009 | 15,534,229 | 1,683 | 9,233,024 |
| 2008 | 13,259,750 | 1,446 | 9,167,944 |
| 2007 | 12,235,743 | 1,439 | 8,502,791 |
| 2006 | 12,672,350 | 1,563 | 8,105,902 |
| 2005 | 12,749,986 | 1,361 | 9,365,022 |
| 2004 | 10, 140,082 | 1,623 | 8,722,142 |
| 2003 | 9,532,780 | 1,123 | 8,486,199 |
| 2002 | 9,000,335 | 1,354 | 6,648,807 |
| 2001 | 9,585,753 | 1,198 | 8,001,604 |
| 2000 | 8,019,830 | 1,116 | 7,184,230 |
| 1990 | 6,137,530 | 1,238 | 4,957,410 |
| 1980 | 6,403,227 | 1,261 | 5,079,000 |
| 1970 | 5,070,300 | 771 | 6,580,200 |
| 1961 | 4,203,000 | 715 | 5,882,000 |

Source: World Bank, Cereal production (Metric tons) - Ethiopia. https://data.worldbank.org/indicator/AG.PRD.CREL.MT?locations=ET

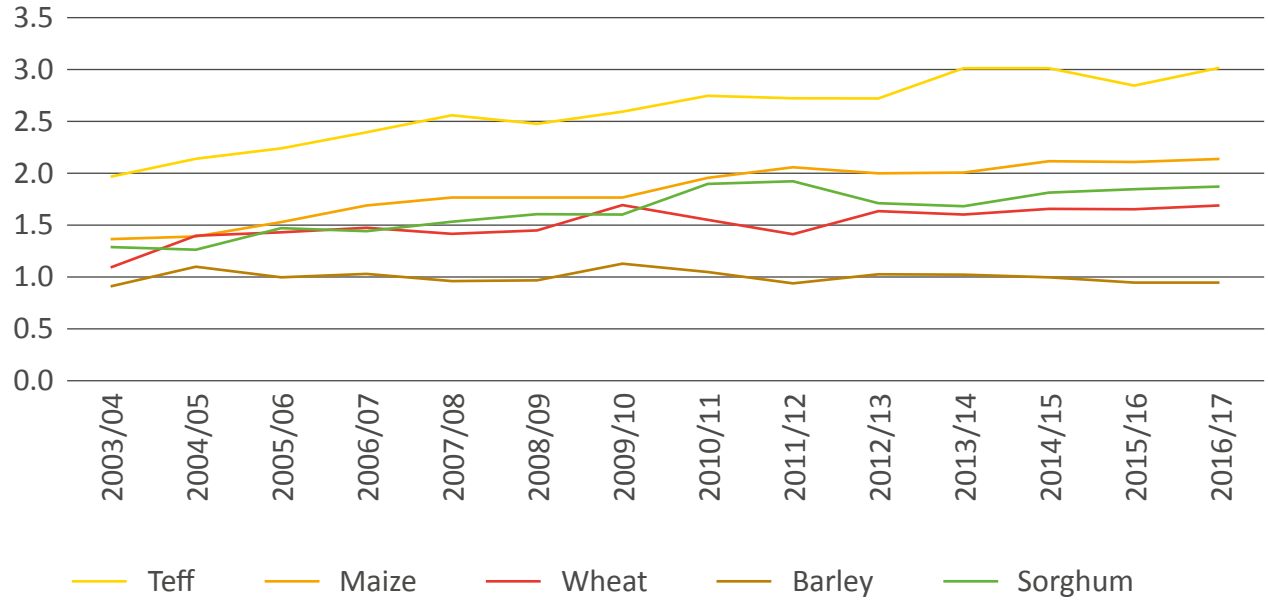
**Figure 1. Cereal production in Ethiopia (1961–2016)**




Source: FAOSTAT, Ethiopia. https://www.fao.org/faostat/en/#country/238

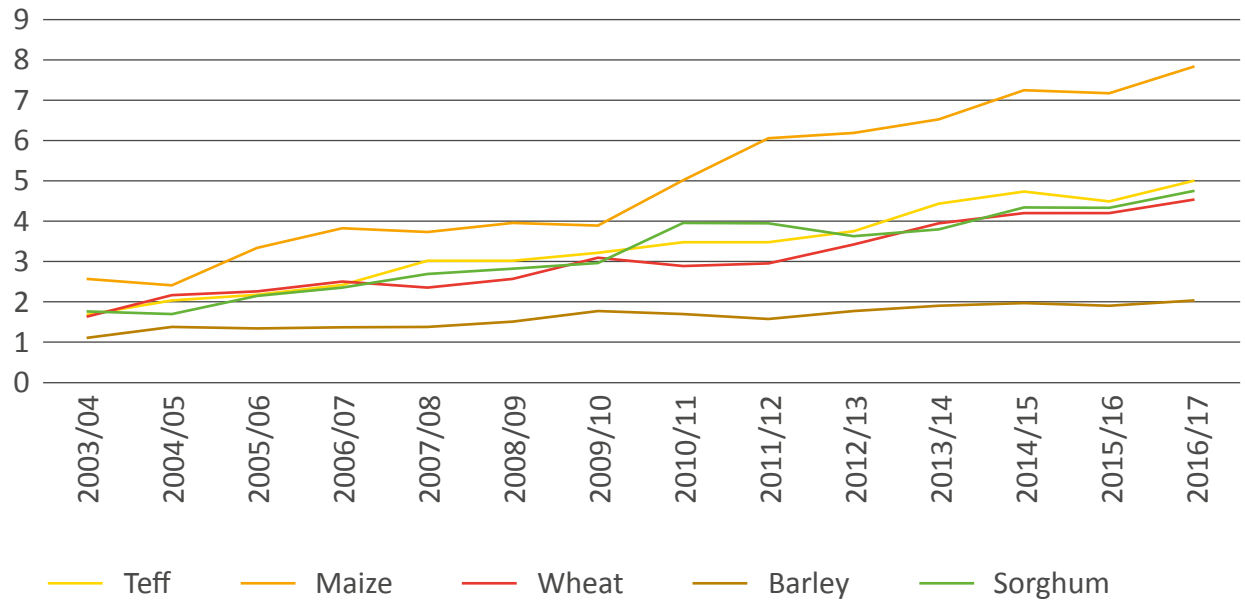
The cereal production system structure in Ethiopia reveals that cereal production is diverse in terms of crop type, farming technology and the scale of the farm enterprise. Figures 2 and 3 show the trend for area and production of the most important cereal crops. Both the area and production of these major cereal crops are on the rise but with different magnitudes. Since the start of the GTP I, the area allocated to teff, maize and wheat has grown by about 10% and production has increased 45–60%. The annual growth rate of the area allocated for teff, maize and wheat production has declined from about 2% a year before the GTP to an annual growth rate of 1% during the GTP.

**Figure 2. Area (million hectares) allocated for major cereal crops in Ethiopia (2003–2017)**




Source: CSA (2016). Agricultural sample survey 2015/2016 (2008 E.C). volume I report on area and production of major crops (private peasant holdings, Meher season), Central statistical agency (CSA), Addis Ababa. AND: CSA (2017a) Agricultural sample survey 2016/2017 (2009 E.C). volume I report on area and production of major crops (private peasant holdings, Meher season), Central statistical agency (CSA), Addis Ababa. https://www.statsethiopia.gov.et/our-survey-reports/

**Figure 3. Production (million tonnes) of major cereal crops in Ethiopia (2003–2017)**




Source: CSA (2016) Agricultural sample survey 2015/2016 (2008 E.C). volume I report on area and production of major crops (private peasant holdings, Meher season), Central statistical agency (CSA), Addis Ababa. AND: CSA (2017a) Agricultural sample survey 2016/2017 (2009 E.C). volume I report on area and production of major crops (private peasant holdings, Meher season), Central statistical agency (CSA), Addis Ababa. https://www.statsethiopia.gov.et/our-survey-reports/

Table 2 shows the average area and production levels of the main crops cultivated between 2007 and 2016. Cereals were grown on 81.3% of the total area cultivated from 2016–2017. Smallholder farmers produce a yearly average of 12 million tonnes of cereals, which is 68% of total agricultural production. In terms of land use, in 2015–2016 teff accounted for 28.7% of total cereal area, followed by maize (20.2%), sorghum (18.6%) and wheat (16.7%). The area under the major five cereal crops increased by 14.2% from 2007–2016. Table 3 also illustrates area and production of cereals by regions from 2007–2008 to 2015–2016.

In 2014, crop exports accounted for 74% of the export earnings of the country. Coffee leads the export revenue taking 23% of the share, followed by oilseeds (19.2%), vegetables and fruits (13.1%), pulses (8.6%) and flowers (6.4%). Export of cereals is insignificant since Ethiopia is a net importer of cereals. Despite its potential for crop production, Ethiopia has not been able to produce sufficient food for its growing population. Hence, it has been importing grain, cooking oil and other processed food. The country imported about two million tonnes of crop products in 2013 at a cost of US$ 1.34 billion (Emama et al., 2015). The money spent per year has increased since 2010. Import of cereal crops accounts for 77% of crop product imports, while import of wheat alone accounts for 62% of grain imports. In terms of value, cereal crop imports accounted for 50.7%, while wheat alone accounted for 34% of the import value of grain.

**Table 2. Area, production and yields of cereals in Ethiopia, 2007–2008 and 2015–2016**

| Cereal crop | 2007–2008 | | | | 2015–2016 | | | | Growth rate (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Area (000 hectares) | Production (000 tonnes) | Yield (tonnes/ ha) | Area share % | Area (000 hectares) | Production (000 tonnes) | Yield (tonnes/ ha) | Area share % | Area | Production | Yield | Area share |
| Teff | 2,565 | 2,992 | 1.2 | 29.4 | 2,866 | 4,471 | 1.6 | 28.7 | 11.7 | 49.4 | 33.7 | -2.2 |
| Maize | 1,767 | 3,749 | 2.1 | 20.2 | 2,111 | 7,150 | 3.4 | 21.2 | 19.5 | 90.7 | 59.6 | 4.6 |
| Wheat | 1,424 | 2,314 | 1.6 | 16.3 | 1,664 | 4,219 | 2.5 | 16.7 | 16.9 | 82.3 | 56.0 | 2.3 |
| Sorghum | 1,533 | 2,659 | 1.7 | 17.6 | 1,854 | 4,323 | 2.3 | 18.6 | 20.9 | 62.6 | 34.4 | 5.9 |
| Millet | 399 | 537 | 1.3 | 4.6 | 465 | 940 | 2.0 | 4.7 | 16.5 | 75.0 | 50.2 | 2.0 |
| Barley | 984 | 1,354 | 1.4 | 11.3 | 944 | 1,856 | 2.0 | 9.5 | -4.1 | 37.1 | 42.9 | -16.0 |
| Other | 54 | 107 | 2.0 | 0.6 | 67 | 167 | 2.5 | 0.7 | 24.1 | 56.1 | 25.8 | 8.6 |
| Total | 8,730 | 13,761 | 1.6 | 100 | 9,974 | 23,128 | 2.3 | 100 | 14.2 | 68.1 | 47.1 | |

Source: Calculated using CSA agricultural sample survey data, see: CSA (2017a) Agricultural sample survey 2016/2017 (2009 E.C). volume I report on area and production of major crops (private peasant holdings, Meher season), Central statistical agency (CSA), Addis Ababa

**Table 3. Area and production of cereals by regions in Ethiopia, 2007–2008 and 2015–2016**

| Regions | 2007–2008 | | | 2015–2016 | | | Growth rate (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Area (000 hectares) | Production (000 quintal) | Area share % | Area (000 hectares) | Production (000 quintal) | Area share % | Area | Production | Area share |
| Tigray | 709.83 | 10,026.22 | 8.1 | 752.29 | 14,380.79 | 7.6 | 6.0 | 43.4 | -7.2 |
| Afar | 17.04 | 401.29 | 0.2 | 4.21 | 71.12 | 0.0 | -75.3 | -82.3 | -78.4 |
| Amhara | 2,923.00 | 43,611.01 | 33.5 | 3,418.73 | 73,973.73 | 34.3 | 17.0 | 69.6 | 2.4 |
| Oromia | 4,051.53 | 68,620.65 | 46.5 | 4,679.26 | 117,225.10 | 47.0 | 15.5 | 70.8 | 1.1 |
| Somali | 75.74 | 711.85 | 0.9 | 67.19 | 1,675.83 | 0.7 | -11.3 | 135.4 | -22.3 |
| Benishangul-Gumuz | 142.47 | 2,244.61 | 1.6 | 162.95 | 3,774.49 | 1.6 | 14.4 | 68.2 | 0.1 |
| SNNPR | 785.38 | 11,172.37 | 9.0 | 864.24 | 19,804.74 | 8.7 | 10.0 | 77.3 | -3.7 |
| Gambela | 10.09 | 191.02 | 0.1 | 6.71 | 121.09 | 0.1 | -33.5 | -36.6 | -41.8 |
| Total | 8,715.08 | 136,979.02 | 100 | 9,955.58 | 231,026.89 | 100 | 14.2 | 68.7 | |

Source: Calculated using CSA agricultural sample survey data, see: CSA (2018) Agricultural sample survey 2017/2018 (2010 E.C). volume I report on area and production of major crops (private peasant holdings, Meher season), Central statistical agency (CSA), Addis Ababa

## 2.3 Categories of farmers

The Central Statistical Agency classifies Ethiopian farmers into two major groups: smallholder 'peasant' farmers and large commercial farmers. Smallholders are defined as those that cultivate less than 25.2 hectares and larger farms more than 25.2 ha. The majority of farmers in Ethiopia are smallholder farmers. The farms are often fragmented and produce food mostly for their own consumption and generate only a small marketed surplus.

Table 4 shows the average farm holding per household by region. According to CSA data, the land holding in Ethiopia averaged around 1.06 ha per household in 2015–2016 showing a 10.2% decrease from 2007–2008. This average is about 1.39b ha in Oromia indicating that the peasant farmers in this region are endowed with relatively larger landholdings compared to farmers in other parts of Ethiopia. The trend analysis also shows that farm landholdings decreased from 2007–2008 to 2015–2016. Sixty percent of smallholders in Ethiopia cultivate less than 0.9 ha of land. While 40% of farmers cultivate less than 0.52 ha, they manage only 11% of the total area cultivated. On the other hand, medium-sized farms, defined as those cultivating 0.9 ha or more, account for 75% of the total land cultivated.

**Table 4. Average farm holding per household by region, 2007–2008 and 2015–2016**

| Region | Average farm holding | | Growth rate |
|---|---|---|---|
| | 2007–2008 | 2015–2016 | |
| Tigray | 1.08 | 1.04 | -3.7 |
| Afar | 0.51 | 0.37 | -27.5 |
| Amhara | 1.31 | 1.16 | -11.5 |
| Oromia | 1.40 | 1.39 | -0.7 |
| Somali | 0.91 | 0.98 | 7.7 |
| Benishangul-Gumuz | 1.32 | 1.3 | -1.5 |
| SNNPR | 0.73 | 0.55 | -24.7 |
| Gambela | 0.52 | 0.45 | -13.5 |
| Ethiopia | 1.2 | 1.06 | -10.17 |

Source: Calculated using CSA agricultural sample survey data, see: CSA (2018) Agricultural sample survey 2017/2018 (2010 E.C). volume I report on area and production of major crops (private peasant holdings, Meher season), Central Statistical agency (CSA), Addis Ababa

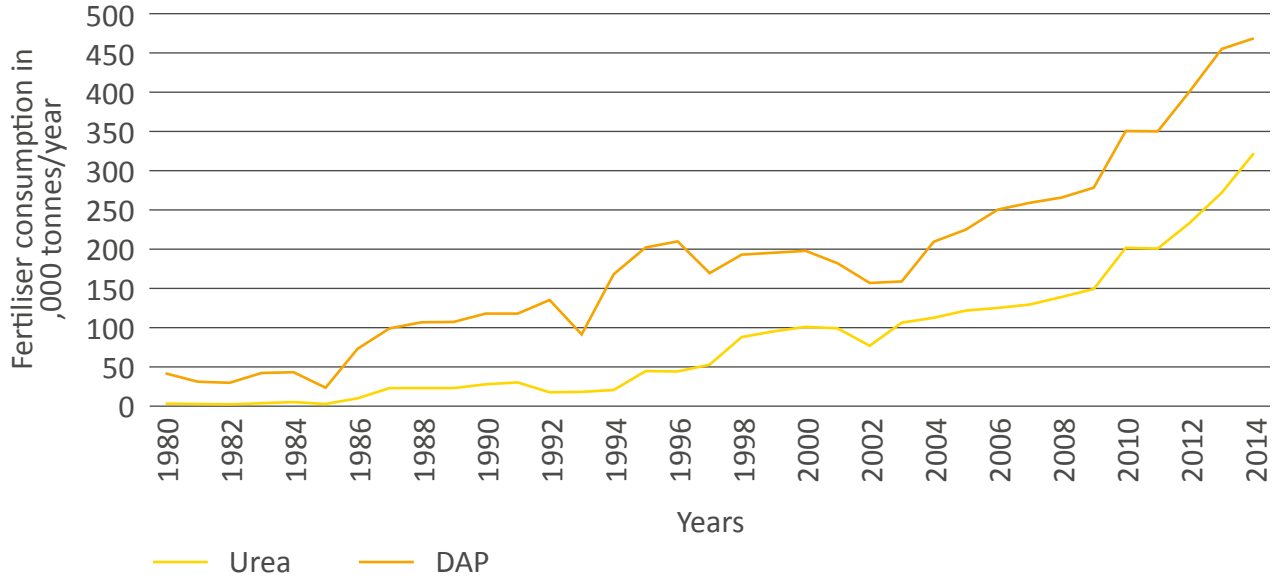
## 2.4 Agricultural inputs and barriers to adoption

The major extension services provided to farmers are the supply of fertiliser, improved seeds and pesticides. Despite the fact that adoption of agricultural inputs such as fertiliser and improved seeds has shown a rising trend over the past years in Ethiopia, it still remains low when compared to other developing countries (Byerlee et al., 2007; Spielman et al., 2011; ATA, 2015). A number of interacting poverty and productivity traps are constraining the wider use of agricultural inputs: limited availability and high cost of inputs, lack of varieties suitable to farmer needs, low levels and high variability of crop yields, and erratic and insufficient rainfall conditions. In addition, while other factors certainly play a role in influencing the adoption of new inputs, limited access to formal financial services (ie credit, savings and insurance) and the lack of formal credit facilities are often major impediments to the adoption of improved agricultural inputs in many developing countries, including Ethiopia (ATA, 2015).

Numerous varieties of modern seeds have been released in Ethiopia over the past decade. The uptake and use of chemical fertiliser in Ethiopia (primarily diammonium phosphate and urea) can be evaluated in terms of total fertiliser imported, percentage of farmers using fertiliser, and improved seed–fertiliser packages; the percentage of cultivated land under fertiliser application; and household-level estimates of fertiliser application per hectare. When measured in terms of quantity imported, fertiliser use in Ethiopia has steadily increased from 145,709 tonnes in 1990 to about 1**,**223,309 Mt in 2015 (Figure 4). Since 2010–2011, the number of farmers who have adopted improved crop varieties and the area covered with improved crop varieties has grown by about 13% annually.

Data on fertiliser use suggest that fertiliser use in Ethiopia is low. Only 39% of smallholders use fertiliser, which is significantly below recommended rates (Spielman et al., 2011). Teff, wheat and maize cultivation account for the majority of fertiliser use. However, data on application rates tell a slightly different story about the intensity of fertiliser use in Ethiopia. While consumption has in fact tripled in the past decade, it is still far behind other African and fast-developing countries. Fertiliser-use intensity, when measured in terms of kilograms per hectare of arable land, was estimated at 18.5kg/ha in 2015. Although Ethiopia's fertiliser consumption has fluctuated substantially in recent years, it increased from 2006, ending at 18.5 kg/ha in 2015. In a ranking of 161 countries by the amount of fertiliser consumed, Ethiopia is ranked 138th, similar to Eritrea and the Gabon. All fertiliser is imported by the Government of Ethiopia. The majority is distributed to smallholders through cooperatives on a credit basis, with a small balance being sold to commercial and state farms.

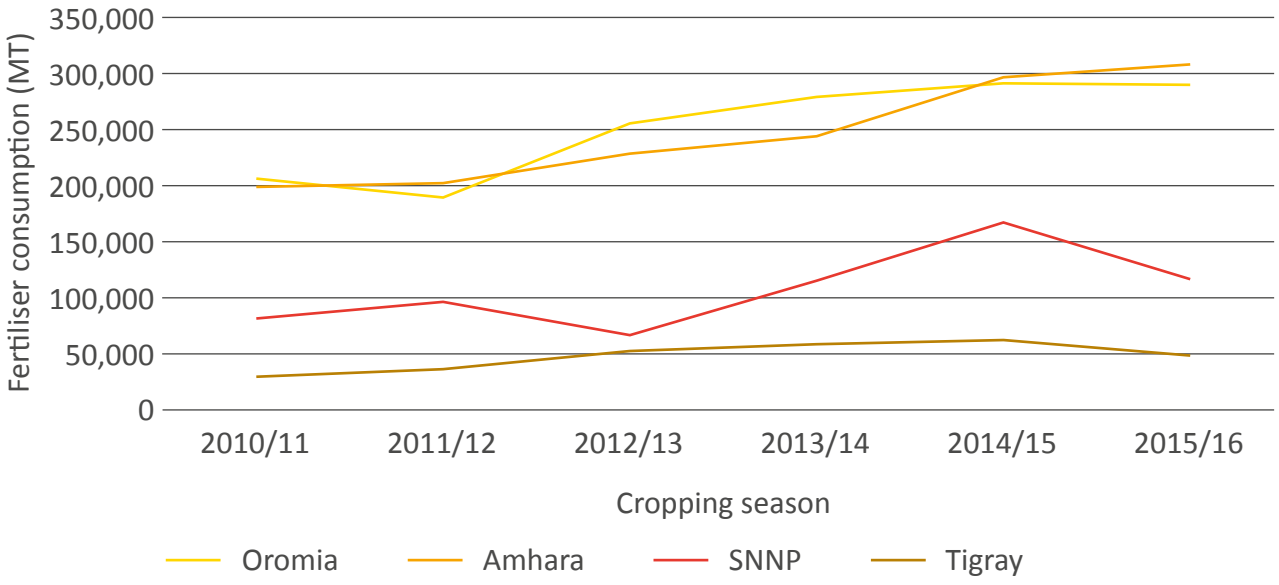
**Figure 4. Fertiliser consumption in Ethiopia (1980–2014)**




Source: adapted from IFDC (2015). Assessment of fertiliser consumption and use by crop in Ethiopia. https://africafertilizer.org/wp-content/uploads/2017/05/FUBC-Ethiopia-Final-Report-2016.pdf.

Given the large variability in farm size and the different types of farming systems in Ethiopia, different regions have different fertiliser consumption trends. The four major regions in Ethiopia (Oromia, Amhara, Tigray, and the Southern Nations, Nationalities and People's Region or SNNPR) consumed on average more than 94.8% of the fertiliser in Ethiopia (Figure 5). Among the four regions, fertiliser consumption is highest in the Oromia region (36.6%) followed by Amhara (35.8), SNNPR (15.5%) and Tigray (6.9%) (IFDC, 2015).

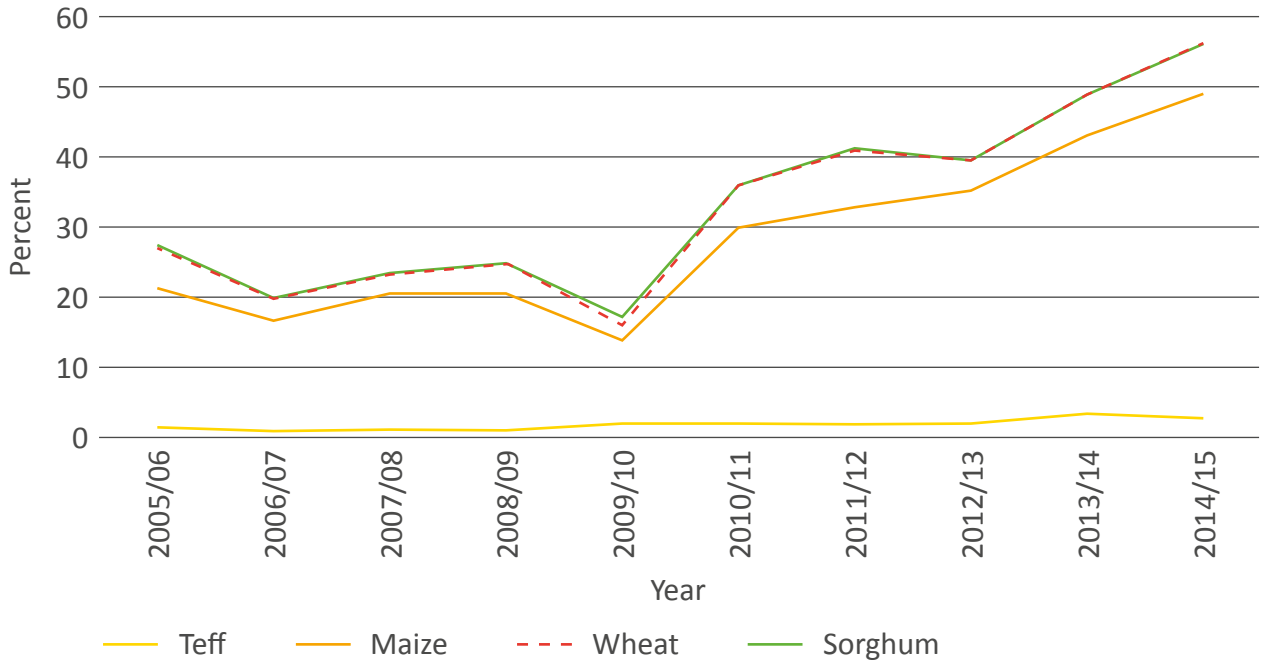
**Figure 5. Fertiliser use in major regions of Ethiopia (2010–2015 cropping seasons)**




Source: adapted from IFDC (2015). Assessment of fertiliser consumption and use by crop in Ethiopia. https://africafertilizer.org/wp-content/uploads/2017/05/FUBC-Ethiopia-Final-Report-2016.pdf.

On the other hand, adoption of improved seed has increased in recent decades. Official estimates from the CSA show that the total quantity of improved seed supplied nationally has been increasing since 1996 and the percentage of area covered by improved seeds has been increasing over time, especially since 2009 (Figure 6). However, the quantity of improved seeds used by farmers has not shown as much increase as the area covered. The intensity of improved seed use does not show much change over the last decade. Improved seeds of cereals and pulses are supplied to farmers through cooperatives, research stations and private seed suppliers.

**Figure 6. Percentage of area under improved seed application for main cereal crops (2005–2015)**




Source: CSA (2005 to 2015) Agricultural Sample Surveys: Volume III-Report on Farm Management Practices (Private Peasant Holdings, Meher Season). Addis Ababa, Ethiopia. https://www.statsethiopia.gov.et/our-survey-reports/

## 2.5 The increasing use of herbicides

Herbicides are increasingly being adopted as a response to labour shortages in rapidly transforming economies such as India and China. While agricultural and economic transformation is also happening in Africa (Reardon et al., 2015), it is estimated that only 5% of the cropped area of Africa receives applications of agrochemicals (Gianessi, 2013). Ethiopia is among those African countries in which adoption rates of agrochemicals by smallholders are highest (Sheahan & Barrett, 2014).

Herbicide imports in Ethiopia have increased fourfold in the last decade, although from a low base, with increasing use by smallholder farmers (Tamru et al., 2016). Imports of agrochemicals increased fivefold, from just below US$20 million in 2005 to over US$100 million in 2015. The biggest share of agrochemical imports are insecticides, making up US$52 million in 2015. The second-most-important agrochemicals are herbicides. The value of herbicide imports quadrupled over the last decade, from about US$5 million to about US$20 million (Tamru et al., 2016). Most insecticides are used in the flower industry. However, herbicides are not commonly used in that sub-sector.

Herbicides are the pesticides most used by smallholder farmers. Of the area cultivated in 2011, 23% was exposed to herbicide use. This compares to 1% for insecticides and 2% for fungicides. Herbicides are especially used on cereals — on an estimated 36% of the cereal area. Among cereals, herbicide use is most prevalent in teff and wheat, the most commercialised crops in Ethiopia. Herbicides were used on 46% and 60% of the area under these crops, respectively (Tamru et al., 2016). The cereal area to which herbicides were applied more than doubled over the last decade to more than a quarter of the cereal area cultivated in 2014. Herbicide use on cereals is found to significantly save on weeding, traditionally a major agricultural task. As a consequence, the increased use of herbicides has important implications for labour markets in rural Ethiopia, where the large majority of its population makes a living. The majority of herbicides available in Ethiopia are imported and distributed by the private sector.

## 2.6 Plant protection and integrated pest management

In Ethiopia, there are several conditions which have created a suitable environment for the introduction of new pest species and the spread of established pests. These include the effects of climate change, the wide use of imported agriculture technologies (including seeds from abroad), the weak regulation governing the movement of imported seeds that are then grown in-country and dispatched to different administrative regions, the increased area of investment, the movement of agricultural equipment, the expansion of irrigation agriculture, and repeated cropping due to availability of water.

Currently, emphasis is given to upgrading existing pest-management support services to provide these services with the capacity needed to meet the demands of Ethiopia's diverse and growing agriculture sector. The aim is to improve pest-management support services and interventions through robust monitoring, forecasting and early warning systems, which can reduce the introduction of new pest species and occurrence. In addition, a fast and modern technology-based pest occurrence information exchange will be developed, using an integrated SMS text messaging and web-based system. The GTP also focuses on building a government of skilled and committed professionals and support personnel at all levels, from district agriculture development offices up to the Ministry of Agriculture and Natural Resources. The GTP also aims to build the capacity of regional plant health clinics, and to develop annual plant protection packages and a national plant protection strategy to reduce the percentage of crop yield losses from 20–30% down to 10% (a key aim of the GTP).

## 2.7 Natural resource management

Land degradation presents a serious threat to food security and the sustainability of agricultural production and ecosystems in many developing countries. Over 75% of the total land area in Ethiopia is considered prone to soil degradation. Because smallholder agriculture is generally carried out in diverse stochastic conditions that make agricultural production unstable from year to year, various risks affect agricultural production and the welfare of farm households. Agricultural activities in Ethiopia are mainly rainfed but are frequently affected by floods, drought, pests and disease. It is often argued that the frequency and severity of droughts in Ethiopia has increased due to climate variability. Therefore, conserving soil and water and using the land sustainably

is an important way out of poverty and food insecurity and would alleviate a major obstacle to Ethiopia's ambitions to realise green and resilient economic growth.

Accordingly, natural resource management and sustainable utilisation are among the Government of Ethiopia's top development-agenda priorities (Emama et al., 2015). It is expected that sustainable natural resource management will reinforce an increase in production and productivity of the agriculture sector by ensuring there are opportunities to adopt sustainable land and water management systems. Government initiatives such as the national Sustainable Land Management Project (SLMP) and Productive Safety Net Programme (PSNP) aim to prevent and reverse arable and rangeland degradation, rehabilitate damaged agricultural areas and prevent further deterioration through better soil fertility management, introduce soil conservation measures, encourage reforestation, and adopt appropriate conservation agriculture methods.

## 2.8 Soil and water conservation

The Government of Ethiopia and donor agencies have been investing substantial resources in promoting sustainable land management as part of efforts to improve environmental conditions and ensure sustainable and increased agricultural production. The SLMP was launched in 2008 to address two of Ethiopia's most significant development and environmental problems: the decline in agricultural productivity and land degradation. The objective of the programme is to reduce land degradation, improve the agricultural productivity of smallholder farmers, and protect or restore ecosystem functions and diversity in agricultural landscapes. It consists of three parts: Watershed management, rural land certification and administration, and project management. The programme is being implemented in six regions of Ethiopia (Oromia, Amhara, Tigray, SNNPR, Benishangul and Gambela). The programme is currently working in 937 *kebeles* (wards) (of which 177 are critical watersheds) and 209 *woredas* (districts) to scale up and increase the adoption of appropriate sustainable land-management technologies tested for specific agroecological conditions.

So far, the programme has had a number of successes. For example, in Amhara, Oromia and Tigray about 77,000 hectares have been rehabilitated. A further 79,000 hectares of forest have been established as participatory forest-management sites and these are now managed in partnership with local communities. And approximately 50,000 households have adopted sustainable land-management practices. The SLMP is expected to contribute to the implementation of both the national REDD+ programme[1] and Ethiopia's Climate-Resilient Green Economy (CRGE) strategy.

A large share of the Ethiopian population relies on agriculture as a main source of income. Despite the importance of the agricultural sector and of the natural potential of the highland region, both soil fertility and agricultural yields remain low. The major causes of soil fertility decline are land degradation caused by soil erosion, deforestation, overgrazing, poor organic-matter management and continuous cultivation. Recent estimates of annual net erosion for areas above 1,000m elevation are about 18 tonnes/ha; this increases to about 20 tonnes/ha when only cropland is considered (Hurni *et al*., 2015).

[1] REDD+ stands for "reducing emissions from deforestation and forest degradation [REDD]; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries [+]".

The Ministry of Agriculture (MoA) and the Agricultural Transformation Agency (ATA) developed the Soil Health and Fertility Roadmap in 2011 and 2012 to address key soil fertility bottlenecks and transform the agriculture sector (Tamene et al., 2017). The government's vision is to achieve "a balanced soil health and fertility system that helps farmers possess and maintain sustained high-quality and fertile soils through the implementation of appropriate soil-management techniques, the provision of required inputs, and the facilitation of the appropriate enablers, including knowledge and finance" (ATA, 2015). So far, MoA has focused on the use of biofertilisers (beneficiary microorganisms/inoculants), vermicomposting and testing (identifying soil deficiencies), and substantial progress has been made.

Furthermore, an integrated soil fertility management project (ISFM+) was launched in 2015 in Amhara, Oromia and Tigray to increase agricultural productivity and reduce farmers' vulnerability. ISFM+ focuses on soil protection and rehabilitation in the Ethiopian highlands and aims at influencing the soil characteristics in ways that optimise plant growth and improve the availability of scarce nutrients. The integrated approach chosen makes use of farmers' own resources and farming practices, including conserving soil and water, and crop rotation in the fields. It targets wheat, maize and teff production. Through advice, capacity building and support provided by Ethiopia's agricultural extension services and agricultural bureaux, the project is expected to achieve wider use of ISFM technologies and increased crop yields.

## 2.9 Ethiopia's Productive Safety Net Programme

In 2005, the Ethiopian government and a consortium of donors initiated a large-scale social safety net programme called the Food Security Programme. Its cornerstone is the Productive Safety Net Programme (PSNP), which is aimed at providing long-term solutions to chronically food insecure households in the country (Debela et al., 2014). The goal is to offer multi-annual transfers, such as food, cash or a combination of both to chronically food insecure households to break the cycle of food aid. The PSNP provides direct income to poor households either as food or wages to those who are able to provide labour for public works projects. Households unable to work on public works receive unconditional direct support in the form of cash or food (Sharp et al., 2006; USAID, 2012). Public works projects consist of activities to improve livelihoods, such as rehabilitating land and water resources, rural road construction and/or maintenance, and building schools and clinics (WFP, 2012). The PSNP is a very large programme, with over 7.7 million beneficiaries in close to 60% of the country (Furtado & Hobson, 2011). The programme operates in Tigray, Amhara, Oromia, SNNPR, Afar, Somali, Dire Dawa, and Harare (WFP, 2012; Debela et al., 2014).

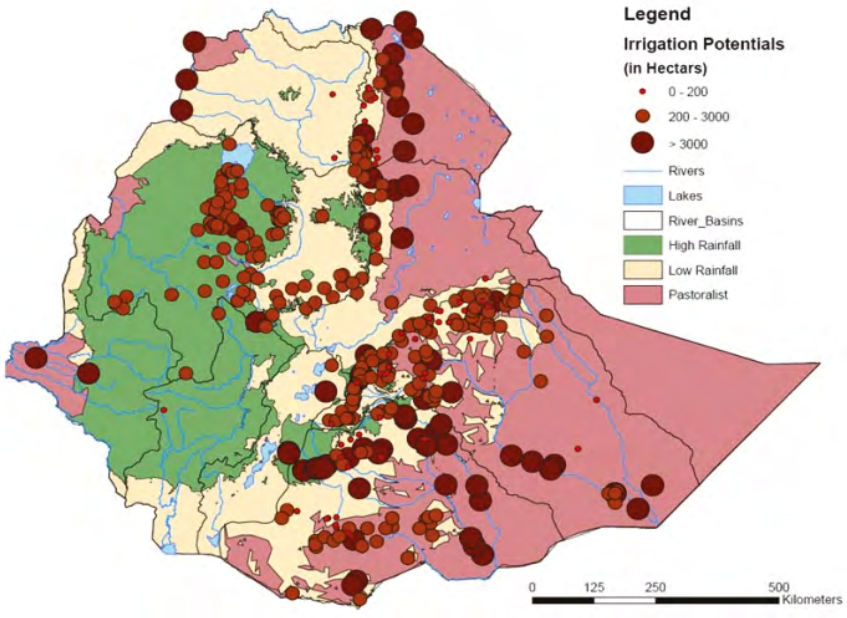
The public works programme has had positive impacts on environmental regeneration. Soil and water conservation activities have significantly contributed to the rehabilitation of natural resources such as land, water, vegetation and biodiversity (MoA, 2015). PSNP public works have already seen an increase in the water table and a significant and visible increase in timber and herbaceous vegetation cover as well as broadened diversity of plant species. The public work interventions have reduced soil loss. Gully rehabilitation and reclamation have provided more cultivated areas or areas for pasture production. Studies have reported that participation in PSNP has increased crop productivity and encourages households to increase investment in trees (Andersson et al., 2011; MoA, 2015).

## 2.10 Investing in irrigation

Unreliable rainfall, recurrent drought and the limited use of available water resources, coupled with heavy reliance on rainfed subsistence agriculture have contributed adversely to the economy of Ethiopia. Enhancing public and private investment in irrigation development has been identified as one of the core strategies aimed to de-link economic performance from rainfall and to enable sustainable growth and development (MoFED, 2006). In government policy documents, irrigation development is identified as an important tool to stimulate sustainable economic growth and rural development and is considered as a cornerstone of food security and poverty reduction (MoFED, 2006). Irrigation is expected to contribute to the national economy in several ways: it enables smallholders to adopt more diversified cropping patterns, and to switch from low-value subsistence production to high-value market-oriented production (Hagos et al., 2007).

There are about 15 million hectares of agricultural land in Ethiopia currently under cultivation (Awulachew et al., 2010). Despite this, the size of potential and actual irrigated areas has not been precisely investigated. Estimates of irrigable land in Ethiopia vary between 1.5 and 4.3 million ha, averaged to about 3.5 million ha (Awulachew et al., 2007; Makombe et al., 2011) (Figure 7). For the existing cultivated area, Awulachew et al. (2010) estimate that only about 4–5% is irrigated, with existing equipped irrigation schemes covering about 640,000 ha. This indicates that a significant portion of cultivated land is currently not irrigated.

**Figure 7. Irrigation potential**

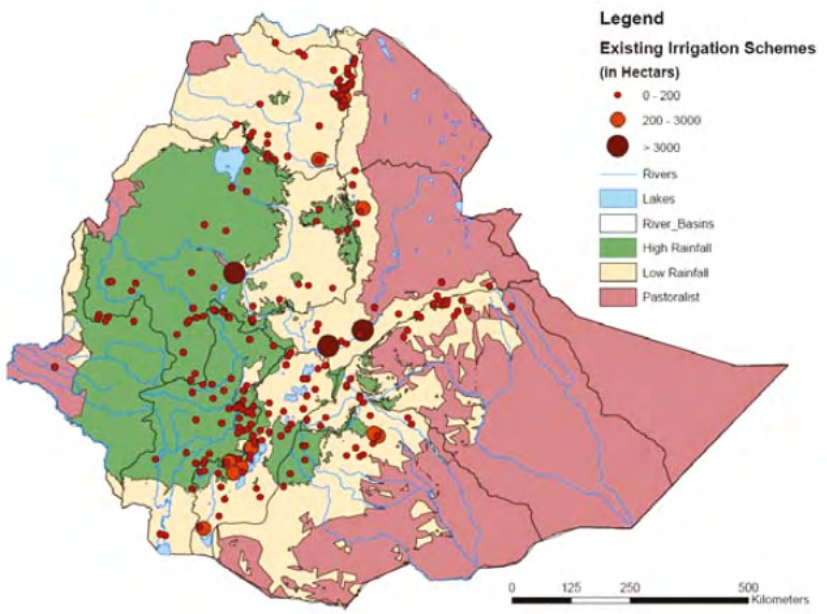



Source: Awulachew, SB, Erkossa, T and Namara, RE (2010) Irrigation potential in Ethiopia: constraints and opportunities for enhancing the system. International Water Management Institute.

Different irrigation development schemes are ongoing across the country (Figure 8). These include small-scale irrigation schemes (SSIs), which are often community-based and use traditional methods, covering areas of less than 200 ha. Examples include household-based hand-dug wells, shallow wells, flooding (spate), individual household-based river diversions and other traditional methods. Medium-scale irrigation (MSI) is community-based or publicly sponsored, covering 200

to 3,000 ha, and large-scale irrigation (LSI) covers areas of more than 3,000 ha and is typically commercially or publicly sponsored (Awulachew et al., 2010). Examples of LSIs include the Wonji-shoa, Methara, Nura Era and Fincha irrigation schemes.

**Figure 8. Existing irrigation development**




Source: Awulachew, SB, Erkossa, T and Namara, RE (2010) Irrigation potential in Ethiopia: constraints and opportunities for enhancing the system. International Water Management Institute.

## 2.11 Ethiopia's agricultural marketing system

With regard to market structure, the Government of Ethiopia liberalised the fertiliser sector soon after the end of the Derg regime in 1991. The government has introduced new policies to intensify cereal production, accelerate agricultural growth and achieve food security under ADLI, its national economic strategy. During the 1990s, ADLI set in motion a series of reforms that sought to liberalise markets for agricultural products and promote the intensification of food staple production through the use of modern inputs, especially seed and fertiliser packages (FDRE, 2006; 2002).

The structure of the national agricultural market system can be viewed in terms of the marketing channel, type and role of market participants, market infrastructure and finance. Agricultural marketing involves producers, product collectors/assemblers at farm level, local traders, brokers/agents and wholesalers in transitory or terminal markets (such as Addis Ababa, Ethiopian Grain Trade Enterprise), processors, retailers, consumers and exporters (Emama et al., 2015).

- **Producers:** Crop producers are largely private smallholder farmers and commercial farmers, as well as state farms. Agricultural products are supplied to local markets from local supply or imports (including commercial imports and food aid). Producers sell to local traders, village collectors, wholesalers, cooperatives/unions, and consumers.
- **Brokers/agents:** Brokers specialise in bringing buyers and sellers together. They buy produce from producers and/or wholesalers to sell to other wholesalers, processors and retailers. They

also disseminate price and other market information and play a leading role in influencing agricultural trade and price formation in towns, especially Addis Ababa. In the absence of standardisation, public information or legal contract enforcement, brokers act as inspectors and guarantors of each transaction, especially in grain and vegetable marketing.

- **Traders (wholesalers or retailers):** Wholesalers are major actors in grain and vegetable marketing channels. Wholesalers could be regional wholesalers who supply produce from surplus areas, or farmers, assemblers or other traders who sell produce to central markets. Wholesalers located in areas with scarce supply purchase in bulk from wholesalers in areas with surplus produce or from central markets. In the case of grain, a government parastatal such as the Ethiopian Grain Trade Enterprise is also considered a wholesaler. Nowadays, cooperatives and cooperative unions also act as wholesalers (when they collect and sell in bulk) or retailers (when they distribute in smaller quantities to consumers).
- **Retailers:** Retailers are traders who buy produce from wholesalers and producers to sell directly to consumers.
- **Processors:** Processors of agricultural produce include, for example, grain mills, food processors, breweries, the malt industry, bakers, meat processors, leather factories, juice processors and cooking oil producers. They can be private or government-owned and sell to traders or consumers.
- **Cooperatives:** Agricultural marketing cooperatives and consumer cooperatives are involved in buying and selling agricultural produce. They stabilise produce prices by competing with traders. As a result, traders pay higher prices to producers. They also protect consumers by stabilising retail prices (Emama et al., 2015).

## 2.12 Agricultural expansion and biodiversity loss

Ethiopia is one of the world's most biodiverse countries. Due to the variation in climate, topography and vegetation, its ecosystems range from humid forest and extensive wetlands to the desert of the Afar Depression. Ethiopia possesses an estimated 6,000 species of higher plants, of which 10% are endemic. The country has 284 species of wild mammals and 861 species of birds. Data on other wild animals are scarce and the number of reptiles, fish, amphibians and arthropod species identified so far are 201, 200, 63 and 1,225 respectively. Of these, 29 species of wild mammal, 18 species of bird, ten species of reptile, 40 species of fish, 25 species of amphibian and seven species of arthropod are endemic to Ethiopia (FDRE, 2014). The country is endowed with ten ecosystems as well as 18 major and 49 minor agroecological zones that are inhabited by a great diversity of animal, plant and microbial genetic resources, making the country one of the world's biodiversity hotspots (FDRE, 2014). The provisioning of forest ecosystem services (for example, the contribution of forest-based insect pollinators to the value added to the agriculture sector or the contribution of protected areas to the tourism industry) contributes 6.77% of GDP and provides value-added services to other sectors, particularly agriculture (UNEP, 2016).

Ethiopia's biodiversity is related to the various ecosystem types across the country: the Afroalpine and Subafroalpine ecosystems; the Montane Grassland Ecosystem; the Dry Evergreen Montane Forest and Evergreen Scrub Ecosystem; the Moist Montane Forest Ecosystem; the Acacia-Commiphora Woodland Ecosystem; the Combretum-Terminalia Woodland Ecosystem; Lowland

Tropical Forest Ecosystem; Desert and Semi-desert Scrubland Ecosystem; Wetland Ecosystem; and Aquatic ecosystem.[2]

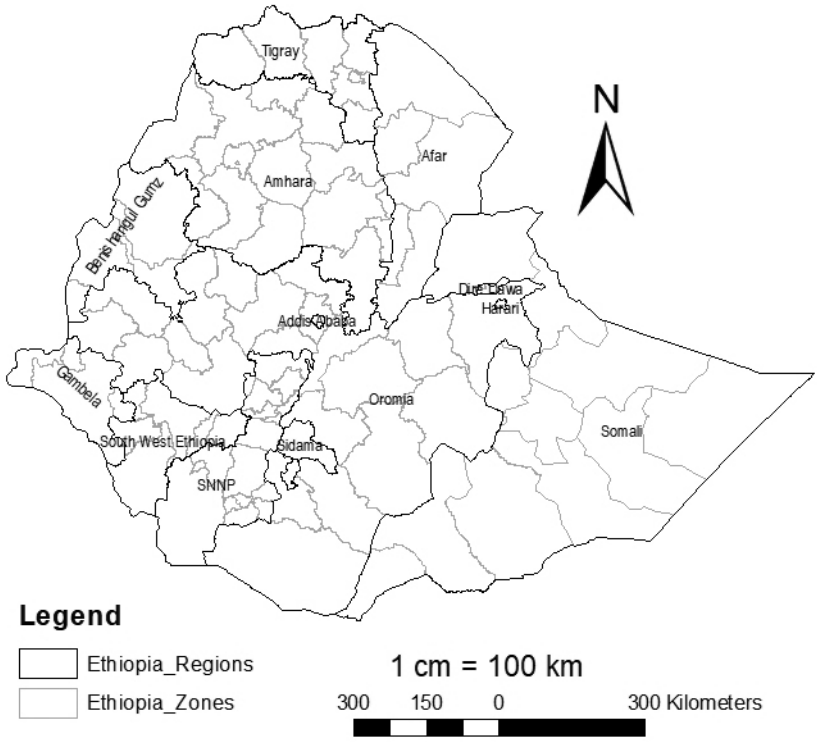
Biodiversity can be split into different components, such as field crop diversity and forest plant diversity. The major field crops grown in Ethiopia are classified into four groups: cereals, pulses, oil seeds and industrial crops. Field crops such as barley, sorghum, durum wheat, finger millet, fava bean, linseed, sesame, safflower, chickpea, lentil, cowpea and grass pea have a large genetic diversity in Ethiopia. But five major cereals (teff, wheat, sorghum, barley and maize) make up the country's building block of agricultural production and food security, covering about three-quarters of cultivated land. The country is a centre of origin for cultivated crops such as coffee, teff and enset, and a centre of diversity for durum wheat, barley and sorghum. The genetic diversity of Ethiopian coffee has a significant economic value in terms of breeding potential for sustaining the world's coffee production. A study estimates the economic value of Ethiopian coffee genetic resources at between US$420 million and US$1,458 million (Gatzweiler et al., 2007). However, the status of field crop diversity is currently declining at an alarming rate. Local farmers' crop varieties are being replaced by new improved and genetically uniform varieties which are believed to give better yields. The major threats to field crop diversity are the replacement of farmers' varieties by a few genetically uniform crop cultivars, invasive species, drought and climate change. Native barley and durum wheat are probably among the most threatened by new improved/introduced varieties and/or replacement by other crop species such as forage oats and bread wheat, which are expanding within the cereal-growing highlands.

Despite housing a large diversity of biological resources, biodiversity in Ethiopia is being negatively impacted by human activities. Assessments of this impact have indicated that forests and biodiversity have become depleted on a large scale as a result of the expansion of agriculture and settlement areas. However, large-scale forest destruction at the national level is not the only change: major land-cover changes have also occurred at the local level (Woldeamlak, 2002). These local-level changes play a pivotal role in affecting the health and existence of forest ecosystems.

Ethiopia has undergone severe losses of forest habitat and biodiversity, especially around the long-inhabited highlands area. There are several examples of where biodiversity and forest habitats have been destroyed and forest cover lost. This is the harsh reality that the country is exposed to in the face of climate-related challenges and increased population pressure and food demand. Although the loss of forest cover in the country is well documented, the extent of destructive activities on a national scale is not and the country lacks regular forest-cover change assessments (CIFOR, 2015). However, there are several location-specific studies that shed light on the extent of deforestation taking place in the country (ibid). The REDD+ readiness preparedness plan estimated annual forest clearing rates for the country's three most-forested regions at 1.16% in Oromia, 1.28% in Gambela and 2.35% in the SNNPR (FDRE, 2011) (see Figure 9 for the regions). A comparison of Landsat 7 satellite imagery between 2000 and 2013 also shows an average annual forest loss of 84,882 hectares; the largest losses were in the Combretum-Terminalia dry lowland woodlands and the second-largest losses were in the moist Afromontane forests in the highlands (FDRE, 2016).

[2] For more information on Ethiopia's ecosystem types, see https://et.chm-cbd.net/biodiversity/ecosystems-ethiopia

**Figure 9. Ethiopian administrative regions and zones**




In Ethiopia, agricultural production is characterised by complex mixed crop and livestock systems. Changes in landscape due to agriculture, urban sprawl and transportation infrastructure are generally recognised as major causes of the loss of biodiversity. Agricultural expansion is the most significant driver of deforestation and loss of forest biodiversity in Ethiopia (FDRE, 2011; CIFOR, 2015). Hence, agriculture is a threat to the levels of biodiversity and ecosystem services vital to human endeavours and from which agriculture itself benefits. In the 20 years prior to 2014, it is reported that crop production more than doubled while the overall production area also increased by 88% (Franks et al., 2017). In a few years alone (2000–2008), 80% of new agricultural land came from the conversion of forests (including woodlands) and shrublands (FDRE, 2011).

Although there are no studies that look at the rate of biodiversity loss at a national level, local-level studies show that agricultural expansion has a profound effect on biodiversity loss. Muzein (2006) reported that agriculture alone was the driving force for 83.4% and 70.1% of the natural vegetation loss in Abijatta-Shalla Lakes National Park and in Ziway-Hawassa Basin respectively from 1973 to 2000. Alemu et al. (2015) similarly found that woodland cover in the three districts of the northwest lowlands of Ethiopia (Humera in Tigray, Metemma in Amhara and Sherkole in Benishangul-Gumuz) has decreased at an average rate of 2833.8 hectares per year due to the agricultural expansion from 1985 to 2010.

The expansion of commercial farms is also increasing through large-scale farms and private-sector investments. Large-scale commercial agricultural investments are expanding in the Benishangul-Gumuz, Gambela and the SNNPR regions. In addition, state-owned investments in sugarcane plantations such as the Kuraz Sugar Development project in South Omo and other parts of the country are also factors that cause the clearance of large areas of forest and woodlands. For example, from 2002–2012, 1.7 million hectares of land were allocated to large-scale commercial farms. Unfortunately, agroecological requirements for the crops commonly grown on commercial

farms overlap with the country's forested areas (Benishangul-Gumuz, Gambela and the SNNPR) instead of other lands with lower tree cover (CIFOR, 2015; Vuorinen et al., 2016; Franks et al., 2017). Growth in agriculture continues to accelerate, and it is expected that agricultural lands could occupy an additional million hectares of land in the near future. Deforestation is also a major threat to biodiversity and many ecosystem services and is closely linked to agricultural expansion (Chaplin-Kramera et al., 2015).

Ethiopia's protected areas account for an estimated 14% of the country's land (FDRE, 2015a) and generate substantial tourism opportunities and ecosystem services. These areas, found throughout the country's diverse landscapes, are vital for the maintenance of biological diversity, forest resources and water-provisioning services, and can contribute to economic development. A recent study estimated the value of ecosystem services provided by protected areas to be around US$325 million per year (Van Zyl, 2015). However, many protected areas in Ethiopia are threatened due to drivers such as human settlements within parks or adjacent to them, deforestation, mineral extraction and forest fires. Invasive alien species are also driving the loss of biodiversity. They compete with native species for food and habitat and alter the physical environment in ways that exclude native species. Other drivers include climate change, the replacement of farmers' varieties and breeds, and pollution (solid and liquid). Indirect drivers include demographic change, poverty and low levels of awareness and lack of coordination among multiple stakeholders working on biodiversity.

Given Ethiopia's huge biodiversity resource and the lack of proper documentation of both its potential and its alarming losses, the implications of biodiversity loss in Ethiopia are far reaching. The literature on the benefits of biodiversity circles around three key features: productivity, yield stability and environmental fluctuation. Ecologists widely argue that greater diversity is associated with increased biomass and productivity of ecosystems (Tilman & Downing, 1994; Tilman, 1996; Tilman et al., 2012). In addition, economists show that multispecies ecosystems are also found to reduce the implication of price and production risk (Di Falco & Chavas, 2009). Recent studies have also found that the effect of diversity on productivity depends on rainfall, thus agrobiodiversity has a larger impact at lower precipitation levels (Di Falco & Chavas, 2008).

Individual farmers may tend not to invest in conserving biodiversity because they do not understand its wider benefits. However, genetic erosion in crops occurs because optimal choices made by individual farmers in response to global trends result in levels of crop biodiversity below a socially optimal threshold (Van Dusen, 2005). Harlan (1972) and Frankel (1970) warned against the extensive displacement of landraces they had observed during the early years of the Green Revolution, particularly in the more favourable agronomic environments where high-yielding varieties were adopted first.

However, a number of studies indicate that smallholder farms are still huge reservoirs of genetic material. For instance, about 127 varieties of seven crops are maintained by just 380 households in a village in Ethiopia (Bezabih, 2008). Based on this, biodiversity conservation requires concerted effort to incentivise farmers and a thorough documentation of genetic erosion in the country in response to extensive introduction of modern agricultural inputs particularly improved seed

# 3. The social impacts of agricultural development

The Ethiopian government gives high priority to agricultural and rural development as being important and effective strategies to achieve broad-based economic growth, food security and poverty reduction. In the following chapter, we consider the pros and cons of Ethiopia's policies to promote pro-poor agriculture, inclusive growth and gender equality in farming. We also discuss the socioeconomic impacts of large-scale agricultural investment in the country.

## 3.1 Pro-poor policies to improve productivity and efficiency

Ethiopia's agriculture and rural development policy framework is based on the ADLI concept. It is the central pillar of the country's long-term development vision since 1990. ADLI is the government's overarching policy response to Ethiopia's food security and agricultural productivity challenges. ADLI strategy focuses on small farms productivity growth as well as labour-intensive industrialisation. This strategy has been justified. Agriculture is now the largest sector in terms of output, employment and exports. This is significant because the bulk of the poor live in rural areas. Considerable gaps exist between rural and urban areas across key dimensions of human wellbeing including health, education and income. The potential to increase agricultural productivity and therefore tackle poverty is substantial (Diao, 2010).

The Government of Ethiopia introduced its Agricultural Growth Programme (AGP I, 2011–2015) in 2011 with the objective of improving agricultural productivity and enhancing production efficiency of smallholder farmers. The AGP aims to increase household income which in turn is expected to improve food security, nutrition and health. The AGP also includes multisectoral sub-projects such as constructing roads and markets, establishing small-scale and micro-irrigation systems, watershed management, soil fertility management (through lime production and application), small-scale animal husbandry, fisheries, livestock breed improvement. Some of the anticipated benefits of AGP II (2016–2020) include:

- Improving extension services for smallholder farmers including capacity-building activities to increase production and productivity,
- Providing clear and measurable benefits in terms of productivity, household income, production diversification and improved household diets through small-scale irrigation (SSI) and micro-irrigation sub-projects,
- Ensuring existing SSI schemes provide enough water for continuous small-scale irrigation during the dry season to increase yield, cropping intensity and irrigated land area,
- Implementing watershed-based soil and water conservation sub-projects to reduce land degradation, improve water flow for SSIs and micro-irrigation sub-projects, and improving the sustainability of irrigation schemes and technologies by protecting them from flood damage and siltation,
- Improving community incomes and livelihoods by implementing different farmer group and community sub-projects,
- Improving the capacity of implementing institutions to better manage projects,

- Improving the sustainability of sub-projects by considering environmental and social safeguarding issues in the project cycle management, and
- Improving community-level participatory project planning, implementation, monitoring and evaluation.

## 3.2 Using agricultural growth to reduce poverty

Agriculture is a key driver for Ethiopia's long-term economic growth and food security. Given that 80% of Ethiopians and more than 90% of the poor live in rural areas, the direct impact of agricultural growth on food security and poverty reduction is significant.

Ethiopia's economic model has succeeded in generating growth that is relatively inclusive. Poverty has declined over time. Improvements in agricultural productivity mean that the proportion of people living below the poverty line (US$1.90) declined from 45.5% in 1995–1996 to 23.5% in 2015–2016 (see Table 7). The proportion of households living in poverty has fallen both in rural and urban areas, although greater reductions have been observed in rural areas since 2005. The 2015–2016 household income, consumption and expenditure (HICE) survey report indicated that food poverty (the inability to purchase enough food to supply 2,200 kilocalories per day) declined from 45.5% in 1995–1996 to 24.8% in 2015–2016. Disaggregated data between rural and urban areas shows that over the same period, food poverty in rural areas reduced from 47.5% to 27.1% while urban food poverty declined from 33.2% to 15.2 (NPC, 2017). The reduction in poverty is higher in rural areas. Poverty reduction was highest in places where agricultural output growth was greater, where safety nets had been introduced, and where improvements in market access had been made (Hill & Tsehaye, 2018). There has been a significant decline in the rural poverty rate, and the low and relatively stable rural Gini coefficients in Ethiopia indicate the benefits of agricultural growth for the majority of Ethiopia's rural population (Diao, 2010).

However, levels of malnutrition are still high, particularly in rural Ethiopia. This is mainly owing to food shortages, although recent evidence shows that "wasting [low weight for height], which is a short-term indicator of child malnutrition, decreased from 12% in 2000 to 10% in 2016" (CSA, 2017b). The prevalence of stunting, a long-term measure of child malnutrition, has also decreased considerably from 58% in 2000 to 38% in 2016, an average decline of more than one percentage point per year. The prevalence of underweight has consistently decreased from 41% to 24% over the 16-year period (CSA, 2017b). However, the prevalence of stunting, underweight and wasting is higher among children in rural areas compared to urban areas. The Ethiopian Demographic and Health Survey (DHS) report shows a substantial spatial variation of undernutrition in Ethiopia. Amhara, Benishangul-Gumuz, Afar and Dire Dawa are most highly affected by child stunting (41–46%), whereas wasting is worse in in Somali, Afar and Gambela, with rates of 23%, 18% and 14%, respectively (CSA, 2017b).

## 3.3 Promoting gender equality in agricultural development

The Government of Ethiopia is strongly committed to promoting gender equality and women's empowerment, and has adopted a number of institutional and policy measures that support these goals. The 1997 Ethiopian Constitution, the 1993 Ethiopian National Policy on Women, the 2005 Family Law, and GTP I and GTP II are among the milestones that aim to further improve gender

equality and empowerment. To strengthen accountability, the government also recently issued proclamation No. 916/2015 that requires all government institutions to address women's issues in policies, laws and development programmes and projects (FDRE, 2015c).

Unequal gender norms limit Ethiopian women's ability to innovate, own land, control resources and income, access credit and engage in leisure pursuits (Drucza and Abebe, 2017). An estimated 46% of all working women (aged 15–49) are engaged in agricultural occupations, although this figure increases to 57% in rural areas (CSA, 2012b). In terms of productivity, male-managed plots produce on average 23% more per hectare than female-managed plots and 10% of this gap is explained by differences in land management, land attributes and unequal access to agricultural assets (Aguilar et al., 2014). The main covariates that explain unequal returns by gender are unequal access to extension services, the field's distance from the house, reduced use of technical inputs (such as fertilisers), livestock use, land size (average land size managed by the holder is 0.68 ha for women and 1.19 ha for men), product diversification and years of schooling (Aguilar et al., 2014).

The government policy emphasises the important role women play in Ethiopia's development agenda. The Ethiopia's GTP II (2015/16–20/1920) was an ambitious development plan that aimed to increase agricultural productivity and production and to maintain at least 8% of total agricultural production growth. One of nine core pillars of GTP II is to "promote women and youth empowerment, ensure their participation in the development process and enable them to equitably benefit from the outcomes of development" (FDRE, 2016). The aim of the gender pillar is to "strengthen the empowerment of women so as to ensure their active participation in the political, social and economic processes that are taking place in the country" (ibid). According to Ethiopia's agricultural sector policy and investment framework (PIF) (2010–2020), "removing gender disparity and ensuring gender equality and women's empowerment is a key to accelerated economic growth and social development (FDRE, 2010)". Gender equality, like agricultural development, is important for Ethiopia's development. However, despite many development gains, Ethiopia lags behind other African countries with a similar growth trajectory on gender indexes. The 2014 Gender Inequality Index (GII) ranks Ethiopia 129 out of 155 countries which reflects the loss in human development due to inequality between female and male achievements (Human Development Report, 2015).

At a micro level, poverty and institutional constraints act as stumbling blocks to the productivity of women. The essence of focusing on disadvantages in terms of wealth and gender groups stems from the weight of evidence on the biases against poorer, vulnerable and female-headed households. In terms of land resources, the bias against female-headed households is well documented. In general, in Africa women are often disadvantaged in both statutory and traditional land tenure systems (Agarwal, 1994; Lastarria-Cornhiel, 1997; Kevane and Gray, 1999). Across Africa in particular, women's rights to property often derive from men in the household and their use of the land is consequently constrained by the choices of men[3] (Quisumbing, 1996; Crummy, 2000; Yngstrom, 2002).

[3] In many cases, widows are dependent on their late husbands' relatives, or on men in their own family, to provide land.

For Ethiopia too, the land-ownership patterns of female-headed households are different from those of male-headed households in three major ways. One is that formal titling of women to land ownership is a fairly recent phenomenon. Previously, women could inherit land from their parents or deceased husbands; they could not, however, claim ownership upon divorce or be included in village redistribution schemes if they did not already own land (Gebreselassie, 2005). Even with recent legislations that ascertain their entitlement to redistributed land and right to claim land upon divorce, making effective claims has been less than successful. Upon divorce, for instance, asking for part of the land, although a legal right, may lead to alienation by community members. It might also be impractical in situations where a woman is married to a man in a different village than her home village, since dividing up the land might require the woman to live outside her home village, in which instance asking for her share of the land is impractical. Similarly, upon the death of her spouse, although it is the woman who generally inherits the land, her husband's family might be inclined to interfere in the management and lease of the land.

Even with land acquired through the process of large-scale land investment, the spillover benefits seem to be biased against poorer and vulnerable households. The process of large-scale land acquisitions is seen by many (especially NGOs), as a threat to the livelihoods of those who are already living in poverty (see for example Richards (2013), Schoneveld et al. (2011)). For opponents of the scheme, large-scale land acquisition is equated to 'land-grabbing' by large-scale investors at the expense of small-scale landholders. Such direct transfer of land is believed not to benefit smallholders, as such schemes largely focus on growing crops for exports at the expense of subsistence crops (Shepard and Mittal, 2009).

Another constraint for female-headed households in Ethiopia is that women are restricted in making full use of their own labour for agricultural purposes. There is a taboo against women undertaking major farming activities (Gebresilassie, 2005). This effectively bars them from managing their own land, resulting in a heavy reliance on leasing out land for production.

## 3.4 Unpacking the socioeconomic impacts of large-scale investments

In the early 2000s, the Government of Ethiopia focused on smallholder production and establishing linkages with large-scale commercial agriculture, trade and foreign investment. The government promoted large-scale agricultural investment as a strategy to improve food security at the national level, to increase foreign exchange earnings, and to improve incomes through jobs created on farms (Keeley et al., 2014). This policy shift was demonstrated most significantly in 2002 and 2003 with the enactment of investment proclamations and new regulations governing incentives for foreign and domestic investors (Rahmato, 2011). Accordingly, a number of large-scale agricultural investments took place in different parts of the country where there was a huge potential for agricultural production and large areas of arable land suitable to both small-scale and large-scale commercial farming. According to the Ethiopian Investment Agency, 3.5 million hectares of land were allocated for large-scale investments between 1996 and 2008. The largest share of land was allocated specifically in the lowland regions of Benishangul-Gumuz, Gambela and the SNNPR.

There have been several motivations for foreign investments in large-scale land acquisitions. In the mid-2000s, most African, Latin American and Central and Southeast Asian countries actively responded to interests from private and governmental investors from Western, Asian and Gulf countries in acquiring shares of agricultural land (Mann & Smaller, 2010). Spikes in food prices in 2007–2008 in foreign-investor countries led to a surge of large-scale land acquisitions (LSLAs) (Cotula et al., 2009; von Braun & Meinzen-Dick, 2009). Motivated by the improved business climate in many countries of the global South, and by population growth and rising income levels in their home countries (Baumgartner et al., 2015), foreign investors began to acquire land to produce biofuels or outsource food production for their home country (Mann & Smaller, 2010).

From the host-country perspective, LSLAs have divided opinion among academics and development practitioners. Positive contributions include improved employment opportunities, income, increased labour productivity, food security, nutrition, improved access to technology and improved physical infrastructure (von Braun & Kennedy, 1994; Otsuka & Yamano, 2006; Cotula et al., 2009). However, negative impacts include increased poverty, and/or social marginalisation, the loss of identity and inter-and intra-community conflict (Smaller & Mann, 2009; Guillozet & Bliss, 2011; HLPE, 2011; Borras & Franco, 2012; Richards, 2013; Cotula et al., 2014; Shete & Rutten, 2015). This conflicting set of findings points to the massive remaining gap in terms of concrete empirical evidence on the impact of such LSLAs on local livelihoods.

For Ethiopia, however, both anecdotal and empirical evidence points to negative outcomes. Most foreign large-scale land investments have negatively affected local populations in several dimensions. For example, in Ethiopia there are no investor regulations that require the hiring of local labour (Besada, 2017). As such, not all projects provide employment opportunities and many rural labourers are engaged with casual contracts with implications for employment insecurity (Rahmato, 2011).

Furthermore, large-scale farms have negative impacts on the environment, with implications for rural livelihoods. Degife and Mauser (2017) reported that large-scale agricultural investments have caused adverse environmental impacts in the Gambela region, particularly due to forest clearances, and wetlands and biodiversity are declining. Forest and reserved areas are allotted to investors without environmental impact assessments (EIAs) nor community consent. As a result, both the destruction of natural resources and the endangerment of local livelihoods and assets were observed (Degife & Mauser, 2017). Land allocations in some lowland areas also have the potential to significantly undermine pastoralist systems, as access to important water resources is lost (Keeley et al., 2014). Another issue is that due to LSLAs, many smallholders and pastoralists lose their lands and are forced to migrate to neighbouring areas.

Meanwhile, corruption and bribery is rife due to the lack of information and coordination between regional and federal government offices (Degife & Mauser, 2017). This poses great obstacles for ensuring the integrity and effectiveness of initiatives related to natural resource management. The government's contentious policy of 'villagisation' (a land reform and resettlement programme) has displaced hundreds of thousands of Indigenous People in order to free up their land for large-scale land acquisitions. The loss of access to fertile land, water and other essential natural resources has had a negative impact, particularly on Indigenous and local people's livelihoods and their ability to produce their own food, leading to food insecurity and a dependence on food aid (Degife & Mauser, 2017).

# 4. Drivers influencing ecosystems and agricultural systems

## 4.1 Economic drivers

Ethiopia's rapid and sustained growth has been driven by agriculture and service sector growth, paired with massive public investment. In 2016, the Ethiopian service sector accounted for about 39.3% of GDP while agriculture and manufacturing accounted for 36.3% and 21.6%, respectively. Between 2005 and 2016, the agriculture and service sectors accounted for 3.6% and 5.4% of average annual growth, respectively. Over the same period, industry and manufacturing accounted for 1.7% of annual growth. Over the past decades, the agricultural share of GDP has been steadily declining while the service sector's share of GDP has been growing (Table 5).

### 4.1.1 The impacts of pursuing economic growth

The major share of the gross national income (GNI) is supplied by agriculture. In the 1980s and 1990s, agriculture accounted for 52.5% and 49.6% of GNI, respectively. This share has, however, declined to 36.3% in 2016 (Table 5). The sector contributed 11.3% to GDP growth rate and grew by 2.3% in the fiscal year 2015–2016. In 2015–2016, the agricultural sector exhibited a slower growth rate of 2.3% compared with the 8.2% target, mainly due to contraction in grain crop production largely due to the El Niño effect.

**Table 5. Agricultural sector contribution to real GDP growth (%)**

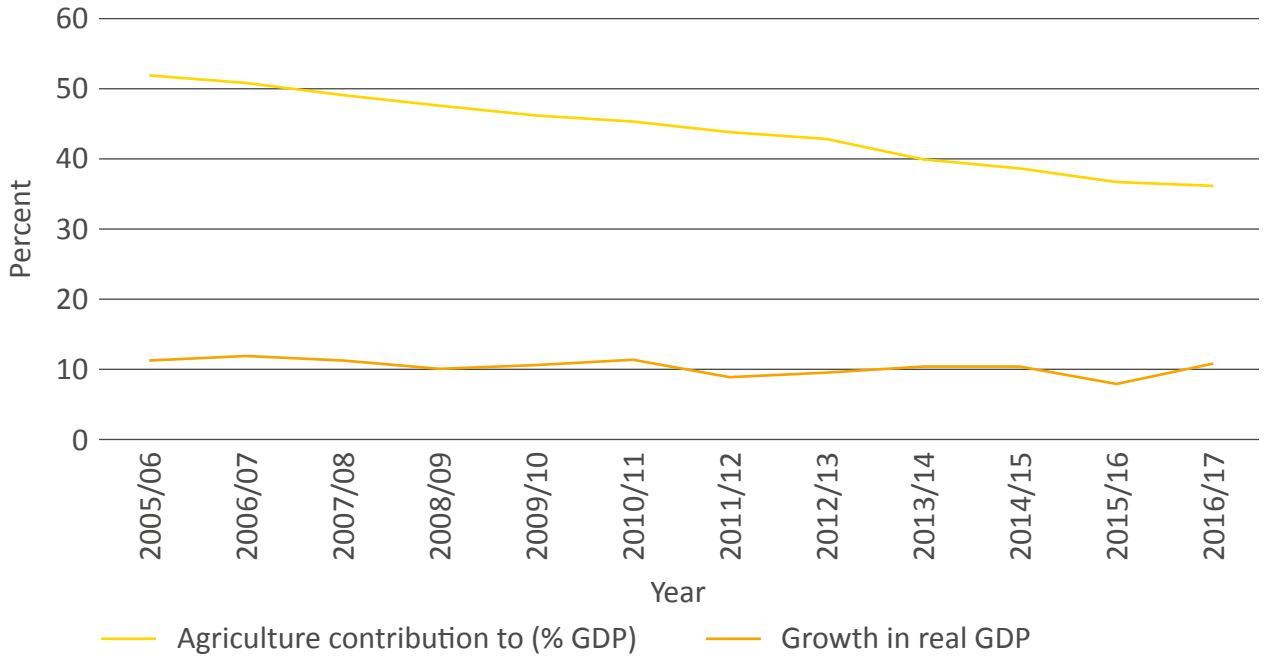
| Fiscal year | Agriculture | Industry | Services | Growth in real GDP |
|---|---|---|---|---|
| 1980s | 2.70 | -0.10 | 0.20 | 3.4 |
| 1990s | 0.90 | 0.80 | 1.00 | 4.6 |
| 2000/01 | 44.6 | 13.1 | 43.4 | 11.3 |
| 2005/06 | 52.0 | 10.6 | 38.4 | 11.5 |
| 2006/07 | 50.9 | 10.4 | 37.6 | 11.8 |
| 2007/08 | 49.1 | 10.3 | 41.3 | 11.2 |
| 2008/09 | 47.5 | 10.2 | 42.8 | 10.0 |
| 2009/10 | 46.2 | 10.3 | 43.8 | 10.6 |
| 2010/11 | 45.3 | 10.7 | 44.1 | 11.3 |
| 2011/12 | 43.7 | 11.5 | 44.9 | 8.8 |
| 2012/13 | 42.7 | 12.4 | 45.0 | 9.7 |

| Fiscal year | Agriculture | Industry | Services | Growth in real GDP |
|---|---|---|---|---|
| 2013/14 | 40.2 | 13.8 | 46.6 | 10.3 |
| 2014/15 | 38.7 | 15 | 47 | 10.4 |
| 2015/16 | 36.7 | 16.7 | 47.3 | 8.0 |
| 2016/17 | 36.3 | 25.6 | 39.3 | 10.9 |

Source: NBE (2017). National Bank of Ethiopia (NBE): Annual Report 2016/17

The greatest share of agricultural sector output in the fiscal year 2015–2016 was crop production, comprising 71.9%, followed by animal farming and hunting (19.5%) and forestry (8.4%). In terms of growth rate, crops and forestry increased by 3.4% and 2.2% respectively; while animal farming and hunting went down by 1.5%. The industrial sector showed a 20.6% annual growth rate and accounted for 16.7% of GDP. The agricultural sector contributed 36.7% to the overall economic growth during the fiscal year (Figure 10).

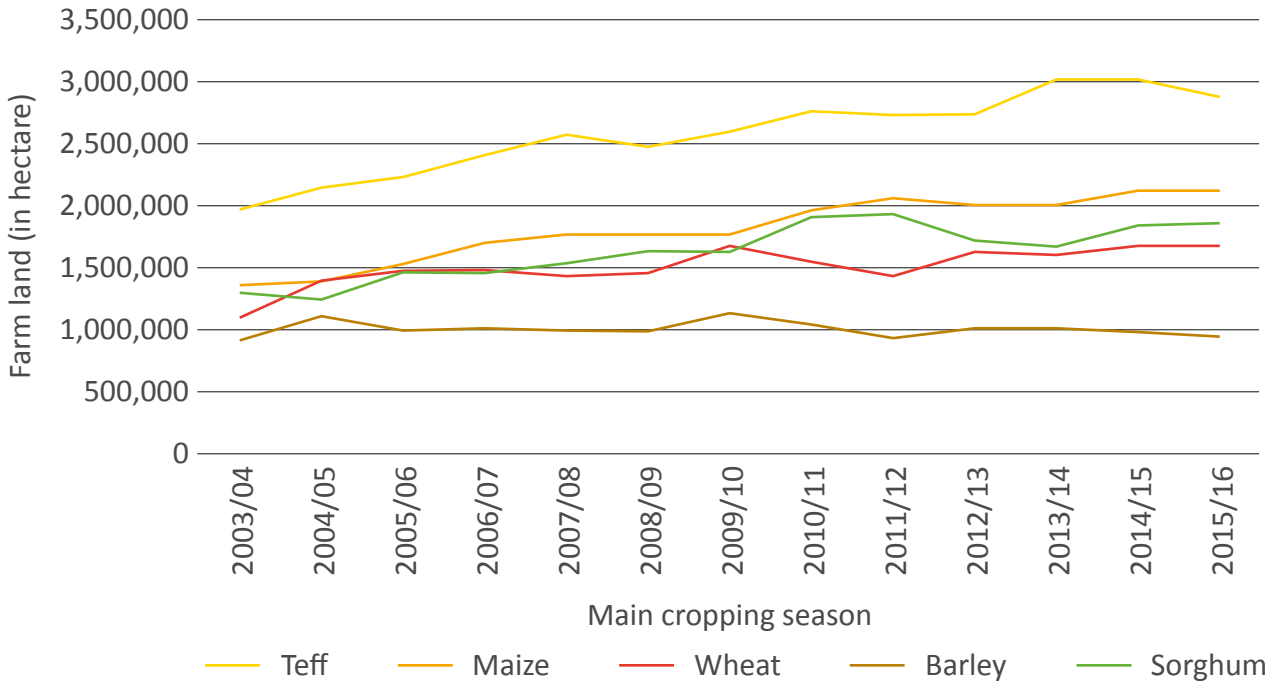
**Figure 10. Share of agriculture contribution to GDP growth, 2005–2006 and 2016–2017, NBE(2017)**




Agricultural practices undertaken by farmers are generally characterised by low productivity and subsistence farming. Moreover, rural fertility rates are much higher than in urban areas, which in turn leads to population pressures on rural farming (CSA & ICF, 2016). To offset this pressure and fulfil food demand, smallholder farmers tend to expand their farms into the nearest forested areas. According to the main season sample survey of private peasant farmer agricultural activities by the CSA (2016), agricultural land areas for the main cereal crop types (maize, teff, wheat, barley and sorghum) changed from about 6.66 million hectares to 9.44 million ha from 2003 to 2016. An additional 2.78 million ha of arable land was converted to farming activities in different parts

of the country by private peasant farmers (Figure 11). In Ethiopia, the expansion of croplands will continue to be the dominant cause of land-use change in the future. Ethiopia's Climate-Resilient Green Economy (CRGE) strategy clearly indicates that agricultural land will need to expand by 3.9% (550,000 hectares) per year to achieve growth targets for the agricultural sector. In a business-as-usual scenario, 55% of this expansion could be at the expense of forests and associated biodiversity and ecosystem services. Thus, land-use and land-cover change — mainly through conversion of natural ecosystems, particularly forests and grasslands to agricultural land — pose the principal threat to biodiversity in the country.

**Figure 11. Area changes for main crop types in Ethiopia during main cropping season on private peasant farms**

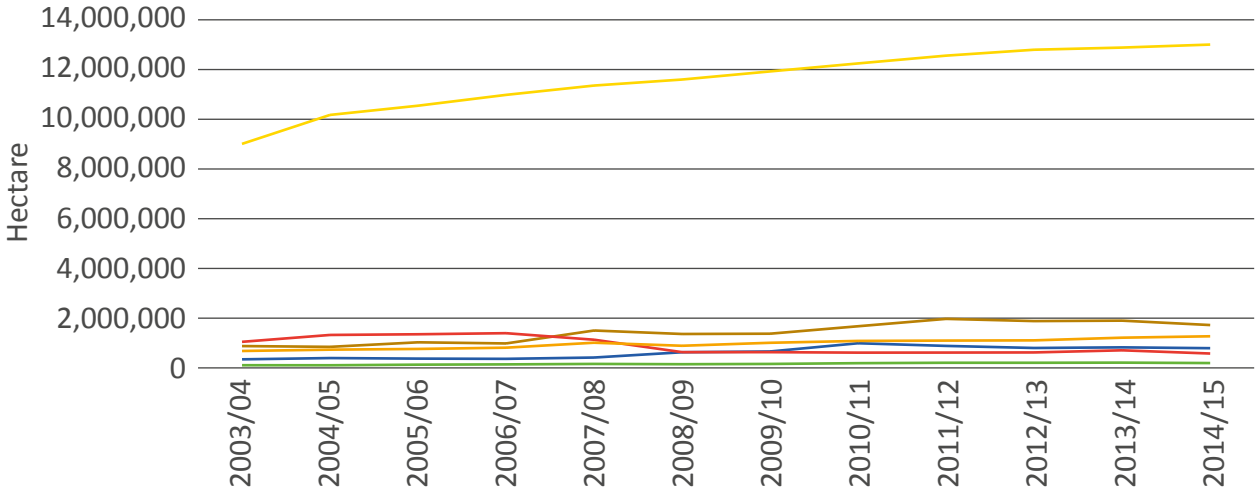



Source: Calculation based on CSA agricultural sample surveys (2003=2016) reports for private peasant farms.

In 2015–2016, the cultivated land for teff, maize, wheat, barley and sorghum increased by 44%, 55%, 51%, 3% and 45% respectively compared with 2003–2004 production. These figures show the presence of a significant amount of farmland expansion into other areas or nearby forest in order to increase food production. This expansion affects the natural environment, especially the forest ecosystem. But despite significant increments in productivity over the last decades, there is still a huge gap between the amount produced and the food demand for the cereal types under investigation. The Government of Ethiopia is currently importing a significant amount of wheat from abroad in order to fulfil domestic demand and for food aid programmes in times of shortfall due to natural disasters.

The CSA (2016) report on land use by private peasant farmers during the Meher season between 2003 and 2015 shows the areas under permanent and temporary crop cultivation, grazing, fallow, woodland and other land uses by farming households (Figure 12). The figures clearly indicate a drastic area increase for each type of use by 2014–2015, except for fallow land, compared with the 2003–2004 Meher season.

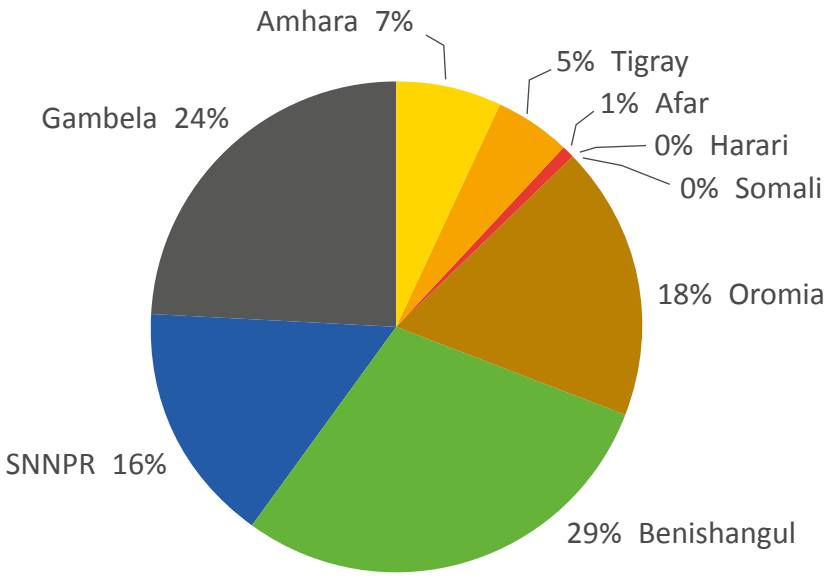
**Figure 12. Land-use area by type of activity on private peasant farms during the Meher season, 2003–2015, CSA report on land use**




However, foreign direct investment (particularly large-scale agricultural investments) are also key economic drivers for the loss of natural forest as well as biodiversity. Over the past decade, Ethiopia has attracted large-scale agricultural investments — both private and stated-owned. Accordingly, 1.7 million hectares of land were allocated to large-scale commercial farms in different parts of the country between 2002 and 2012. These land transfers have greatly impacted the forest cover of the country. Oromia, SNNPR, Gambela and Benishangul-Gumuz contributed about 87% of the total area transferred to commercial farming activities (Figure 13). Among the regional states, Gambela and Benishangul-Gumuz constitute 53% of the total transferred land mass undertaken for commercial purposes. Despite the economic benefits in terms of increasing foreign earnings, creating employment opportunities and technology transfer, the transfer of land to large-scale agricultural investments schemes has intensified the level of deforestation and habitat loss. The environmental consequences have been hugely negative in all cases. These relate foremost to the fact that these schemes are established in dense forest areas instead of grasslands or other lands with lower tree cover.

In terms of agricultural production, cotton, oil crops and pulses constitute about 67% of the total land area transferred to commercial farming activities. It is likely that land clearing and deforestation for large-scale agricultural investments will continue and threaten genetic diversity as species loss occurs. Furthermore, displacing smallholder farmers who use shifting cultivation practices and replacing them with large-scale commercial farms has a negative effect on the forest landscape. Farmers are displaced to nearby forested areas, affecting the natural environment and forest cover (Oakland Institute, 2011).

**Figure 13. Regional share of the total area transferred for commercial agriculture**



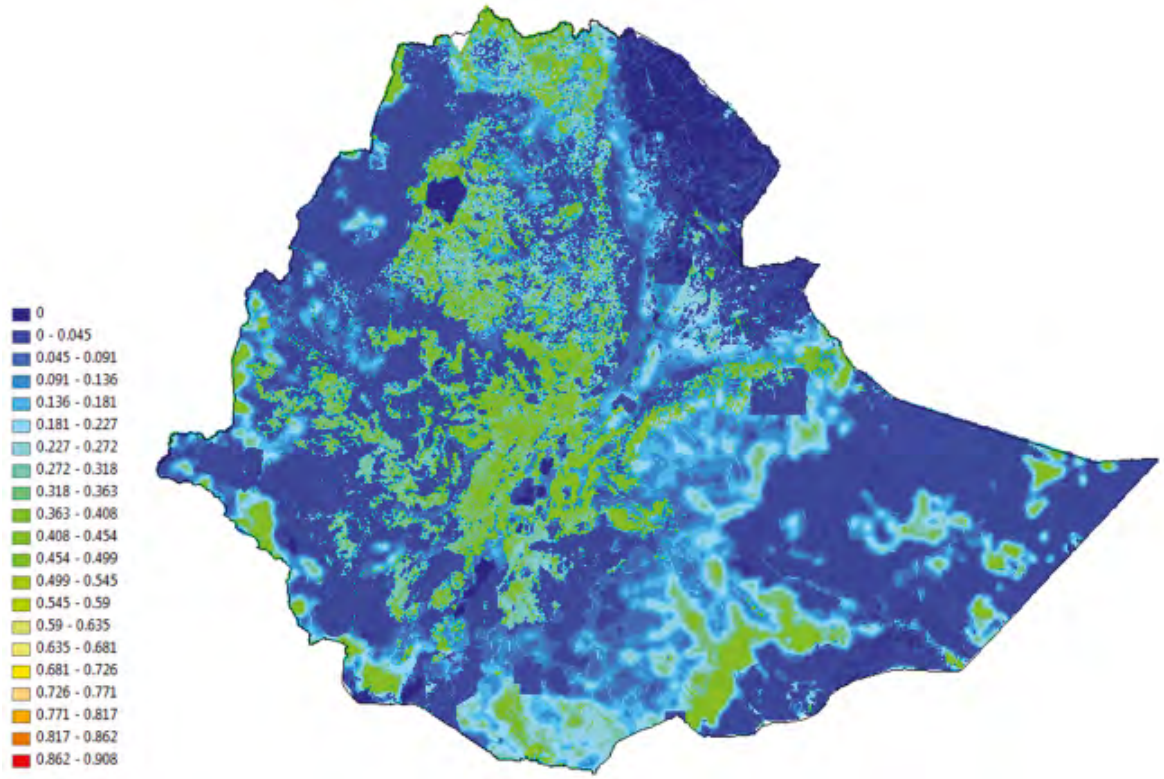

Source: Oakland Institute (2011) Understanding land investment deals in Africa. Country report: Ethiopia. https://bit.ly/33FkGrD.

Ethio pia's agriculture-based economy has been experiencing a high level of deforestation of about 163,000 hectares per year (Reusing, 1998). Between 2000 and 2008 alone, agricultural land expanded in Ethiopia by about four million ha, and 80% of this new agricultural land was converted from forests, woodlands and shrublands. Ethiopia's forest reference-level study has estimated a net forest loss of approximately 70,000 ha per year from 2000 to 2013 (FDRE, 2016). Furthermore, the study indicated that agricultural expansion (both small- and large-scale agriculture) was the main driver of forest loss from 2000 to 2013 (see Figure 14). FAO (2010) also estimates that 141,000 ha of forest have been lost annually between 1990 and 2010 and the average annual deforestation rate, based on forest-cover change from 2005 to 2010, amounted to 1.11% of total forest cover. However, a review of different studies reveals that the average deforestation rate may range between 1% and 1.5% annually (FDRE, 2011). The CRGE projections also indicate that if no action is taken to change the country's development path, nine million ha will be deforested between 2010 and 2030 (FDRE, 2011). It is also expected that the requirement for agricultural land will increase from 15 million ha in 2008 to 34 million ha by 2030; most of the additional agricultural land is expected to come from the conversion of forested lands (EDRI, 2010).

Using the Co$ting Nature[4] tool, a map of the current pressures on forest ecosystem was developed to identify the key drivers of deforestation in Ethiopia. The outputs of the tool suggest that agriculture dominates the pressures on ecosystems across Ethiopia (Figure 14). This is confirmed by a recent assessment of Ethiopia's forest ecosystems which found that deforestation is principally due to the clearance of forests for agriculture.

[4] Co$ting Nature measures the current pressure on population, wildfire frequency, grazing intensity, agricultural intensity, dam density, infrastructure (dams, mines, oil and gas, urban) density according to the best globally available data. Current pressure on systems is an indicator of the risk to provision of ecosystem services by those systems. See: http://www.policysupport.org/costingnature

**Figure 14. Current pressure on ecosystem services in Ethiopia (normalised fraction)**




Source: Co$ting Nature, www.policysupport.org/costingnature

In addition to agricultural land conversion, infrastructural investments such as building dams, road infrastructures, mining and settlements emanating from economic activities initiated near those investment areas have led to stresses on the natural environment. The resettlement programmes undertaken by the government have also had negative effects on forest resources (SESA, 2017). Most smallholder farming resettlement schemes are established on forest lands.

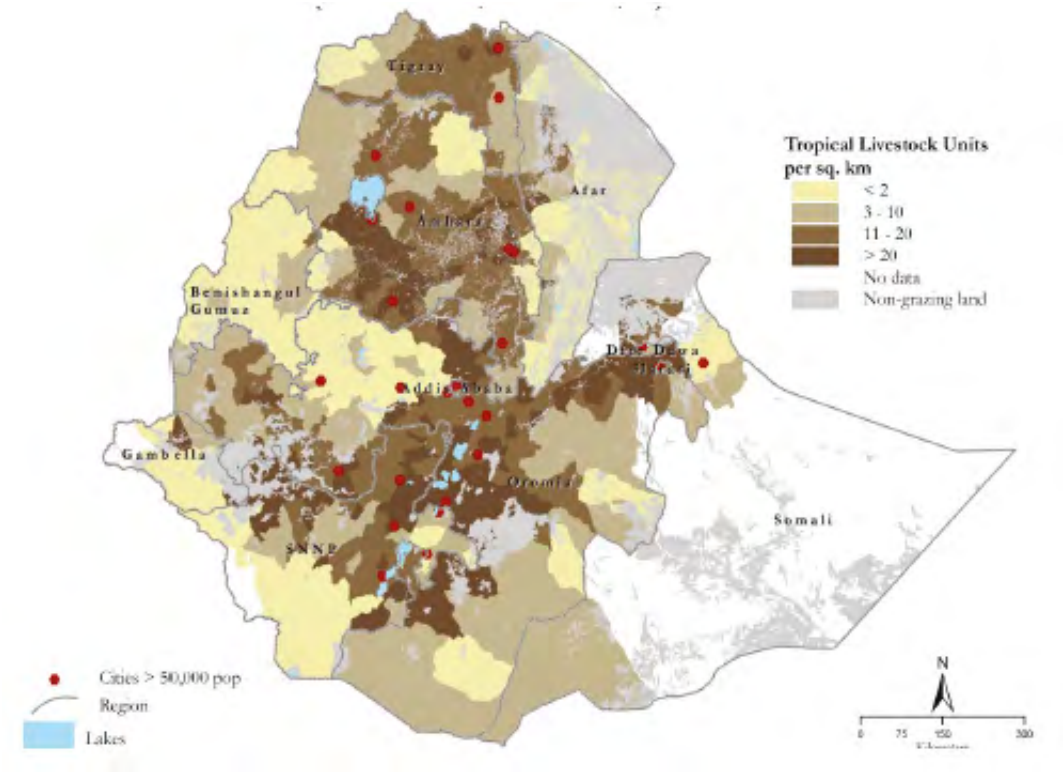
### 4.1.2 The impacts of livestock on the natural environment

Apart from crop production, the other major occupation in the agricultural sector is rearing animals for cultivation purposes, food and transportation. According to (FDRE, 2015), Ethiopia has the largest livestock population in Africa, which is composed of 53 million cattle, 26 million sheep, 23 million goats and 50 million poultry. The livestock sub-sector was estimated to account for about 10% of the total GDP and about 21% of the agricultural GDP in 2016–2017. Usually, it is the second largest contributor to the country's export earnings. Major export items include hides and skins, live animals and meat.

Between 2004 and 2016, livestock populations increased: cattle (54%), sheep (70%), goats (104%), horses (42%), donkeys (115%), mules (29%), camels (164%), poultry (93%) and beehives (30%) (FDRE, 2015c). These figures show a significant increase in the number of livestock held by private peasant farming households, which led to an increased demand for feed and fodder. As farmers sought out new grazing areas, traditional grazing practices consequently put more pressure on the natural environment and disrupt biodiversity. Figure 15 below shows the distribution of livestock (which is presented in terms of tropical livestock units or TLUs) and the effects on grazing area in 2001–2002 and 2007–2008.

There are initiatives to address the growing demand for animal feed. For instance, the Feed Enhancement for Ethiopian Development (FEED) project launched in 2009 works to increase the incomes of smallholder farmers by improving their access to, and use of, high-quality feed for livestock and poultry. The project, implemented by ACDI/VOCA[5] partners with the United States Department of Agriculture's Food for Progress Programme in six regions of Ethiopia (Addis Ababa, Amhara, Oromia, Somali, Tigray and SNNPR). FEED has been the only major development project in Ethiopia to focus on the development of livestock feed resources and their contribution to growth of livestock and poultry production. Project interventions include developing sustainable forage production systems on smallholder farms and communal pastures, setting up cooperative-based commercial feed manufacturing enterprises, and strengthening the feed supply chain.

**Figure 15. Change in pressure on grazing land between 2001–2002 and 2007–2008**




Source: Tilamun, H, and Schmidt, E (2012) Spatial Analysis of Livestock Production Patterns in Ethiopia. ESSP II Working Paper 44. International Food Policy Research Institute (IFPRI): Addis Ababa/Washington DC.

Figure 15 clearly indicates that those areas with more TLUs are located in the central highlands, northwest, southwest and western parts of the country. In addition to having more TLUs, those areas also have potentially larger areas for grazing land. These areas are also known for their biodiversity, forest cover, flora and fauna, and surface and groundwater resources. However, climate change, population pressures, over-exploitation by farmers (crop production and grazing) and the disruption of the natural environment have led to land degradation, which will have negative consequences for both the livestock sector and the country's overall economy.

[5] ACDI/VOCA (Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance) is an international development non-profit organisation.

### 4.1.3 The impacts of poverty on natural resources

The Ministry of Finance and Economic Cooperation (MoFEC — formerly the Ministry of Finance and Economic Development) measured poverty using two parameters: income poverty and food poverty (MoFED, 2012). Total poverty compares the per capita income to the total poverty line which was 7,184 Ethiopian Birr per person per year in 2015–2016. Food poverty is part of the total poverty line and is measured as the income needed to purchase enough food to consume 2,200 kcal per person per day for a year. The food poverty line was 3,772 Ethiopian Birr in 2015–2016.

According to NPC (2017), approximately 30% of the population experienced food poverty in 2010–2011 and 23.5% was poor (earning less than 7,184 Ethiopian Birr per capita which was the poverty line during 2015–2016) (Table 6). The poverty gap index that measures the average poverty gap in the population as a proportion of the poverty line is also estimated to be 6.7%. By this measure of poverty, the rural poverty gap (7.4%) is just over twice the urban poverty gap (3.6%) (NPC, 2017). The proportion of the population below the poverty line in Ethiopia declined from 30% in 2010–2011 to 23.5% in 2015–2016, indicating a 21.7% decline during the period. The proportion of the population falling below the poverty line was higher (25.6%) in rural areas compared to in urban areas (14.8%). Income inequality as measured by the Gini coefficient remained low at 0.3 in 2015–2016, while the Gini coefficient was 0.38 in urban areas and 0.28 in rural areas, showing greater income inequality in urban areas.

**Table 6. Poverty headcount and Gini coefficient (2015–2016)**

| | Total poverty | Food poverty | Gini coefficient |
|---|---|---|---|
| National level | 23.5 | 24.8 | 32.8 |
| Urban | 14.8 | 15.2 | 38.0 |
| Rural | 25.6 | 27.1 | 28.4 |

Source: NPC (2017) Ethiopia's progress towards eradicating poverty: an interim report on 2015–2016 poverty analysis study. National Planning Commission, Ethiopia.

Analysis of poverty in Ethiopia shows that total poverty and food poverty have declined over time. Nationally, the trends show significant declines in the poverty headcount, poverty gap and poverty intensity. For instance, the percentage of poor people living below the total poverty line in Ethiopia declined from 45.5% in 1995–1996 to 29.6% in 2010–2011 and further to 23.5% in 2015–2016 (Table 7). A substantial decline was observed between 2010 and 2016. Incidence of poverty or headcount index has shown a 19% decline between 2010 and 2016, while poverty gap and poverty severity indices declined by 11% and 5% respectively. About 5.3 million people were lifted out of poverty between 2010 and 2016 (NPC, 2017).

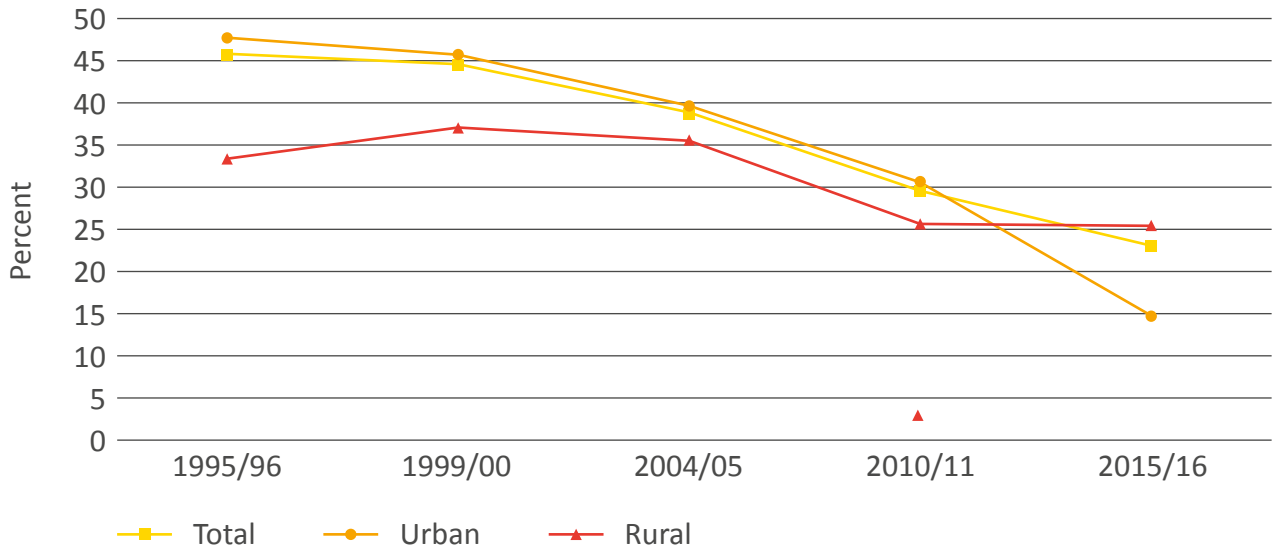
**Table 7. Trend in total poverty (headcount index)**

| Year | National poverty line | Urban | Rural |
|---|---|---|---|
| 1995/96 | 45.5 | 47.5 | 33.2 |
| 1999/00 | 44.2 | 45.4 | 36.9 |
| 2004/05 | 38.7 | 39.3 | 35.1 |
| 2010/11 | 29.6 | 30.4 | 25.7 |
| 2015/16 | 23.2 | 14.8 | 25.2 |

Historical data on measures of food poverty indices in Ethiopia show significant progress. The proportion of people below the food poverty line decreased from 33.6% in 2010/11 to 24.8% in 2015/16 indicating a 26.2% decline in 2015/16. Disaggregating between rural and urban areas, the data shows a significant reduction in food poverty indices in both rural and urban areas, but with stronger reductions in urban poverty indices (46%) than rural (22%) between 2010/11 and 2015/16 (NPC, 2017).

There is a general decline in total poverty in urban and rural Ethiopia. Although the proportion of people below the absolute poverty line in rural Ethiopia is higher than that in urban areas, the gap has narrowed during the last five years (Figure 16).

**Figure 16. Decline in total poverty in urban and rural Ethiopia (1995–2015)**




Source: International Household Survey Network (IHSN) (a,b,c,d,e), Household Income, Consumption and Expenditure Survey 1995–1996: Ethiopia, 1995–1996/1999-2000/2004-2005/2010-2011/2015-2016: Ethiopia; AND: NPC (2017) Ethiopia's progress towards eradicating poverty: an interim report on 2015–2016 poverty analysis study. National Planning Commission, Ethiopia.

Spatially disaggregated poverty analyses also indicate noticeable disparities among regions, largely attributed to differences in stages of development and to resource endowments. In 2015–2016, the poverty headcount was the highest in the Tigray region (27%) followed by the Benishangul-Gumuz (26.5%) and Amhara (26.1%) regions. These regions recorded a poverty headcount index of above the national average poverty incidence (23.5%) (Table 8). Poverty estimates were lowest in the Harari region (7.1%) followed by the cities of Dire Dawa (15.4%) and Addis Ababa (16.8%). In terms of food poverty, Tigray (32.9%), Amhara (31.3%), Afar (28.3%) and Benishangul-Gumuz (23.7%) recorded higher food poverty incidences compared to other regions in Ethiopia (Table 7), which indicates that they are the most food-insecure regions in Ethiopia. The lowest food poverty incidence was observed in Harari (6.3%) followed by Dire Dawa (12.2%) and Addis Ababa (19.1%).

Although the causal linkages are not easily identifiable or established, rural poverty is strongly associated with unsustainable land-use practices, soil loss and soil degradation, and deforestation. The poor are most dependent on their natural resources for their survival. Rural poverty is one of the proximate causes of deforestation and biodiversity loss as poor communities depend on forests for sources of energy, food, timber and income. There exists a vicious circle of poverty, resource degradation and further impoverishment in Ethiopia.

**Table 8. Trends in regional poverty headcount (indices by region)**

| Region/city | National poverty line per adult | | | |
|---|---|---|---|---|
| | 1999–2000 | 2004–2005 | 2010–2011 | 2015–2016 |
| Tigray | 61.4 | 48.5 | 31.8 | 27.0 |
| Afar | 56 | 36.6 | 36.1 | 23.6 |
| Amhara | 41.8 | 40.1 | 30.5 | 26.1 |
| Oromia | 39.9 | 37 | 28.7 | 23.9 |
| Somali | 37.9 | 41.9 | 32.8 | 22.4 |
| Benishangul-Gumuz | 54 | 44.5 | 28.9 | 26.5 |
| SNNPR | 50.9 | 38.2 | 29.6 | 20.7 |
| Gambela | 50.5 | - | 32 | 23.0 |
| Harari | 25.8 | 27 | 11.1 | 7.1 |
| Addis Ababa | 36.1 | 32.5 | 28.1 | 16.8 |
| Dire Dawa | 33.1 | 35.2 | 28.3 | 15.4 |
| Total | 44.2 | 38.7 | 29.6 | 23.5 |

Source: NPC (2017) Ethiopia's progress towards eradicating poverty: an interim report on 2015–2016 poverty analysis study. National Planning Commission, Ethiopia.

### 4.1.4 The impacts of food self-sufficiency strategies

Like other sub-Saharan Africa countries, food insecurity and malnutrition remain a persistent problem in Ethiopia and the country has a long history of receiving food aid (Gilligan et al., 2008). As in other sub-Saharan countries, food insecurity and malnutrition remain a critical issue, despite several programmes aimed at improving household food security. A Food and Agriculture Organization of the United Nations (FAO) assessment report estimated 28.8 million Ethiopians are undernourished, indicating food shortages are a serious problem (FAO et al., 2017). Child malnutrition is also a serious problem. According to the recent Ethiopian DHS report, the country's malnutrition indicates that 40% of children under the age of five years were stunted, 19% wasted and 25% underweight in 2014 (CSA, 2014b).

Food security is assessed in two ways: the number of months of food security as perceived by the respondents and by using a food balance sheet. Table 9 shows that in 2014, about 52% of food-insecure households in Ethiopia faced food gaps for less than 4 months. In 2004, the proportion of food-insecure households was 31.1%. This declined to 21.2% in 2011. The proportion of households facing food gaps was higher in rural areas than in urban areas.

**Table 9. Proportion of food insecure households (%) in Ethiopia (2004 and 2011)**

| Number of food insecure months | 2004 | 2011 | | |
|---|---|---|---|---|
| | | Total | Rural | Urban |
| <1 | 8.6 | 17.8 | 16.4 | 29.8 |
| 2–3 | 43.7 | 46.3 | 47.3 | 37.4 |
| 4–6 | 32.8 | 27.4 | 28.3 | 19.5 |
| 7–9 | 5.6 | 4.7 | 4.8 | 4.4 |
| 10–12 | 3.8 | 1.1 | 0.8 | 3.6 |
| Not stated | 5.5 | 2.7 | 2.4 | 5.3 |
| Total food insecure months | 31.1 | 21.2 | 24.2 | 10.1 |

Source: CSA (2003 & 2011). Welfare monitoring survey. Addis Ababa: Central Statistics Authority.

Achieving food security continues to be a challenge in Ethiopia. Increasing the amount of food available requires not just increases in productivity in agriculture, but also a need to lower production losses (Kader, 2005). A major source of food losses are post-harvest losses during harvesting, handling, transporting, storage, processing, packaging and distribution (Kader, 2005; FAO, 2010). This reduces the availability of food crops and income that could be generated by selling these products and are thus linked to food security (FAO, 2010). In Ethiopia, the average post-harvest loss along staple crop food value chain ranges from 5 to 25%. The post-harvest loss varies greatly among food crops, production, areas, seasons, handling and management practices.

More recently, the Ethiopian government launched a National Post-Harvest Management Strategy. The five-year strategy launched by the Ministry of Agriculture and Natural Resources (MoANR) aimed to reduce the level of post-harvest loss from 25% to 5% by 2020. This strategy aimed to reduce quantitative and qualitative food losses through the adoption and implementation of appropriate post-harvest management systems along agricultural value chains.

The concept of food security can be analysed for units at different conceptual levels and the exact dimensions that need to be measured vary depending on the level of analysis chosen. At a national or regional level, the status of food security can be analysed in terms of supply indicators by looking at the ability of the country or region to obtain sufficient food to meet the needs of all citizens. The most widely used indicator is the quantity of food available compared with needs. Availability is a function of domestic production, imports, food aid and security stock. Of these, domestic production is critical in ensuring food availability.

One of the major successes in the last five years has been achieving the target of national food self-sufficiency. The national GTP II for 2016–2020 aimed to strengthen Ethiopia's capacity to maintain food self-sufficiency by increasing cereal productivity by 47% by 2020 (FDRE, 2016). In this section, a food balance sheet was computed by comparing national food supply and food utilisation using FAO statistical data (FAO, 2013). The domestic food supply was computed by aggregating food production, import and stock available, and deducting exports. Food utilisation aggregates food consumption, food used for processing, livestock feed, seed, waste and other uses. A negative balance indicates a food deficit. Table 10 summarises the food balance sheet and nutrition intake of the country in 2013. The table clearly indicates that national-level food self-sufficiency is ensured.

**Table 10. Summary of food balance of Ethiopia in 2013**

| | Domestic Supply | | | | | Domestic Utilisation | | | | | | | | Per Capita Supply | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1000 Metric tons | | | | | | | | | | | | | Total | Calorie | Protein | Fat |
| Single items | Prod. | Import | Stock Var. | Export | Total | Food | Food Manu | Feed | Seed | Waste | Other Uses | Total Utilisation | Food balance | Kg/Yr | KCal/ Day | Gr/Day | Gr/ Day |
| Cereals — excluding beer | 22646 | 1054 | -3397 | 25 | 20278 | 14158 | 332 | 667 | 385 | 1168 | 3569 | 20279 | -1 | 150.45 | 1361 | 36.7 | 6.07 |
| Starchy roots | 8522 | 1 | 0 | 53 | 8470 | 7614 | 0 | 0 | 179 | 678 | 0 | 8471 | -1 | 80.91 | 281 | 3.11 | 0.43 |
| Sugar Crops | 2750 | 0 | 0 | 0 | 2750 | 0 | 2750 | 0 | 0 | 0 | 0 | 2750 | 0 | 0 | 0 | 0 | 0 |
| Sugar and sweeteners | 406 | 216 | 0 | 1 | 621 | 621 | 0 | 0 | 0 | 0 | 0 | 621 | 0 | 6.6 | 64 | 0.01 | 0 |
| Pulses | 1279 | 21 | 610 | 269 | 1641 | 1488 | 0 | 0 | 55 | 98 | 0 | 1641 | 0 | 15.82 | 149 | 10.07 | 0.97 |
| Tree nuts | 65 | 1 | 0 | 0 | 66 | 62 | 0 | 0 | 0 | 3 | 0 | 65 | 1 | 0.66 | 5 | 0.13 | 0.45 |
| Vegetable oils | 98 | 314 | -70 | 0 | 342 | 271 | 0 | 0 | 0 | 0 | 71 | 342 | 0 | 2.88 | 70 | 0 | 7.88 |
| Vegetables | 1890 | 16 | 0 | 98 | 1808 | 1694 | 0 | 0 | 0 | 114 | 0 | 1807 | 1 | 18 | 17 | 0.81 | 0.11 |
| Fruits — excluding wine | 672 | 61 | 0 | 14 | 719 | 671 | 2 | 0 | 0 | 48 | 0 | 719 | 0 | 7.13 | 10 | 0.12 | 0.15 |
| Stimulants | 277 | 1 | 0 | 204 | 74 | 74 | 0 | 0 | 0 | 0 | 0 | 74 | 0 | 0.78 | 1 | 0.15 | 0 |
| Spices | 145 | 2 | 0 | 19 | 128 | 122 | 0 | 0 | 0 | 5 | 0 | 127 | 1 | 1.3 | 11 | 0.42 | 0.6 |
| Alcoholic beverages | 1429 | 2 | 0 | 3 | 1428 | 1428 | 0 | 0 | 0 | 0 | 0 | 1428 | 0 | 15.17 | 20 | 0.19 | 0 |
| Meat | 679 | 0 | 0 | 15 | 664 | 665 | 0 | 0 | 0 | 0 | 0 | 664 | 0 | 7.06 | 37 | 2.82 | 2.8 |
| Animal fats | 39 | 3 | 0 | 0 | 42 | 42 | 0 | 0 | 0 | 0 | 0 | 42 | 0 | 0.45 | 10 | 0.01 | 1.15 |
| Eggs | 41 | 0 | 0 | 0 | 41 | 34 | 0 | 0 | 5 | 2 | 0 | 41 | 0 | 0.36 | 1 | 0.11 | 0.1 |
| Milk — excluding butter | 4288 | 13 | 0 | 5 | 4296 | 4153 | 0 | 18 | 0 | 129 | 0 | 4300 | -4 | 44.14 | 72 | 4.06 | 3.81 |
| Grand total | 46102 | 1713 | -2857 | 941 | 44017 | 33365 | 3442 | 685 | 640 | 2255 | 3640 | 44027 | -3 | 354.58 | 2130 | 60.4 | 25.95 |

## 4.2 Demographic drivers

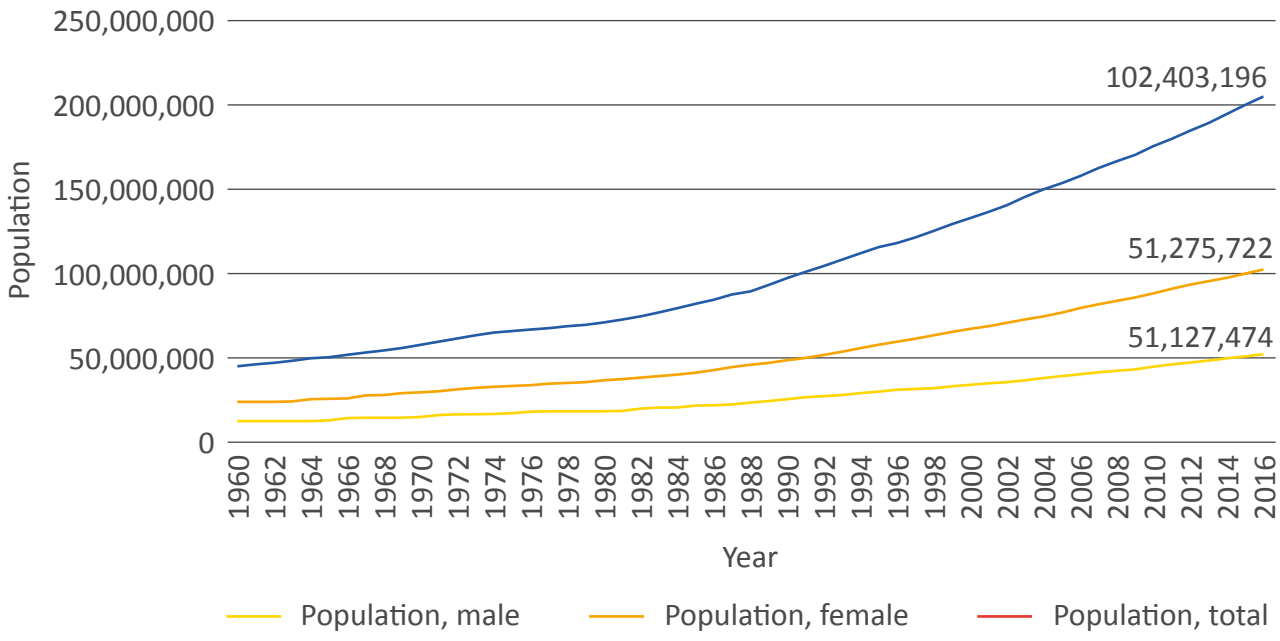
Ethiopia is the second most populous country in Africa after Nigeria. As of 2007, Ethiopia's population has been growing at a rate of 2.5% per annum, which means the estimated total population of the country in the year 2017 was 104.9 million (Table 11). The population is 89.3% and 29.6% higher than it was in 1994 and 2007 respectively. This rapid population growth can be seen either as an opportunity for growth or a threat to its development due to natural resources degradation by expanding farmland to marginal areas. The gender ratio of the population is almost balanced (49.59% female). There are more than 16 million households in Ethiopia, with an average household size of five persons. Approximately 25.26% are female-headed households. About 80% of the populations live in rural areas, and in 2017, the rural population reached 83.6 million — meaning almost twice as many farmers in 2017 as in 1994. The population dynamics show a sharp increase in population size after 1988 and a steady increase over the last two decades (Figure 17).

**Table 11. Ethiopian population (1994, 2007, 2017)**

| Year | Total population | Rural population | Urban population |
|---|---|---|---|
| 1994 | 55,431,123 | 47,877,524 | 7,553599 |
| 2007 | 81,000,409 | 67,946,383 | 13,054,026 |
| 2017 | 104,957,000 | 83,568000 | 21,389,000 |

Source: World Bank, Ethiopia, https://data.worldbank.org/country/ET

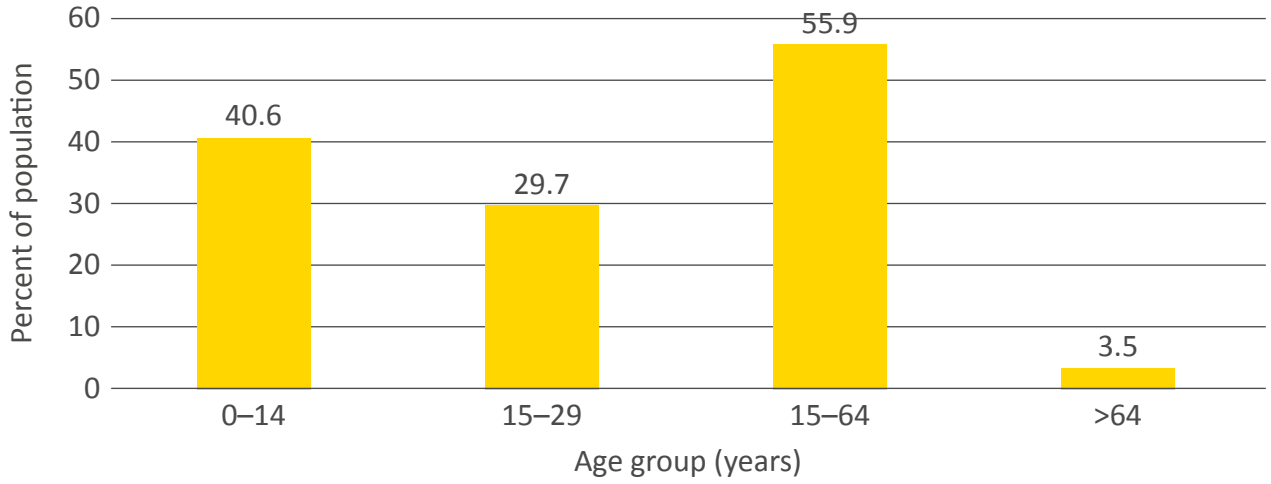
**Figure 17. Population of Ethiopia (1960–2016)**




Source: World Bank, World Development Indicators, https://databank.worldbank.org/source/world-development-indicators

The age structure is characterised by a high number of children below the age of 15, constituting nearly 40.6% of the total population. Nearly 3.5% is above the age of 64 (Figure 18). The youth population (ages 15 to 29) is 29.7%, while the economically active population (ages 15 to 64) is 55.9%. According to UN data, the share of the working-age population started increasing in 2005. Having been constant since 1985 at about 50–51%, the working age population increased to 52.3% in 2010, 55.9% in 2016 with a projected peak of 67.5% in 2055. Ethiopia's demographic transition is taking place faster than in the rest of Africa owing to a more rapid decline in mortality. This growth presents both opportunities and challenges over the coming decades (World Bank, 2016).

**Figure 18. Distribution of population by age group (%)**




Source: World Bank, World Development Indicators, https://databank.worldbank.org/source/world-development-indicators

According to projections by the CSA (2016), Ethiopia's population is expected to be around 143 million by 2037, which is 49% higher than current population. WDI (2017) estimates indicate the country's population will reach 191 million by 2050: 86% higher than the current population. Based on these estimates, Ethiopia will have between 140 million people by 2037 and 190 million by 2050. Ethiopian forests are already under threat, but this will lead to increased demands for resources (fuelwood and food in particular) and will consequently accelerate deforestation and forest degradation, impacting on the many free-of-charge goods and services such as fuelwood, construction timber, food and fodder, available land for farming and housing, and drinking water. Projections in the CRGE strategy indicate that without taking action to change the country's development path, 90,000 square kilometres (56% of total forest area) might be deforested between 2010 and 2030. Over the same period, annual fuelwood consumption could rise by 65%. Uncontrolled population growth would put undue pressures on all natural resources and would undoubtedly have a serious impact on biodiversity.

Despite variations on population projections, it is clear that food demand both in volume and composition is expected to be much higher in the near future than can be currently met by the agricultural sector. The International Food Policy Research Institute's (IFPRI) International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)[6] (2015) projects that

[6] See: www.ifpri.org/publication/ifpri-impact-webtool

Ethiopia's domestic demand for cereals in 2050 will be 2.62 times higher than in 2010 (Thomas, 2019). Population growth is estimated to be more than 2.5% per year and is directly driving and exacerbating problems such as agricultural expansion and natural resource depletion (UNFCC, 2016; Franks et al., 2017). Business-as-usual food production usually practiced in developing countries cannot meet this growing food demand while also conserving ecosystems unless production-enhancing techniques are intensively applied.

By and large, population size, age composition and population density are the primary underlying drivers for increased demand for food, agricultural land and fuelwood in Ethiopia. Increases in household income have also influenced food demand. Concomitant with the increase in population, a considerable increase in the quantity of food consumed associated with an increase in household income has been observed in Ethiopia over the past decade. Hassen et al. (2016) found that in 2011, the average Ethiopian household consumed 447 kilograms per adult equivalent, corresponding to a 55% increase in the quantities of foods consumed in 1996 (288kg of food per adult equivalent).

Although diets in Ethiopia are generally characterised as being monotonous (Headey, 2014), this seems to be slowly changing. More diverse consumption expenditure has been observed over recent decades. Food consumption patterns vary and different regions have preferences for different cereal crops. A study by Berhane et al. (2011) reported increasing demand for processed cereals and wheat, due largely to the preferences of an increasing urban population. Thus, shifts in dietary consumption patterns will also be the main driver for demand for agricultural land in the future. Increased urbanisation will also influence the demand for different food types. While urbanisation rates have been low in Ethiopia, recent urbanisation rates have been high (Schmidt and Kedir, 2009) and these rates are expected to remain high in the future, with 30% of Ethiopia's population expected to be living in cities by 2028 (World Bank, 2015). People in cities are shown to have different diets than rural populations. Increasing urbanisation, therefore, will have important implications for food systems.

## 4.3 Cultural and religious drivers

Indigenous cultural beliefs and practices play a significant role in the conservation of forests. People believe that forests are sacred resources associated with spiritual realities and interconnected with humans and nature. But there are few studies on the impact of cultural and religious factors on agriculture and ecosystems in the Ethiopian context. However, management and use of forest resources have traditionally been tied to the local community's religious beliefs and social systems in different parts of Ethiopia. For example, in the southwest, the Shekacho people have developed traditional management practices based on religious taboos and customary tenure rights that have sustained the Sheka Forest for centuries, known as the last Indigenous forest in Ethiopia. According to local tradition, it is forbidden to log forested areas around wetlands and river corridors, in addition to old growth and specific species of trees. Many of these traditional practices are based on taboo, as well as a belief that such trees are essential to the public and the common good. The clan and ritual leader, the *gepitato*, is at the heart of the land tenure and forest-management system, as his permission is required before anyone may clear the forest or acquire farming land. According to religious beliefs, settlement or clearing for agricultural

activities is never allowed on land that is in contact with forest areas, cultural places, wetlands and headwaters (the source of a stream or river).

Similarly, the Indigenous Kafecho people in southwestern Ethiopia, have also ritual practices called *Qoollee deejjoo*. It is a thanksgiving sacrifice ceremony to the forest spirit (*Qoolloo*). The ritual ceremony, which is performed in the forested landscape, is a symbolic reminder to worshippers that their survival depends on the forest. It recognises and honours the ethics and taboos of the forested landscape. The ritual has been institutionalised with its customary laws, values, ritual taboos and conventions within the community. The rules of such rituals are powerful tools for sustainable forest management, including crop fertility, livestock production, social cohesion and conflict resolution (Woldemariam, 2017). Furthermore, 'church forests' were highly revered in Ethiopia because they were considered the homes of the gods. Indiscriminate felling or other anthropogenic activities that affected church forests were considered taboo and forbidden. In effect, church forest resources were successfully conserved.

There are also work taboos in rural Ethiopia whereby individuals are not allowed to work on specific days (locally called *Be'al* or holy days). The majority of agricultural households have at least two days per week when they are not allowed to work on their farm due to religious norms. These habits, customs and norms have important consequences on the wellbeing of households and the management of their farms and natural resources. Religious and cultural factors have contributed in the making of Ethiopian peasantry poor.

Cultures and societies and the type of contact individuals have with one another influence food choices. The food practices of humans are determined by values, attitudes, beliefs and environmental and religious circumstances — all of which are the products of tradition, culture and contacts (Onuorah & Ayo, 2003). A review of literature shows that culture, religion and traditional knowledge affect food and nutrition security by shaping a community's diet, food preferences, intra-household food distribution patterns, food processing and preparation techniques. In different parts of Ethiopia, food taboos or the restriction of specific foods as a result of social or religious customs are common. However, studies on the impact of cultural and religious factors on agriculture or food systems are generally lacking in the Ethiopian context.

## 4.4 Physical drivers

### 4.4.1 The impacts of climate change and variability

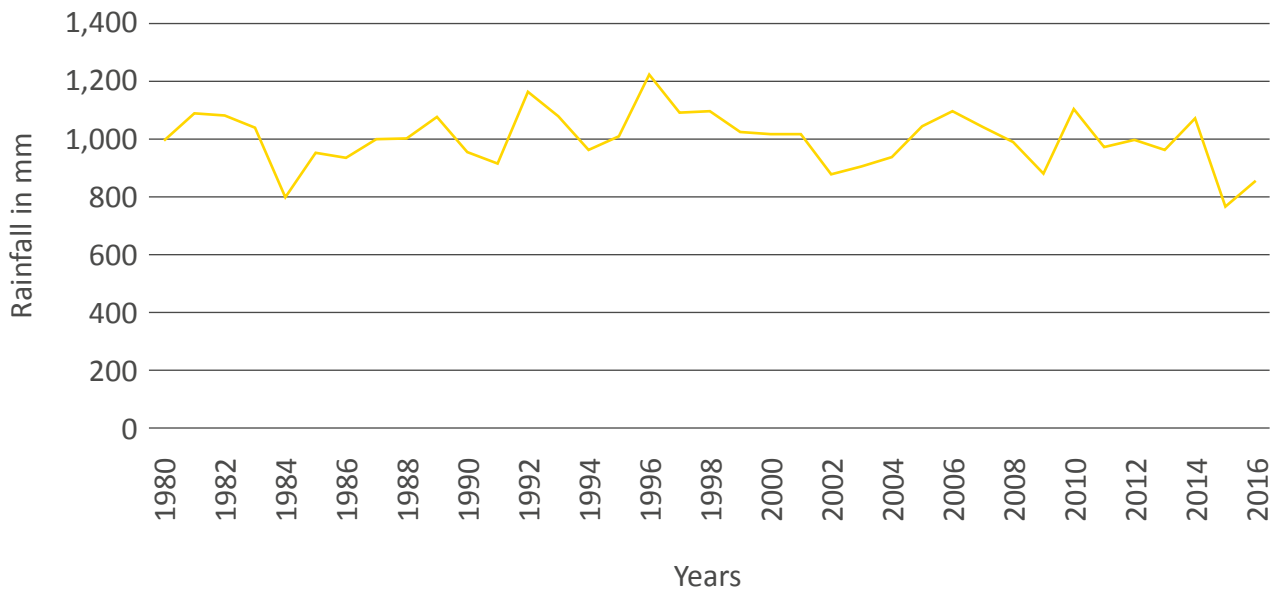
Future climate variability and change may accelerate already high levels of land degradation, deforestation and forest degradation, loss of biodiversity, desertification, and water and air pollution. There is increasing evidence that the African continent, which depends mainly on agriculture, is expected to suffer the most from the negative impacts of climate change and variability. This will be a key challenge for future development, particularly for the drier regions (Huq et al., 2004; Adger et al., 2007). Furthermore, it is one of the key environmental drivers impacting agriculture and ecosystems. Despite the emerging threat of climate change and variability, agriculture remains the crucial mainstay of local livelihoods for most rural communities in developing countries in general and for Ethiopia in particular. Agriculture is facing serious challenges caused by climate change-induced natural and man-made disasters.

Drought remains the country's major hazard, followed by floods. The country's vulnerability to natural hazards is due to a number of factors including dependence on rainfed agriculture, land degradation and weak institutions. Ethiopia has a long history of recurring droughts, which, since the 1970s, have increased in magnitude, frequency and intensity. Crop production in Ethiopia is affected by the failure of rains or occurrence of successive dry spells during the growing season. Food shortages resulting from adverse weather conditions are not new in Ethiopia. The 2002–2003 drought led to a 4% decline in GDP and a 12% reduction in agricultural output.

Ethiopia, due to its geographical location and topography, and in combination with low adaptive capacity, is highly vulnerable to the impacts of climate change. The degree of vulnerability varies between different regions based on wealth, technology, availability of infrastructure and institutions, potential for irrigation and literacy rates. A study by Deressa et al. (2008) on Ethiopian farmer's vulnerability to climate change indicates that the relatively least-developed, semiarid and arid regions — Afar and Somali — are highly vulnerable. The Oromia region (characterised both by areas of good agricultural production in the highlands and midlands and by recurrent droughts, especially in the lowlands) is also vulnerable. The Tigray region, which is characterised by recurrent drought, is also vulnerable to negative impacts of climate change in comparison with other regions.

Rainfall, which is the main climatic factor, is distributed very unevenly in Ethiopia. Many parts of Ethiopia experience high inter-annual and intra-seasonal rainfall variability. The climate is characterised by large spatial variations in rainfall ranging from more than 2000 millimetres in some areas in the southwest to less than 250mm in the southeast and the Afar lowlands in the northeast. Rainfall variability is high over the eastern half of the country compared to the western half. Though the average rainfall shows a decreasing trend on an annual timescale for the whole country, the trend varies from region to region and from season to season (Figure 19). Some studies have identified downward trends in parts of the country, however, reviews of recent literature show that the situation is non-uniform and is highly sensitive to which region/period of time is used for analysis (Woldeamlak & Conway, 2007; MEFCC, 2017).

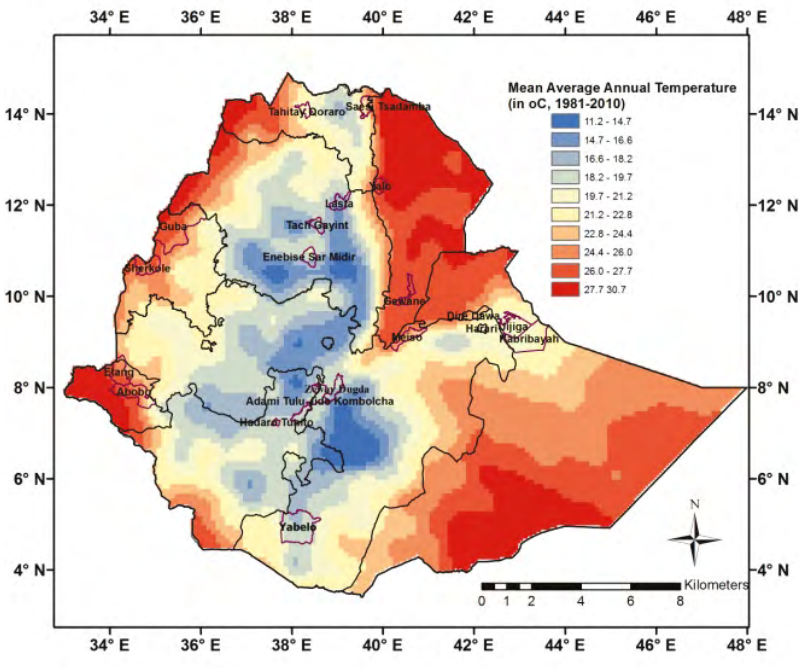
**Figure 19. Mean annual rainfall in Ethiopia (1980–2016)**



Adapted from: Abebe, G (2017) Long-term climate data description in Ethiopia. Data in Brief 14: 371–392

Ethiopia's average temperature is mild for its tropical latitude because of topography, with considerable variation over the country based on altitude. Warming has occurred across much of Ethiopia, particularly since the 1970s, at a variable rate but broadly consistent with wider African and global trends (Conway et al., 2004; Conway & Schipper, 2011). The historic mean annual temperature distribution over the country varies between 15° Celsius and 20°C in the highlands, while the low-lying regions experience a range of temperature between 25°C and 30°C (MEFCC, 2017) (Figure 20). Over recent decades, the temperature in Ethiopia increased at about 0.2°C per decade. The increase in minimum temperatures is more pronounced with roughly 0.4°C per decade. Temperature anomalies over agricultural cropped areas continued to be higher than the long-term mean throughout 2011–2016, leading to more frequent extremely hot conditions in the last five years (FAO et al., 2018). According to the report, Ethiopia has experienced three or more years where maximum daily temperatures were much more frequently extreme.

**Figure 20. Mean annual surface temperature in °C**




Source: Data from: Abebe, G (2017) Long-term climate data description in Ethiopia. Data in Brief 14: 371–392

Most of the global climate models project an increase in precipitation in both the dry and wet seasons in Ethiopia. Studies with more detailed regional climate models, however, indicate that the direction of the expected precipitation change is uncertain. The temperature will very likely continue to increase for the next few decades with the rate of change as observed. The impacts of the ongoing and projected climate change and variability are widespread in both socioeconomic and natural systems. It is predicted that changes in climate will lead to recurrent droughts and heavy rainfall in different parts of Ethiopia, reducing the amount of land that can be used for agriculture and decreasing crop productivity.

According the World Bank (2015), by 2050, climate change could reduce Ethiopian GDP by 8–10%. The climate resilience strategy for agriculture and forestry indicates that, under some extreme

scenarios, the impact of climate change on all sectors could cause a 10% or more reduction in GDP by 2050 (FDRE, 2015b). Floods also cause damage to land and agriculture. Climate change impacts are likely to be felt most by the rural poor and particularly women. In order to offset the negative impacts of climate change and to fulfil demands for food, farmers are likely to expand their farmlands to areas they believe are relatively more fertile than their previous farms (Franks et al., 2017). Moving or expanding farms to new areas will affect the natural resources (forest cover and biodiversity), which in turn affects the overall ecosystem.

Climate change will also impact ecosystems and biodiversity. For example, climate change and human drivers such as forest fires threaten forest ecosystems. Increased heavy rainfall as a result of climate change can cause soil erosion, crop damage and waterlogging, which makes the land difficult or impossible to cultivate for agriculture. It is estimated that Ethiopia loses more than 1.5 billion tonnes of fertile soil each year through heavy rain and flooding. Furthermore, climate change is also expected to affect biodiversity significantly. A large number of plant and animal species are threatened by extinction, as climate conditions are changing too quickly for them to adapt. In Ethiopia, the unique environments that support already-endangered species are becoming less hospitable as climate change is causing longer dry periods and shrinking the available water resources.

### 4.4.2 The need for climate-smart strategies

For poor countries like Ethiopia, climate change poses a greater challenge as mitigation and adaptation strategies will need to be coherent with the need to foster economic growth and improve the livelihoods of citizens. In Ethiopia, the agricultural sector (including forestry) is currently responsible for an estimated 85% of greenhouse gas (GHG) emissions (FDRE, 2011) and is also a key driver of deforestation. At the same time, climate change will have significant negative impacts on many agricultural communities, particularly smallholders and poor farmers who have limited capacity to adapt to adverse shocks (Howden et al., 2007). Thus, both mitigation efforts to reduce GHG emissions and adaptation measures to maintain sustainable production are of global significance.

With the overall vision of sustaining current fast economic growth while increasing resilience and keeping GHG emissions low, the Government of Ethiopia has designed its Climate-Resilient Green Economy (CRGE) strategy. The CRGE strategy sets a target of making Ethiopia a middle-income country by the year 2025 while keeping the amount of GHG emissions at the current level of 150 Mt $CO_2$e (FDRE, 2011). This is an ambitious target in comparison to the 400 MT $CO_2$e GHG emissions that would result if the country chooses to take the alternative pathway of conventional development. The GTP also lays out the basis for building this economy. The GTP addresses climate change as a crosscutting issue under the strategic priority of “environment and climate change”. It outlines its CRGE as one of the key policies for developing long-term sustainability in the context of climate change and emphasises the need to implement climate-resilient strategies as a way to address development losses caused by climate change (MoFED, 2010).

One of the pillars for the CRGE strategy in the agricultural sector is the adoption and diffusion of various climate-smart strategies for improving crop and livestock production for higher food security and farmer income while reducing emissions (FDRE, 2011). Accordingly, the CRGE strategy for the agricultural sector has identified about 41 promising climate change adaptation options to

support both crop and livestock farming systems and build resilience against the risks of current climate variability and future climate change. The key aim of supporting smallholder farmers to adopt climate-smart agriculture[7] practices is to provide an opportunity to enhance productivity, and improve the resilience of smallholder systems to extreme weather events. Climate-smart agriculture can also sequester carbon in trees and soils providing climate change mitigation co-benefits and enhancing development/rehabilitation of the natural resource base and more sustainable and efficient use of natural resources.

Under climate change, increasing and sustaining food production is a scientific and policy challenge. There is lack of information on factors that hinder or promote adoption of multiple climate-smart practices and on the synergies among such practices in increasing household resilience by improving agricultural income. Teklewold et al. (2017) revealed that a farm with a combination of climate-smart practices will have a relative advantage in the future in a warmer and moisture-stressed climate, which will encourage more farmers to adopt risk-increasing inputs (such as fertiliser and modern seeds) in combination with risk-decreasing inputs (such as agricultural water management practices). Hence, a package approach rather than a piecemeal approach is needed to maximise the synergies implicit in various climate-smart practices. This implies policymakers should focus their strategies on promoting the application of combinations of climate-smart practices rather than the adoption of a practice in isolation to earn higher farm incomes. The other important issue is providing farmers with better rainfall information/forecasts in terms of amount, timing and distribution targeted with reference to the agroecological settings of their farm plots.

## 4.5 Science and technology drivers

The Ethiopian government has put agriculture at the heart of its policies to generate economic growth and development. To achieve this objective, its Agricultural Development-Led Industrialisation (ADLI) development strategy was launched in 1992–1993. The strategy is based on agriculture as the primary stimulus to generate increased output, employment and income, using land management, on-farm, technology (such as chemical fertilisers, soil and water conservation), improved seed, extension services, and credit facilities.

### 4.5.1 The impacts of agricultural inputs

Objective evidence on the impacts of agricultural technologies and practices on ecosystem services is lacking in the Ethiopian context. The adoption of improved farm inputs (such as seeds, herbicide, pesticides and fertilisers) affects poverty and economic growth in different ways. Improved inputs can increase productivity and income. However, their increased use may negatively impact on ecosystem services such as such as soil fertility, water, biodiversity, air quality and climate.

The use of agricultural technology in Ethiopia is trivial compared to other developing countries. For instance, supplementing agricultural systems with inorganic fertiliser has allowed Ethiopian farmers to increase area yields dramatically in recent decades. However, due to inefficiencies in

[7] Climate-smart agriculture is composed of the following pillars — sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; reducing and/or removing greenhouse gas (GHG) emissions, where possible, and enhancing sustainable and efficient use of natural resources.

fertiliser application and crop uptake, increases in fertiliser use have impacted soil fertility and GHG emissions. Nitrate leaching and ammonium-based fertilisers contribute to soil acidification, while the inefficient use of fertiliser is also a major source of nitrous oxide ($N_2O$). $N_2O$ emissions have contributed to GHG emissions. Furthermore, the effects of the unbalanced use of fertiliser on soil fertility (the gap between recommended dose and type of fertiliser and its actual use in fields) has become evident in recent years, especially the use of urea. As a result, declining soil fertility is significant in Ethiopia (IFDC, 2015).

Cognisant of this problem, the Ethiopian government is addressing soil depletion caused primarily by intensive cropping and overgrazing with the end goal of sustainably increasing productivity. The Fertiliser Blending Programme was launched in 2013 to oversee the establishment of four high-capacity blending facilities. In addition, the Integrated Soil Fertility Management (ISFM) project and the Ethiopian Soil Information System (EthioSIS) are designed to map and assess the soil nutrient needs of each area, aiding the creation of optimal fertiliser blends and informing application rates.[8]

The Ethiopian government is also promoting improved seed varieties. The adoption of high-yielding wheat and maize varieties has been extensive in Ethiopia. Environmental concerns around improved seeds relate to their high-input requirements such as increased fertiliser and pesticide, which may negatively impact soil conditions and biodiversity, and threaten genetic diversity, as modern crop varieties frequently displace many local varieties. Furthermore, Ethiopian farmers have increasingly used chemical pesticides to limit crop losses from pests, diseases and weeds, which then leach into soil and water, affecting biodiversity.

Changes in agricultural technologies have different socioeconomic impacts. For instance, the Green Revolution in the 1950s and 1960s promoted the use of high-yielding crop varieties and fertiliser to increase food production by boosting a handful of crop species — particularly rice, wheat and maize (Gómez et al., 2013). However, although this increased food availability, it did not necessarily translate into enhanced nutrition for the poor (Beuchelt & Badstue, 2013). The Green Revolution and other past interventions have had profound effects on human health in terms of micronutrient deficiencies known as the 'hidden hunger' — a trend towards a simplification of diets and accompanying nutritional degradation (Fanzo et al., 2013).

The use of agrochemicals, including pesticides, herbicides and fungicides were the driving forces behind the Green Revolution era. These agricultural inputs increase crop production and yields and help manage pest and weeds — but at the expense of the natural environment and human health (Van Hoi et al., 2009; 2013). Aside from nutrient deficiencies, farmers in developing countries — and especially smallholders — who use pesticides are at a high risk of exposure to toxic chemicals due to mismanagement (Ngowi et al., 2007; Williamson et al., 2008). Several studies highlight these issues in Ethiopia. Belay et al. (2015) reported that smallholder vegetable farmers in the Central Rift Valley of Ethiopia are exposed to pesticide hazards due to unsafe storage facilities, the lack of protective equipment when applying pesticides, and unsafe disposal of containers. Begna (2015) found a dramatic decline in the honeybee colony and honey yield mainly attributed to the indiscriminate application of pesticides in three districts of Amhara, causing the destruction of 22,987 honeybee colonies and incurring an economic loss amounting to US$819,291.37 (ibid).

[8] See www.fao.org/3/a-i4181e.pdf

Finally, Ethiopia's agriculture is highly dominated by farming practices that rely on animal traction. This is less productive and more labour intensive compared to mechanisation. This has an impact on welfare, especially for women, whose labour demands include land preparation, post-harvest management and transfer of agricultural produce, fetching water, and childcare (van Eredewijk & Danielsen, 2015). As a result, women have a higher workload, which prohibits them from pursuing other home-based activities such as childcare or earning an additional income from off-farm labour.

### 4.5.2 Information and communication technologies

The Ethiopian government aims to strengthen information dissemination to smallholder farmers through the use of information and communication technologies (ICTs). In 2014, the Agricultural Transformation Agency (ATA), in collaboration with MoANR and the Ethiopian Institute of Agricultural Research, launched an interactive voice response/short-messaging service (IVR/SMS) platform in 21 pilot *woredas* in four regional states of Ethiopia (Oromia, Amhara, Tigray and SNNPR). The platform was then expanded to all *woredas* across the country five months after the pilot phase. The objective is to develop and deliver information via the IVR/SMS platform across Ethiopia to farmers, development agents and agricultural officers on key staple crops, household irrigation, and other crops such as cotton, with the capacity to expand the service to include information on other essential MoANR priorities in the future. The project aims to provide smallholder farmers real-time and immediate access to pertinent agronomic information to help them make better-informed decisions, share information on best practice and create a framework for knowledge sharing among farmers, experts and other stakeholders implementing farmer-targeted interventions. The IVR/SMS approach will complement extension services by sharing information and knowledge, and enhancing skills development in the adoption of improved agricultural technologies. It will also facilitate linkages with other institutional support services (such as input supply, output marketing and credit).

### 4.5.3 The impacts of Ethiopia's Agricultural Growth Programme

The Ethiopian government introduced the AGP with the objective of improving agricultural productivity and enhancing the production efficiency of smallholder farmers. Despite potential positive impacts, there are also potentially some negative socioeconomic impacts. Most of the sub-projects planned under the AGP II will vary in a scale. Sub-projects include SSI and micro-irrigation, rural road construction, building and managing new market centres, watershed management and introducing improved agricultural technologies. However, without appropriate planning and design or local environmental impact assessments, these sub-projects may have localised, site-specific and perhaps reversible environmental impacts. For example:

- Agricultural intensification as a result of irrigation may introduce new and invasive species,
- Infrastructure sub-projects may increase land degradation if not properly managed,
- Land acquisition may lead to property losses,
- Implementing SSIs may lead to water-user conflict between upstream and downstream communities,
- Intensive agricultural practices may increase the use of agrochemicals,
- Rehabilitation of degraded areas may limit community access to some natural resources,

- The use of hazardous laboratory chemicals in animal health services and soil testing laboratories may cause environmental pollution and pose a risk to human health,
- Increased salinity of soil in irrigated agriculture due to inefficient water application methods,
- Introduction of exotic livestock species may reduce livestock diversity and introduce new diseases, and
- Poorly planned watershed management sub-projects may result in the introduction of invasive species.

## 4.6 Sociopolitical drivers

### 4.6.1 The impacts of agricultural policies and institutions

Ethiopia's ADLI strategy builds on the development theories of the 1960s, where smallholder agriculture must be developed first to facilitate demand for industrial commodities and inputs. ADLI is defined as the 'development strategy which aims to achieve initial industrialisation through robust agricultural growth and close linkage between the agricultural and industrial sector'.

Since the late 2000s, ADLI has been gradually complemented by efforts to support a process of structural transformation. GTP I increasingly promoted light manufacturing in key sectors where the country has a perceived comparative advantage (such as clothing, leather, agribusiness, cement and metal). This was supported by a two-pronged industrial policy: cross-cutting sectoral support (in the form of tax incentives and preferential access to land, credit and foreign exchange) and a reliance on industrial parks as a tool to attract foreign direct investment (FDI). Where progress in GTP I had been modest, GTP II (2015–2020) put an even stronger emphasis on structural transformation, industrialisation, urbanisation and export promotion. GTP II has an ambitious strategy for Ethiopia to reach middle-income status by 2025 through inclusive and sustainable growth. A critical theme in the GTP II is the CRGE strategy initiative launched in 2011. Its objectives include orienting economic development to improve resilience to climate risks and lower GHG emissions.

By and large, these key government policies and strategies shape agricultural systems in the country. In Ethiopia, the government is the key actor, with policies acting as a dynamic driver to establish developmentalism and invite the assistance of donors and international organisations, and donor assistance must align closely to the development strategy. The federal institutions responsible for managing and implementing the government's agricultural and environmental policies and its supporting strategies include MoANR, the Ministry of Environment, Forest and Climate Change (MEFCC), the Ethiopian Investment Commission and the Ethiopian Biodiversity Institute.

In terms of implementation, government effectiveness is strong in Ethiopia. However, it is less effective at fetching objective evidences to inform policy choices or conduct private-sector consultations (World Bank, 2016). Weak enforcement of laws and regulations is a key bottleneck and is one of the main challenges in the development of the forest sector. Moreover, rules and regulations differ at regional and federal levels, which challenges the consistent implementation of forest laws. These inconsistencies have created huge legal barriers for forest-sector development.

Law enforcement agencies are hindered by the lack directives or guidance for implementing laws and regulations.

### 4.6.2 The impacts of agricultural research and extension services

Ethiopia's rural development policy prioritises the transformation of smallholder subsistence agriculture to market-orientated production. The government is investing heavily in agriculture with a focus on public extension services by deploying considerable human and financial resources. For instance, the Ethiopian government has allocated more than 16% of its annual budget to agricultural development and attained an annual mean agricultural growth rate of more than 8% for the last eight years. This is significantly higher than the agreement among Comprehensive Africa Agriculture Development Programme (CAADP) member countries to allocate 10% of their national budgets to agricultural development and to attain a mean annual agricultural growth rate of 6% (NEPAD, 2009).

Under Ethiopia's current ADLI strategy, the extension system remains a critical tool. The government firmly believes that an effective and efficient extension system must play an important role in bringing about agricultural growth and transformation by facilitating the adoption and utilisation of yield- and quality-improving agricultural technologies. Over the years, a number of reforms have been made to address gaps in the various systems adopted. In 1993, the SG-2000 project — an initiative of the Sasakawa Africa Association (SAA) — began demonstrating agricultural technologies within the country. The approach was later used as a basis for the current extension package services. The demonstration conducted by SG-2000 clearly showed great success and captured the attention of top-level officials and development practitioners, encouraging them to replicate the experience of SG-2000 nationwide. In line with this, in 1995 the government designed and implemented a participatory demonstration and training extension system (PADETES). Its main objective was to improve participation of smallholder farmers and demonstrate improved agricultural technologies for improved productivity, incomes and rural livelihoods.

Ethiopia has recently developed and deployed a participatory extension system (PES), a modified version of PADETES, although the approach is not yet fully implemented nationwide. PES was started in 2010, following the commencement of GTP I, as a means of strengthening participatory extension services. Ethiopia's extension system has great potential to help farmers throughout the country. With approximately 21 development agents per 10,000 farmers, and even more in high-potential areas, Ethiopia has one of the densest agricultural extension systems in the world (EATA, 2014). The approach organises farmers into development groups and social networks (development groups with 25–30 members on average and 'one-in-five' groups consisting of one model farmer as a leader and five farmers as followers) and farmer training centres (FTCs). The FTC-based agricultural extension approach coupled with farmer groups provides an entry point for providing bottom-up grassroots extension services. Assisted by development agents, FTCs and farmer groups are expected to provide a wide range of agricultural extension services to farmers in their vicinities such as farmer training, demonstrating improved farming techniques, and providing market information and advisory services. Currently, the government has established close to 11,000 FTCs and 25 agricultural technical vocational education and training programmes (ATVETs) to train development agents in different areas of specialisation.

However, despite efforts to make the extension system more effective and efficient, it is not producing the desired results. Many yield- and quality-improving technologies have been generated, but they are not reaching smallholder farmers. Equally, the agricultural sector is not reaching its full potential in terms of attaining food self-sufficiency and reducing poverty. On reason for this has been poor implementation and insufficient strategic interventions to overcome system-wide bottlenecks. The government's new national strategy for Ethiopia's agricultural extension systems aims to overcome these issues (EATA, 2014).

In addition, the government has also established a National Agricultural Research System (NARS). It consists of eight public research institutions: the Ethiopian Institute of Agricultural Research (EIAR), seven regional research institutes, and 69 research centres under respective jurisdictions. NARS plays a fundamental role in agriculture by generating, adapting and adopting improved technologies, and disseminating information and knowledge to farmers. For instance, the EIAR is organised into four main work processes covering crops, livestock, soil and water, and agricultural mechanisation. Its agricultural economics, extension and gender directorate generates research information on policy-related issues. The research strategies are to adapt technologies from abroad to the Ethiopian agriculture context and generate new technologies through research locally. The research is undertaken in different agroecological areas and farming systems to address specific needs farmers.

The research agenda is in line with the government's policy priorities. It aims to develop market-competitive agricultural technologies that will contribute to increased productivity, better nutrition, food security, economic development and conservation. Another objective is to demonstrate, popularise, catalyse, scale-up and scale-out improved technologies by establishing effective partnerships with stakeholders and build research-extension-farmer linkages with FTCs, agroprocessers, CGIAR agricultural research centres, NGOs and others.

### 4.6.3 The impacts of Ethiopia's land tenure system

In Ethiopia, land is the principal resource. Important provision about property rights in the Constitution (sub-Article 7) says that "Every Ethiopian shall have the full right to the immovable property he builds and to the permanent improvements he brings about on the land by his labor or capital. This right shall include the right to alienate, to bequeath, and, where the right of use expires, to remove his property, transfer his title, or claim compensation for it". The people are not therefore entitled to sell or use land as a means of exchange.

The Constitution states (Article 51) that the federal government shall enact laws for the utilisation and conservation of land and other natural resources. Article 52 also states that regional governments have the duty to administer land and other natural resources according to federal laws. The Rural Land Administration Proclamation No 89/1997 law vested regional governments with the power to administrate land (defined as "the assignment of holding rights and the execution of distribution of holdings" (Article 2, sub-Article 6) (Adal, 2002). Holding rights were also defined as "the right any peasant shall have to use rural land for agricultural purposes as well as to lease and, while the right remains in effect, bequeath it to his family member; and includes the right to acquire property thereon, by his labor or capital, and to sell, exchange and bequeath same" (Article 2, sub-Article 3). Federal land administration and land-use proclamations provide

unlimited periods of use rights to farmers, pastoralists and semi-pastoralists, and they give the power to regions to enact their own proclamations with regard to federal proclamations.

In 2005, the federal government issued a revised proclamation, the Rural Land Administration and Land Use Proclamation No 456/2005. The proclamation emphasised the importance of land measurement, registration and certification of those holding rights, but the rights remain restricted. Following the issuance of the 2005 proclamation, regional governments passed their own respective rural land laws. Both the federal and regional proclamations give rights to rural landholders to use rural lands for the purposes of agriculture and natural resource development and to inherit, bequeath and lease the land. The proclamations impose obligations on landholders to "properly manage" and use rural lands, farmlands and grazing lands.

Regarding forest ownership, the current forest proclamation recognises both state and private forest ownership, although community ownership is treated as private ownership. However, forest-resource use rights are still unclear. The proclamation affects forest-dependent communities and local communities, whose livelihoods depend directly or indirectly on forest resources and who are uncertain about their use rights over the forests in their localities. This has left the forests as classic 'open access' resources where everybody has access and no proper control is exerted by either formal or customary mechanisms. This has remained a disincentive to forest-dependent communities to invest in forest management and development activities. However, a new forest-management and land-use proclamation is being developed that will give MEFCC a mandate to manage forest land (the 15.5% of the total land area currently designated as forest land).

In terms of land-use planning, land allocation has led to unguided and uncontrolled land use without due consideration of the land's best potential use or conserving and safeguarding the environment (Gebeyehu et al., 2017). This has resulted in the use of prime agricultural land for industry, construction and human settlements, and wetlands and reserve areas for agriculture (Gebeyehu et al., 2017). Consequently, important wetland ecosystems, high-potential arable lands, grasslands and forest areas have been converted to urban centres and industrial sites, with undesirable environmental and social consequences. As a result, government officials now want to develop a better understanding of the importance of land-use planning.

Recently, the Government of Ethiopia is developing a national land-use policy and integrated land-use plan. This is now a top priority for the nation's development agenda. The land-use plan will have multifaceted benefits. It will facilitate coordination of the allocation of land to avoid or minimise sectoral competition and conflict over land use, and create a system that regulates land use in the country. It will align national, sectoral and regional demand for land and thereby protect biodiversity and environmental hot spots.

Land use in Ethiopia can be categorised generally into agricultural land, permanent crops, forests and other land, as shown in Table 12. Data from FAOSTAT shows that in 2012 the land-use estimate in the country indicates that about 15.3% is arable land while the rest is covered by forest (12.4%), permanent crops (1.1%) and other land use (71.1%).

**Table 12. Changes in land use (1900–2000 and 2000–2012)**

| | Area (1,000 ha) | | Annual growth (%) | |
|---|---|---|---|---|
| | 1900–2000 | 2000–2012 | 1900–2000 | 2000–2012 |
| Land area | 1,000,000 | 1,000,000 | 0 | 0 |
| Arable land | 9,956.13 | 12,766.82 | 0.00 | 3.44 |
| Permanent crops | 587.63 | 875.85 | 3.24 | 4.52 |
| Forest | 14,198.15 | 12,901.29 | -0.99 | -0.86 |

Source: FAOSTAT, Land Use. https://www.fao.org/faostat/en/#data/RL

### 4.6.4 Key policies for the protection of forests and other habitats in Ethiopia

Policies for protecting forest resources and biodiversity have undergone several changes. To reduce the impact of deforestation and loss of biodiversity, both the federal and regional governments have designed different policies, strategies, programmes and projects. Supported by various donors, international agencies and NGOs, they have made large-scale investments in natural resource management-related activities, such as soil conservation and land rehabilitation. The rehabilitation of degraded lands, which started through food-for-work relief assistance, has become a major component of both federal and regional approaches to mitigate the impact of soil degradation, by focusing on building physical structures to control soil erosion, rehabilitate degraded lands, improve soil and water conservation (for example by building terraces and dams, cut-off drains and micro-basins), and implementing afforestation and revegetation of fragile and hillside areas.

Among others, the Government of Ethiopia's strategic initiatives to promote conservation include ADLI, the Natural Resource Conservation Strategy of Ethiopia, and the Ethiopian Strategic Investment Framework for Sustainable Land Management. Government initiatives have included:

- **Plan for Accelerated and Sustained Development to End Poverty (PASDEP):** Between 2005 and 2010, PASDEP included plans to develop the agricultural sector and commercial farming practices. The plan also promoted forest rehabilitation by setting a target to increase national forest cover from 3.6% to 9% (FDRE, 2006).
- **Growth and Transformation Plan I 2010–2015 (GTP I):** The successor to PASDEP, GTP I aimed to transform Ethiopia into a middle-income country by 2025 through agricultural-led industrialisation. GTP I aimed to double agricultural production to enhance food security at family, regional and national levels by harmonising with the CRGE strategy to develop a green economy. GTP I also had forest targets: increasing agroforestry coverage from 6.06 million hectares to 16.21 million ha, increasing the area of protected forest land with management plans from 0.07 million ha to 2.2 million ha, and also increasing the total forest area from 12 million to 18 million ha. The plan mainly concentrated on the degraded highland parts of the country (MOFED, 2010).
- **Large-scale commercial farming:** GTP I placed a great emphasis on the expansion of large-scale commercial farming and agroindustries, which has had a significant impact on forest resources.

Between 2012 and 2013, 3.31 million ha of land (much of it forested land) was identified and transferred to the federal land bank for transfer to investors (Bekele et al., 2015). During the first three years of the planning period for GTP I, a total of 473 thousand hectares of land was reportedly transferred to investors (FDRE, 2014).

- **Growth and Transformation Plan II 2016–2020 (GTP II):** GTP II aimed to "protect, restore and promote sustainable use of terrestrial ecosystems by managing forests, combating desertification, and halting and reversing land degradation and halt biodiversity loss". GTP II aimed to increase forest coverage from 15.5% in 2014–2015 to 20% in 2019–2020 and reduce deforestation by half. Around 10.8 million hectares of land was planned to be rehabilitated, increasing the total area of land rehabilitated to 22.5 million ha.
- **Climate-Resilient Green Economy strategy (CRGE):** The CRGE launched in 2010 and emphasised forest-sector development and conservation activities. Forestry is one of the key pillars of the CRGE strategy. The CRGE aims to reverse the current deforestation and forest degradation trends by tackling major drivers and also by protecting and increasing the economic and ecosystem services that can be provided by the forest sector. These activities can be achieved through effective implementation of agricultural intensification, the introduction of efficient energy-use technologies, increasing afforestation and reforestation, improved forest management and the rehabilitation of degraded lands. It also aims to reduce GHG emissions in the agricultural sector while building resilience to climate change.
- **Ministry of Agriculture and Natural Resources (MoANR):** A key objective of MoANR is to reduce land degradation and improve productivity, and this is reflected in various sectoral and national strategies, investment frameworks, plans and programmes. Ethiopia's National Action Programme of the United Nations Convention to Combat Desertification (UNCCD) recognises "land degradation, soil erosion, deforestation, loss of biodiversity, desertification, and recurrent drought" as priority issues for the country (see also Section 4.7.3). To this end, the Ethiopian government, together with development partners, has implemented several programmes at scale to boost agricultural productivity while protecting natural resources, reducing vulnerability and increasing resilience. Activities include sustainable land management, land tenure certification, safety nets and early warning systems, small-scale irrigation, and extension services.

### 4.6.5 Key policies driving agricultural production systems

Both GTP I and GTPII focused on accelerating agricultural productivity through technology adoption and increasing investment. GTP II further aims to reduce degradation and enhance food security by priotising high-value crops and livestock production. The 2010–2020 Agricultural Policy Investment Framework (PIF) aims to align the nation's agricultural sector investment priorities with higher-level goals to transform the sector. The PIF articulates the strategic framework for the sustainable growth of the agricultural sector by the provision of necessary inputs including production-enhancing technologies and technical support via extension services. The PIF also presents policy priorities including productivity increments and conservation activities.

These agricultural policies and strategies provide an overarching plan for economic development on the basis of increased agricultural productivity which also increases employment, incomes, and investable surplus production for the development of other sectors of the economy. As described in Ethiopia's agricultural PIF, the policy gives greater emphasis to food security and disaster risk management practices.

### 4.6.6 Governance and the devolution of power

For centuries, Ethiopia was governed by a highly centralised monarchy. In 1991, the National Peace Conference in Addis Ababa paved the way for the installation of an elected government under a pluralist political system. Key features of the newly constituted political system included an ethnic-based political map and extensive devolution of power to regions. The 1995 Ethiopian Constitution transformed Ethiopia into a federal system of government comprised of the federal state and nine regional states, drawn along the lines of Ethiopia's major language groups, with each having legislative, executive and judicial powers. In addition, two cities (Dire Dawa and Addis Ababa) are administered by the federal government.

The governance structures at the region level follow the same tripartite structure. The regional governments are responsible for implementing economic and social development policies and for maintaining public order. Ethiopia's regional states have followed an asymmetric pace of decentralisation with the four most populous regions (Amhara, Oromia, SNNPR and Tigray) decentralising more rapidly than the other regions including devolution to *woreda* (district) level. The governance structures at the *woreda* and the *kebele* (ward) level also follow the tripartite structure. Almost all sector bureaus at regional levels are represented at *woreda* level. The policies and work of the *woreda* and *kebele* administrations have a great impact on the welfare of citizens and local communities as the different institutions are increasingly involved in community development. With regard to the hierarchy between the federal and regional laws, federal laws are generally considered to be a framework from which regional states derive their respective specific laws.

## 4.7 International drivers: policies, institutions and treaties

The 1995 Constitution enshrines the country's commitment to sustainable development, environmental protection and also the social safety of its citizens and, to this end, Ethiopia has ratified a number of international policies, institutions and treaties that influence agricultural and environmental policies at national level in Ethiopia. Most importantly, Ethiopia is an active participant in global climate change initiatives. These commitments are briefly summarised here.

### 4.7.1 Sustainable Development Goals

The Sustainable Development Goals (SDGs) are a set of 17 interlinked global goals and 169 targets adopted by the United Nations and agreed by world leaders in 2015. The SDGs are designed to end poverty, protect the planet and bring peace and prosperity to everyone. In Ethiopia SDGs have played a significant role in pursuing Ethiopia's renaissance journey: accelerating economic, infrastructure and environmental development, and building democratic systems. The government has aligned the SDG goals with its GTP II national development priorities and also its long-term national development plan (2015–2030), which is currently under preparation (FDRE, 2016).

### 4.7.2 United Nations Framework Convention for Climate Change (UNFCCC)

The UNFCCC is an international environmental convention negotiated at the 1992 United Nations Conference on Environment and Development (UNCED — also known as the Earth Summit) in Rio de Janeiro. The main objective is to "stabilize greenhouse gas concentrations in the atmosphere

at a level that would prevent dangerous anthropogenic interference with the climate system". Ethiopia ratified the convention in 1994 and has actively participated in forest conservation activities since then, through various REDD+ projects and voluntary carbon market schemes (SESA 2017).

### 4.7.3 United Nations Convention to Combat Desertification (UNCCD)

Established in 1994 and ratified by Ethiopia in 1997, UNCCD aims to support arid and semi-arid areas of the world by building national goals for pastoral and semi-pastoral communities (SESA, 2017). The UNCCD initiates the adoption and scaling up of sustainable forest-management policies and practices to prevent soil erosion and flooding, to increase the resilience of nature, and promote the sustainably use of biodiversity. UNCCD plays a significant role as a legally binding instrument for conserving land and soil resources in dryland areas, tackling land degradation, and promoting sustainable economic growth and poverty alleviation (Arbonaut, 2017).

### 4.7.4 United Nations Convention on Biological Diversity

The United Nations Convention on Biological Diversity (CBD) aims to conserve and promote the sustainable use of biological diversity and the equitable sharing and appropriate use of genetic resources globally. Ethiopia ratified the convention in 1994. Its biodiversity conservation activities under the CBD also tie in with REDD+ strategies and forest-sector conservation and development (SESA 2017). The Government of Ethiopia has also ratified other related international and regional treaties, including the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the African-Eurasian Migratory Waterbird Agreement (AEWA) and the Nagoya Protocol (in 2012).

### 4.7.5 Agenda 2063 of the African Union

Agenda 2063 was launched in 2014 and is Africa's blueprint for transforming Africa and provides a strategic framework for inclusive and sustainable development across the continent. Agenda 2063 aims to modernise and increase productivity using science, technology, innovation and Indigenous knowledge. It also aims to modernise African agriculture and agrobusiness through scaled-up value addition and productivity by 2025. The strategy also addresses climate change and environmental issues through the Climate Action in Africa programme. Ethiopia has been actively involved from the beginning and the African Union secretariat has its headquarters in Addis Ababa.

### 4.7.6 New York Declaration on Forests

In September 2014, Ethiopia declared its support for the New York Declaration on Forests and the Bonn Challenge (a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million ha by 2030) by pledging to restore 15 million ha of degraded and deforested lands (nearly a seventh of the country's total area) by 2025. This would achieve the CRGE goal of annual emission mitigation of 130 Mt $CO_2$e from forestry. The National Potential and Priority Maps for Tree-Based Landscape Restoration in Ethiopia, a collaborative project between the MEFCC and the World Resources Institute, assessed and mapped tree-based restoration potential at the national level. The study identified ten forest landscape restoration options, using eight prioritisation criteria, and categorised the options by their level of urgency.

Priority 1 calls for a very urgent response for 11 million ha; Priority 2 for an urgent response for 18 million ha; and Priority 3 a moderately urgent response for 25 million ha.

## 4.8 Agriculture, forestry and biodiversity goals: tackling the disconnects

The Government of Ethiopia has set different goals and targets for agriculture, forestry and biodiversity in its main policies and supporting documents, which are outlined in sections 4.8.1 to 4.8.3. In Section 4.8.4, we then discuss the disconnects between these different sectoral policies and strategies and the key challenges that need to be addressed.

### 4.8.1 Agriculture

Under GTP II, agriculture is defined as the main driver of "rapid and inclusive economic growth and development". According to Ethiopia's CRGE, agricultural land will need to expand by 3.9% per year, on top of continued yield increases, in order to achieve the growth targets set for the agriculture sector by 2030. Under a business-as-usual scenario, 55% of this agricultural land expansion (550,000 hectares per year) could be at the expense of forests, down from 69% in 2011. Technological interventions in the agriculture sector are at the forefront of actions to achieve the CRGE and GTP II objectives of enhancing agricultural productivity and reducing the pressure on forests. The government is also adopting sustainable land management and climate-smart agricultural practices to increase rural incomes, boost food and nutrition security, and reduce crop failure and agrochemical use (especially nitrogen-based fertilisers, pesticides and herbicides).

By 2020, GTP II aimed to:

- Strengthen Ethiopia's capacity to maintain food self-sufficiency by increasing cereal productivity by 47%,
- Reduce carbon emissions in the sector by 25.97 million metric tonnes (with an additional 51.93 million tonnes by 2030) through the use of low-emission inputs and by expanding small-scale irrigation,
- Industrialise agricultural production and increase agricultural productivity by 44%, and
- Reduce the share of employment held by the sector by 7.5% (from 75% to 67.5%).

Key agriculture targets for GTP II included:

- Maintain at least 8% total agricultural production growth,
- Increase production of major food crops from 270.08 to 406.32 million quintals,
- Increase productivity of major food crops from 16 quintals per hectare to 23 quintals/ha,
- Increase the average productivity of stalk cereals by 47.03% from 29 quintals/ha in 2015 to 42.64 quintals/ha by 2020, which would increase the total volume of produce from 115 million quintals to 171.78 million quintals,
- Increase the average productivity of pulse crops by 53.48% from 17.2 quintals/ha in 2015 to 26.4 quintals/ha by 2020, which would increase the total volume of produce from 26.4 million quintals to 38.75 million quintals,
- For coffee, increase total production from 419,980 tonnes to 1,045,040 tonnes,

- Increase the area of land covered by existing horticulture farms from 1,565.1 hectares to 2,466.4 ha and up to 600 ha to new horticulture farms, and
- Transfer new agricultural land to investors (commercial agriculture) and increase land for commercial agriculture from 2.4 million hectares to 3.1 million ha by 2020.

### 4.8.2 Forestry

The Government of Ethiopia has made far-reaching commitments to develop the forest sector, devolve its management, and increase forest cover. GTP II set out to:

- Increase forest cover from the current 15% to 20% (from about 16.67 million to 22.09 million hectares): of this forest cover, about 16 million ha is natural forest, of which 19% (or 3% of total land area) is high forest and the remainder is plantation.
- Double the contribution of the forest sector to GDP from 4% to 8%: this also contributes towards improved ecosystem services.
- Increase rehabilitated degraded areas from the current 11.7 million hectares to 22.5 million ha and increase watershed management from the current 12.2 million ha to 41.4 million ha.
- In the longer term, the government is targeting 22 million hectares for broader landscape restoration by 2030, in line with the CRGE ambitions: afforestation on two million ha, reforestation on one million ha, and improved forest management of two million ha of high forests and two million ha of woodlands, to be achieved by 2030.
- The CRGE also aims to reforest three million hectares with plantations and, as part of the Bonn Challenge, restore 15 million ha of degraded land by 2030 through reforestation and forest restoration, including agroforestry.

For MoANR, a key objective is to reduce land degradation and improve the productivity of natural resources. Ethiopia's National Action Programme under the UNCCD recognises "land degradation, soil erosion, deforestation, loss of biodiversity, desertification, and recurrent drought" as priority issues. Working with development partners, MoANR has implemented several programmes at scale to boost agricultural productivity while protecting natural resources, reducing vulnerability and increasing resilience. These activities include sustainable land management, land tenure certification, safety nets and early warning systems, small-scale irrigation schemes and extension services.

For the CRGE strategy, REDD+ is one of its four fast-track initiatives as increases in forest investment (notably through REDD+) present good opportunities for forest conservation. In addition to activities to reduce pressure on forests, the strategy also prioritises activities to reduce demand for biomass fuel (firewood and charcoal) by promoting the use of cleaner cooking technologies. Other initiatives include reducing soil-based GHG emissions by intensifying agriculture, improving inputs and residue management, and creating new agricultural land in degraded areas through irrigation. The CRGE also aims to increase the total industrial timber supply for market from 263,959 tonnes (of which 57,815 is imported) to 700,000 tonnes.

### 4.8.3 Biodiversity

Protecting biodiversity is high on the federal government's policy agenda. Ethiopia's first National Biodiversity Strategy and Action Plan (NBSAP) (2005–2010), aimed to guide national efforts in conservation, sustainable utilisation and fair access to natural resources (through benefit sharing).

The second NBSAP (2015–2020) included national targets for determining the spatial priorities to establish and safeguard protected areas, reduce agricultural expansion, increase forest cover and manage wetlands with the following four strategic objectives:

- Effective management of protected areas,
- Sustainable use and management of ecosystems outside protected areas by 2020,
- Equitable sharing of benefits among the community for further sustainable use and marketing of biodiversity, and
- Conservation of the country's biodiversity through a combination of in-situ and ex-situ conservation mechanisms.

### 4.8.4 Addressing policy disconnects: key challenges

The goals and targets set by the Ethiopian government for agriculture and forestry clearly indicate disconnects between sectoral policies and strategies. If targets to reduce and reverse deforestation and loss of biodiversity remain in place, agricultural and forest policies could be on a collision course. Challenges to overcoming disconnects include the following (Franks et al., 2017):

- **Weak functional links and coordination between ministries:** Sectoral ministries promote their mandates (such as investment, agriculture, environment, energy and forestry), but mechanisms to align these mandates are often weak. Cross-sectoral synergy in policy, joint planning and implementation is rare. A lack of coordination among the relevant institutions is contributing to increased deforestation and loss of biodiversity, with overlapping mandates and activities between different government bodies. For example, the rehabilitation of degraded areas is currently being undertaken by both MoANR and MEFCC.
- **Scale disconnects:** Discrepancies exist at various scales (national, regional and local) in the capacities, responsibilities and priorities of key stakeholders in making and implementing land-use decisions.
- **Restructuring:** Frequent restructuring or institutional reorganisation of ministries with changing mandates has created problems. Collaboration among line ministries (for example between MoANR and MEFCC) is still relatively weak. The changing mandates have caused confusion over land management, especially for reforestation on degraded agricultural land.
- **Information gaps:** In some cases, information necessary for the effective management of risks and trade-offs (such as spatial data on deforestation and threats to biodiversity) exists. But it is either publicly unavailable or lacking completely.
- **Lack of human and technical resources:** At the regional level, environmental bureaux and agencies have a wide range of environmental responsibilities and roles, some of which overlap with sectoral mandates. However, these responsibilities and roles are not matched with adequate human and technical resources. All regional states and local governments (zones, *woredas* and *kebeles*) face technical capacity constraints to effectively set, implement and/or enforce environmental laws, regulations and standards.

- **Lack or weak implementation capacity:** This remains a challenge at *woreda* level, despite policies and institutional framework for sustainable natural resource management.
- **Lack of political support:** The targets of GTP II and its strong alignment with CRGE suggest that protecting biodiversity is fairly high on the federal government's policy agenda. However, at the sectoral level (such as in agriculture and forestry), there is little evidence that this priority is being addressed. In addition to the challenges posed by institutional change, there is a lack of political support among forestry and agriculture policymakers for conserving biodiversity.

For more details on the barriers to overcoming disconnects between sectoral policies and supporting strategies, see Franks et al. (2017).

# 5. Conclusions

The agriculture sector continues to dominate the Ethiopian economy. Ethiopia has long recognised the importance of agriculture sector transformation for stability and growth. Over the last two decades, Ethiopia has put agriculture at the forefront of its economic development vision, as encapsulated in its Growth and Transformation Plan. Founded on the experiences of PASDEP, GTP I (2010–2015) was an advanced strategy intended to sustain rapid and broad-based growth to eventually end poverty by bolstering smallholder productivity, enhancing marketing systems, upgrading the participation of the private sector, increasing the volume of irrigated land and improving food security. Meanwhile, GTP II (2016–2020) laid out a plan for dramatic structural transformation: shifting from an agrarian economy to one more geared towards manufacturing and services, with the overarching goal of making Ethiopia a middle-income country by 2025. GTP II envisaged 11% average annual economic growth with an improved trade balance and higher foreign reserves.

In terms of the social and environmental trade-offs, impacts and associated risks of different agricultural development pathways in Ethiopia, this contextual analysis report has highlighted that agricultural expansion is the most significant driver of deforestation and loss of biodiversity in the country. Foreign direct investment — particularly large-scale agricultural investments — is also a key driver for the loss of natural forest as well as biodiversity. The transfer of land to large-scale commercial farms has intensified the level of deforestation and habitat loss to a greater extent as these schemes are established in dense forest areas instead of grasslands or other lands with lower tree cover. As a result of agricultural expansion and resettlement, forest resources have become depleted at a large scale. In addition, widespread poverty and food insecurity has driven deforestation and biodiversity loss as poor communities depend on forests for sources of energy, food, timber and income.

Ethiopia's population size, age composition and population density is also a primary underlying driver due to the increased demand for food, agricultural land and fuel, affecting both the agriculture sector and ecosystems. Meeting increasing food demand while maintaining the health and resilience of agricultural and natural ecosystems is one of the greatest challenges facing the country.

Agricultural technologies also have different socioeconomic impacts. Although some of these impacts are positive, the increased use of agricultural technologies also negatively impacts on ecosystem services such as soil fertility, water, biodiversity, air quality and climate. The increased use of improved seed also impacts on biodiversity and threatens genetic diversity, as modern crop varieties displace many local varieties. Climate change and climate variability is also expected to have a significant impact on ecosystems and biodiversity. Finally, the lack of land-use plans has led to unguided and uncontrolled land use. This has resulted in the use of prime agricultural land for industry, construction and human settlements, and the use of wetlands and reserve areas for agriculture.

# References

Abebe, G (2017) Long-term climate data description in Ethiopia. *Data in Brief* 14: 371–392.

Adal, Y (2002) Review of landholding systems and policies in Ethiopia under the different regimes. EEA/Ethiopian Economic Policy Research Institute, Working Paper No 5/2002.

Adger, N, Agrawala, S, Mirza, MMQ, Conde, C, O'Brien, K, Pulhin, J, Pulwarty, R, Smit, B and Takahashi, T (eds.) (2007) Assessment of adaptation practices, options, constraints and capacity. In: Parry ML, Canziani, OF, Palutikof, JP, van der Linden PJ and Hanson, CE (eds). *Climate Change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. www.ipcc.ch/report/ar4/wg2

Agarwal, B (1994) A Field of One's Own: Gender and Land Rights in South Asia. Cambridge University Press.

Aguilar, A, Carranza, E, Goldstein, M, Kilic, T and Oseni, G (2014) Decomposition of Gender Differentials in Agriculture Productivity in Ethiopia. World Bank. https://bit.ly/3IhgZri

Alemu, B, Garedew, E, Eshetu, Z and Kassa, H (2015) Land use and land cover changes and associated driving forces in north western lowlands of Ethiopia. *International Research Journal of Agricultural Science and Soil Science* 5(1): 28–44.

Amede, T, Auricht, C, Boffa, JM, Dixon, J, Mallawaarachchi, T, Rukuni, M and Deneke, TT (2017) A farming system framework for investment planning and priority setting in Ethiopia. ACIAR Technical Reports 90. https://bit.ly/3Ih4aNC

Andersson, C, Mekonnen, A and Stage, J (2011) Impacts of the productive safety net program in Ethiopia on livestock and tree holdings of rural households. *Journal of Development Economics* 94(1): 190–126.

Arbonaut (2017). Consultancy services for carrying out strategic environmental and social assessment of REDD+ options and development of environmental and social management framework for Uganda's REDD+ strategy option. Strategic Environmental and Social Assessment (SESA), Arbonaut Ltd., Finland.

ATA (2014). Soil Fertility Mapping and Fertilizer Blending. Agricultural Transformation Agency (ATA), Addis Ababa, Ethiopia.

ATA (2015) Agricultural Transformation Agenda: progress report covering 2011–15 GTP I period. Agricultural Transformation Agency (ATA), Addis Ababa. https://bit.ly/3qBuJXN

Awulachew, SB, Denekew, A and Luelseged, M (2007) Status of irrigation development in Ethiopia. International Water Management Institute (IWMI), Addis Ababa.

Awulachew, SB, Erkossa, T and Namara, RE (2010) Irrigation potential in Ethiopia: constraints and opportunities for enhancing the system. International Water Management Institute.

Baumgartner, P, von Braun, J, Abebaw, D and Müller, M (2015) Impacts of large-scale land investments on income, prices, and employment: empirical analyses in Ethiopia. *World Development* 72: 175–190.

Begna, D (2015) Assessment of Pesticides Use and its Economic Impact on the Apiculture Subsector in Selected Districts of Amhara Region, Ethiopia. *Journal of Environmental & Analytical Toxicology* 5(3): 1–4. https://bit.ly/3AaiLaI

Bekele, M, Tesfaye, Y, Mohammed, Z, Zewdie, S, Tebikew, Y, Brockhaus, M and Kassa, H (2015) The context of REDD+ in Ethiopia: Drivers, agents and institutions. CIFOR. https://bit.ly/3qD7kFc

Belay, TM, Arthur, PJM and Peter, JMO (2015). Pesticide use practice among smallholder vegetable farmers in Ethiopian Central Rift Valley. Environment, Development and Sustainability.

Berhane, G, Paulos, Z, Tafere, K and Tamru, S (2011) Food grain consumption and calorie intake patterns in Ethiopia. IFPRI. https://bit.ly/3KmFrsR

Besada, H (2017) Ethiopia: Natural Resource Exploitation and Emerging Investors. *Revue Gouvernance* 14(1): 66–87. https://bit.ly/3tzehsZ

Beuchelt, TD and Badstue, L (2013) Gender, nutrition- and climate-smart food production: Opportunities and trade-offs. *Food Security* 5: 709–721. https://bit.ly/3qFV8Uw

Bezabih, M (2008) Agrobiodiversity conservation under an imperfect seed system: the role of community seed banking schemes. *Agricultural Economics* 38(1): 77–87. https://bit.ly/3Ae9Bds

Borras, SJ and Franco, JC (2012) Global Land Grabbing and Trajectories of Agrarian Change: A Preliminary Analysis. *Journal of Agrarian Change* 12(1): 34–59. https://bit.ly/3rnP1TM

Byerlee, D, Spielman, DJ, Alemu, D and Gautam, M (2007) Policies to promote cereal intensification in Ethiopia: a review of evidence and experience. IFPRI. https://bit.ly/3KlO7Qe

Chaplin-Kramera, R, Sharp, RP, Mandle, L, Sim, S, Johnson, J, Butnar, I, Canals, LM, Eichelberger, BA, Ramler, I, Mueller, C, McLachlan, N, Yousefi, A, King, H and Kareiva, PM (2015) Spatial patterns of agricultural expansion determine impacts on biodiversity and carbon storage. *PNAS* 112(24): 7,402– 7,407. https://bit.ly/3Kkfj1Z

Conway, D, Mould, C and Bewket, W (2004) Over one century of rainfall and temperature observations in Addis Ababa, Ethiopia. *International Journal of Climatology* 24: 77–91. https://bit.ly/3AakZqA

Conway, D and Schipper, ELF (2011) Adaptation to climate change in Africa: challenges and opportunities identified from Ethiopia. *Global Environmental Change* 21(1): 227–237.

Co$ting Nature, www.policysupport.org/costingnature

Cotula, L, Oya, C, A Codjoe, E, Eid, A, Kakraba-Ampeh, M, Keeley, J, Kidewa, AL, Makwarimba, M, Seide, WM, Nasha, WO, Asare, RO and Rizzo, M (2014) Testing claims about large land deals in Africa: findings from a multi-country study. *Journal of Development Studies* 50(7): 903–925. https://bit.ly/3nAYLsQ

Cotula, L, Vermeulen, S, Leonard, R and Keeley, J (2009) Land grab or development opportunity? Agricultural investment and international land deals in Africa. IIED, FAO and IFAD. https://pubs.iied.org/12561iied

Crummy, D (2000) Land and society in the Christian Kingdom of Ethiopia. University of Illinois Press.

CSA (2003) Welfare monitoring survey. Addis Ababa: Central Statistics Authority.

CSA (2005) Agricultural sample survey 2004/2005 (1997 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2006) Agricultural sample survey 2005/2006 (1998 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2007) Agricultural sample survey 2006/2007 (1999 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2008) Agricultural sample survey 2007/2008 (2000 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2009) Agricultural sample survey 2008/2009 (2001 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2010) Agricultural sample survey 2009/2010 (2002 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2011) Agricultural sample survey 2010/2011 (2003 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2011b) Welfare monitoring survey. Addis Ababa: Central Statistics Authority.

CSA (2012a) Agricultural sample survey 2011/2012 (2004 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2012b) Ethiopia demographic and health survey 2011. Central Statistical Agency and ICF International. https://bit.ly/3JiV2Yy

CSA (2013a) Agricultural sample survey 2012/2013 (2005 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2013b) Population Projections for Ethiopia 2007–2037, Addis Ababa, Ethiopia.

CSA (2014a) Agricultural sample survey 2013/2014 (2006 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA (2014b) Ethiopia mini demographic and health survey. Central Statistical Agency, Addis Ababa.

CSA (2015) Agricultural sample survey 2014/2015 (2007 E.C.) Volume III Report on Farm Management Practices (Private Peasant Holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa.

CSA report on land use, 2003–2015,

CSA (2016) Agricultural sample survey 2015/2016 (2008 E.C.) Volume I Report on area and production of major crops (private peasant holdings, Meher season), Central Statistical Agency (CSA), Addis Ababa

CSA (2017a) Agricultural sample survey 2016/2017 (2009 E.C.) Volume I Report on area and production of major crops (private peasant holdings, Meher season), Central statistical agency (CSA), Addis Ababa

CSA (2017b) Ethiopia: demographic and health survey 2016. Central Statistical Agency (CSA), Addis Ababa. https://bit.ly/3tSNJmP

CSA (2018) Agricultural sample survey 2017/2018 (2010 E.C.) volume I report on area and production of major crops (private peasant holdings, Meher season), Central statistical agency (CSA), Addis Ababa

CSA and ICF (2016) Ethiopia Demographic and Health Survey 2016.Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF.

Debela, BL, Shively, G and Stein T Holden, ST (2014) Does Ethiopia's Productive Safety Net program improve child nutrition? Norwegian University of Life Sciences (NMBU), Centre for Land Tenure Studies. https://bit.ly/3AcDJ96

Degife, AW and Mauser, W (2017) Socio-economic and environmental impacts of large-scale agricultural investment in Gambela Region, Ethiopia. *Journal of US-China Public Administration* 14(4): 183–197. https://bit.ly/3fxgrBc

Deressa, T, Hassan, RM and Ringler, C (2008) Measuring Ethiopian farmers' vulnerability to climate change across regional states. IFPRI. https://bit.ly/3rrWL79

Di Falco, S and Chavas, J-P (2008) Rainfall shocks, resilience and the dynamic effects of crop biodiversity on the productivity of the agroecosystem. *Land Economics* 84(1): 83–96. https://bit.ly/3IhBRyo

Di Falco, S and Chavas, J-P (2009) On crop biodiversity, risk exposure and food security in the highlands of Ethiopia. *American Journal of Agricultural Economics* 91(3): 599–611. https://bit.ly/3GHTpiT

Diao, X (2010) 'Economic importance of agriculture for sustainable development and poverty reduction: the case study of Ethiopia.' Global Forum on Agriculture, 29–30 November 2010: Policies for agricultural development, poverty reduction and food security. OECD Headquarters, Paris.

Dixon, JG, Gulliver, A and Gibbon, D (2001) Farming systems and poverty: improving farmers' livelihoods in a changing world. FAO/World Bank. www.fao.org/3/ac349e/ac349e.pdf

Drucza, K and Abebe, W (2017) Gender transformative methodologies in Ethiopia's agricultural sector: a review. CIMMYT, Addis Ababa.

EATA (2014) National strategy for Ethiopia's agricultural extension system. Ethiopian Agricultural Transformation Agency (EATA).

EDRI (2010) Preliminary assessment by the EDRI of impacts, cost and feasibility of strategy options — Climate Resilient Green Growth initiative. Ethiopian Development Research Institute, Addis Ababa.

Emama, B, Mohammed, H and Mohammed, S (2015) A situational analysis of agricultural production and marketing, and natural resource management systems in the Ethiopian highlands. ILRI. https://bit.ly/3GHsPKS

Fanzo, J, Hunter D, Borelli T and F, M (2013) Diversifying food and diets: using agricultural biodiversity to improve nutrition and health. First edition. Earthscan.

FAO (2010) 'Lessons learned and practical guidelines.' FAO/World Bank Workshop on reducing post-harvest losses in grain supply chains in Africa. FAO Headquarters, 18–19 Mar 2010, Rome, Italy.

FAOSTAT, Ethiopia. https://www.fao.org/faostat/en/#country/238

FAOSTAT, Land Use. https://www.fao.org/faostat/en/#data/RL

FAO, IFAD, UNICEF, WFP and WHO (2017) The state of food security and nutrition in the world 2017: building resilience for peace and food security. https://bit.ly/3IhavZq

FAO, IFAD, UNICEF, WFP and WHO (2018) The state of food security and nutrition in the world 2018. Building climate resilience for food security and nutrition. https://bit.ly/3nE7xq2

FDRE (2002). Ethiopia: Sustainable Development and Poverty Reduction Program. Federal Democratic Republic of Ethiopia (FDRE), Ministry of Finance and Economic Development (MOFED), Addis Ababa, Ethiopia.

FDRE (2006). Ethiopia: Building on Progress: A Plan for Accelerated and Sustained Development to End Poverty. Addis Ababa: Ministry of Finance and Economic Development, Federal Democratic Republic of Ethiopia (FDRE).

FDRE (2010). Ethiopia's agricultural sector policy and investment framework (PIF) 2010–2020. Federal Democratic Republic of Ethiopia, Ministry of Agriculture and Rural Development.

FDRE (2011) Climate-resilient green economy vision. Federal Democratic Republic of Ethiopia.

FDRE(2011) REDD+ readiness preparation proposal (R-PP) submitted to Forest Carbon Partnership Facility. Government of Ethiopia.

FDRE (2014) Ethiopia's fifth national report to the Convention on Biological Diversity. Ethiopian Biodiversity Institute, Federal Democratic Republic of Ethiopia.

FDRE (2015a) Ethiopia's National Biodiversity Strategy and Action Plan 2015–2020. Ethiopian Biodiversity Institute, Federal Democratic Republic of Ethiopia.

FDRE (2015b) Ethiopia's climate-resilient green economy climate resilience strategy: agriculture and forestry.

(FDRE, 2015c). Federal Negarit Gazette of the Federal Democratic Republic of Ethiopia (2015), Proclamation No. 916./2015, 22nd Year No.12 , Page 8582

FDRE(2016) Ethiopia's forest reference level submission to the United Nations Framework Convention on Climate Change. Government of Ethiopia.

FDRE (2016) Growth and Transformation Plan II (GTP II) (2015/2016–2019/20). Federal Democratic Republic of Ethiopia.

Frankel, OH (1970) Genetics dangers in the Green Revolution. *World Agriculture* 19(3): 9–13.

Franks, P, Hou-Jones, X, Firkreyesus, D, Sintayehu, M, Mamuye, S, Danso, EY, Meshack, CK and McNicol, I (2017) Reconciling forest conservation with food production in sub-Saharan Africa: case studies from Ethiopia, Ghana and Tanzania. IIED, London. https://pubs.iied.org/17605iied

Furtado, X and Hobson, M (2011) 'From aid effectiveness to development effectiveness in Ethiopia: a national review with case studies.' An input to the 4th High Level Forum on Aid Effectiveness (HLF4), 29 November–1 December 2011, Busan, Republic of Korea.

Gatzweiler, F, Reichenhuber, A and Hein, L (2007) Why financial incentives can destroy economically valuable biodiversity in Ethiopia. Center for Development Research, Bonn. https://bit.ly/3rsyY7g

Gebeyehu, ZH, Woldegirorgis, SB, Belete, AD, Abza, TG and Desta, BT (2017) 'Ethiopia's move to a national integrated land use policy and land use plan.' Paper prepared for presentation at the 2017 World Bank Conference on Land and Poverty, 20–24 March 2017, World Bank, Washington DC.

Gebreselassie, M (2005) Women and land rights in Ethiopia. Relief Society of Tigray and the Development Fund.

Gianessi, LP (2013) The increasing importance of herbicides in worldwide crop production. *Pest Management Science* 69(10): 1,099–1,105.

Gilligan, DO, Hoddinott, J and Seyoum Taffesse, AS (2009) The impact of Ethiopia's Productive Safety Net Program and its linkages. IFPRI. https://bit.ly/3IktcLR

Gómez, M, Barrett, C, Raney, T, Andersen, P, Meerman, J, Croppenstedt A, Carisma, B and Thompson, B (2013) Post-green revolution food systems and the triple burden of malnutrition. *Food Policy* 42: 129–138.

Guillozet, K and Bliss, JC (2011) 'Household livelihoods and increasing foreign investment: pressure in Ethiopia's forests.' Paper presented at the International Conference on Global Land Grabbing, 6–8 April 2011, Institute of Development Studies, University of Sussex. https://bit.ly/3Aammpa

Hagos, F, Makombe, G, Namara, R and Awulachew, SB (2007) Does access to small scale irrigation promote market oriented production in Ethiopia? In: Awulachew, SB, Loulseged, M, Yilma, AD, (Comps.). *Impact of irrigation on poverty and environment in Ethiopia: draft proceedings of the symposium and exhibition, Addis Ababa, Ethiopia*, 27-29 November 2007. Colombo, Sri Lanka: International Water Management Institute (IWMI). pp.262-281.

Harlan, JR (1972) Genetics of Disaster. *Journal of Environmental Quality* 1(3): 212–215.

Hassen, IW, Dereje, M, Minten, B and Hirvonen, K (2016) Diet transformation in Africa: the case of Ethiopia. IFPRI. https://bit.ly/3Kp1Ky2

Headey, D (2014) An analysis of trends and determinants of child undernutrition in Ethiopia, 2000–2011. IFPRI. https://bit.ly/3qCvShz

Helina, T and Emily, S (2012) Spatial analysis of livestock production patterns in Ethiopia. IFPRI. https://bit.ly/3GJT4Aa

Hill, RV and Tsehaye, E (2018) Growth, safety nets and poverty: assessing progress in Ethiopia from 1996 to 2011. World Bank. https://bit.ly/3tG3VHN

HLPE (2011) Land tenure and international investments in agriculture: a report by the high level panel of experts on food security and nutrition of the Committee on World Food Security. https://bit.ly/3nDT11q

Howden, SM, Soussana, JF, Tubiello, FN, Chhetri, N, Dunlop, M and Meinke, H (2007) Adapting agriculture to climate change. *Proceedings of the National Academy of Sciences of the United States of America* 104(50): 19,691–19,696. https://bit.ly/3FFxHPm

Huq, S, Reid, H, Konate, M, Rahman, A, Sokona, Y and Crick, F (2004) Mainstreaming adaptation to climate change in Least Developed Countries (LDCs). *Climate Policy* 4: 25–43.

Hurni, H, Giger, M, Liniger, H, Studer, RM, Messerli, P, Portner, B, Schwilch, G, Wolfgramm, B and Breu, T (2015). Soils, agriculture and food security: the interplay between ecosystem functioning and human well-being. Current Opinion in Environmental Sustainability, 15, pp.25–34.

IFDC (2015). Assessment of fertiliser consumption and use by crop in Ethiopia. https://africafertilizer.org/wp-content/uploads/2017/05/FUBC-Ethiopia-Final-Report-2016.pdf

IFPRI's IMPACT Webtool (2015) https://www.ifpri.org/publication/ifpri-impact-webtool

IHSN a, International Household Survey Network, Household Income, Consumption and Expenditure Survey 1995–1996: Ethiopia, 1995–1996, https://catalog.ihsn.org/catalog/3600

IHSN b, International Household Survey Network, Household Income, Consumption and Expenditure Survey 1999–2000: Ethiopia, 1999–2000, https://catalog.ihsn.org/catalog/158

IHSN c, International Household Survey Network, Household Income, Consumption and Expenditure Survey 2004–2005: Ethiopia, 2004–2005, https://catalog.ihsn.org/catalog/161

IHSN d, International Household Survey Network, Household Consumption Expenditure Survey 2010–2011: Ethiopia, 2010–2011, https://catalog.ihsn.org/catalog/3123

IHSN e, International Household Survey Network, Household Consumption Expenditure Survey 2015–2016: Ethiopia, 2015–2016, https://catalog.ihsn.org/catalog/9245

Kader, AA (2005) Increasing food availability by reducing postharvest losses of fresh produce. *V International Postharvest Symposium* 682: 2,169–2,176. https://bit.ly/3Ab1heq

Keeley, J, Seide, WM, Eid, A and Kidewa, AL (2014) Large-scale land deals in Ethiopia: scale, trends, features and outcomes to date. IIED. https://pubs.iied.org/12575iied

Kevane, M and Gray, LC (1999) A Woman's Field is Made at Night: Gendered Land Rights and Norms in Burkina Faso. *Feminist Economics* 5: 1–26.

Lastarria-Cornhiel, S (1997) Impact of privatization on gender and property rights in Africa. *World Development* 25(8): 1,317–1,333.

Makombe, G, Namara, R, Hagos, F, Awulachew, SB, Ayana, M and Bossio, D (2011) A comparative analysis of the technical efficiency of rainfed and smallholder irrigation in Ethiopia. International Water Management Institute. https://bit.ly/3qGRDgw

Mann, H and Smaller, M (2010) Foreign land purchases for agriculture: what impact on sustainable development? United Nations. https://bit.ly/32aZtFw

MEFCC (2017) Ethiopia's climate resilient green economy: National Adaptation Plan. Ministry of Environment, Forest and Climate Change, Ethiopia.

MoA (2015) Productive Safety Net Program (PSNP) — Phase III public works impact assessment. Ministry of Agriculture, Ethiopia.

MOFED (2006) Ethiopia: building on progress. A Plan for Accelerated and Sustained Development to End Poverty (PASDEP). Ministry of Finance and Economic Development, Ethiopia.

MoFED (2010) Growth and Transformation Plan (GTP) 2010/11-2014/15. Volume 1. Ministry of Finance and Economic Development, Ethiopia.

MoFED (2012) Ethiopia's progress towards eradicating poverty: an interim report on poverty analysis study (2010/11). Ministry of Finance and Economic Development, Ethiopia.

Muzein, BS (2006) 'Remote sensing & GIS for land cover/ land use change detection and analysis in the semi-natural ecosystems and agriculture landscapes of the Central Ethiopian Rift Valley.' PhD dissertation. Dresden University of Technology. https://bit.ly/3fF91M4

NBE (2017). National Bank of Ethiopia (NBE): Annual Report 2016/17

NEPAD (2009). Comprehensive Africa Agriculture Development Programme (CAADP), Sustainable Land Water Management. The CAADP Pillar I Framework. "Tool" for use by countries in mainstreaming and upscaling of sustainable land and water management in Africa's Agriculture and rural development agenda. The New Partnership for Africa's Development (NEPAD).

Ngowi, AVF, Mbise, TJ, Ijani, ASM, London, L and Ajayi, OC (2007). Smallholder vegetable farmers in Northern Tanzania: Pesticides use practices, perceptions, cost and health effects. *Crop Protection*, 26(11): 1617–1624.

NPC (2017) Ethiopia's progress towards eradicating poverty: an interim report on 2015–2016 poverty analysis study. National Planning Commission, Ethiopia.

Oakland Institute (2011) Understanding land investment deals in Africa. Country report: Ethiopia. https://bit.ly/33FkGrD

Onuorah, CE and Ayo, JA (2003) Food taboos and their nutritional implications on developing nations like Nigeria — a review. *Nutrition and Food Science* 33(5): 235–240.

Otsuka, K and Yamano, T (2006) Introduction to the special issue on the role of nonfarm income in poverty reduction: evidence from Asia and East Africa. *Agricultural Economics* 35(s3): 393–397.

Quisumbing, AR (1996) Male–female differences in agricultural productivity: methodological issues and empirical evidence. *World Development* 24(10): 1,579–1,595.

Rahmato, D (2011) Land to investors: large-scale land transfers in Ethiopia. Forum for Social Studies, Addis Ababa.

Reardon, T, Tschirley, D, Minten, B, Haggblade, S, Liverpool-Tasie, S, Dolislager, M and Ijumba, C (2015) 'Transformation of African agrifood systems in the new era of rapid urbanization and the emergence of a middle class.' In: Proceedings of the ReSAKSS Annual Conference: Beyond a Middle Income Africa — Trends and Outlook Report Conference, Addis Ababa, 1–3 September 2015.

Reusing, M (1998). Monitoring of natural high forests in Ethiopia. Ministry of Agriculture, Addis Ababa, Ethiopia.

Richards, M (2013) Social and environmental impacts of agricultural large-scale land acquisitions in Africa. Rights and Resources Initiative. https://bit.ly/3ruePxy

Sebastian, K (2009). Agro-ecological zones of Africa. International Food Policy Research Institute. http://hdl.handle.net/1902.1/22616

Sebastian, Kate. 2009. Agro-ecological Zones of Africa. Washington, DC: International Food Policy Research Institute (datasets). http://hdl.handle.net/1902.1/22616

Schmidt, E and Kedir, M (2009) Urbanization and spatial connectivity in Ethiopia: urban growth analysis using GIS. IFPRI. https://bit.ly/3AgKYNg

Schoneveld, GC (2011) The anatomy of large-scale farmland acquisitions in sub-Saharan Africa. CIFOR. https://bit.ly/3qGvxdP

Sharp, K, Brown, T and Teshome, A (2006) Targeting Ethiopia's Productive Safety Net Programme (PSNP). Overseas Development Institute. https://bit.ly/3nCScWs

Sheahan, M and Barrett, CB (2014) Understanding the agricultural input landscape in sub-Saharan Africa: recent plot, household, and community-level evidence. World Bank. https://bit.ly/3ImRLrv

Shepard, D and Mittal, A (2009) The great land grab: rush for world's farmland threatens food security for the poor. The Oakland Institute. https://bit.ly/3AcUuAQ

Shete, M and Rutten, M (2015) Large-scale land acquisition in Ethiopia: implications for agricultural transformation and livelihood security. In Hall, R, Scoones, I and Tskikata, D (eds). *Africa's land rush: implications for rural livelihoods and agrarian change*. James Currey.

Smaller, C and Mann, H (2009) A thirst for distant lands: foreign investment in agricultural land and water. IISD. https://bit.ly/3nDLEXG

Spielman, DJ, Kelemework, D and Alemu, D (2011) Seed, fertiliser, and agricultural extension in Ethiopia. Extension in Ethiopia. IFPRI. https://bit.ly/3GIXPtU

Taffesse, AS, Dorosh, P and Asrat, S (2011) Crop production in Ethiopia: regional patterns and trends. IFPRI. https://bit.ly/3GK7zUC

Tamene L, Amede T, Kihara J, Tibebe D, Schulz S (eds). 2017. A review of soil fertility management and crop response to fertilizer application in Ethiopia: towards development of site- and context-specific fertilizer recommendation. CIAT Publication No. 443. International Center for Tropical Agriculture (CIAT), Addis Ababa, Ethiopia. http://hdl.handle.net/10568/82996

Tamru, S, Minten, B, Alemu, D and Bachewe, F (2016) The rapid expansion of herbicide use in smallholder agriculture in Ethiopia: patterns, drivers, and implications. IFPRI. https://bit.ly/3KpevJi

Teklewold, H, Mekonnen, A, Kohlin, G and Di Falco, S (2017) Does adoption of multiple climate smart practices improve climate resilience of farmers? Empirical evidence from the Nile Basin of Ethiopia. *Climate Change Economics* 8(1).

Thomas, TS (2019). Changes in food supply and demand by 2050. In: Yadav, S et al. (eds). Food Security and Climate Change. Wiley, New York.

Source: Tilamun, H, and Schmidt, E (2012) Spatial analysis of livestock production patterns in Ethiopia. ESSP II Working Paper. International Food Policy Research Institute (IFPRI): Addis Ababa/ Washington DC. https://www.ifpri.org/publication/spatial-analysis-livestock-production-patterns-ethiopia

Tilman, D (1996) Biodiversity: population versus ecosystem stability. *Ecology* 77: 350–363.

Tilman, D and Downing, JA (1994) Biodiversity and stability in grasslands. *Nature* 367: 363–365.

Tilman, D, Reich, PB and Isbell, F (2012) Biodiversity impacts ecosystem productivity as much as resources, disturbance, or herbivory. *Proceedings of the National Academy of Sciences of the United States of America* 109: 10,394–10,397.

UNDP (2015) Work for human development: briefing note for countries on the 2015 Human Development Report, Ethiopia.

UNEP (2016) The contribution of forests to national income in Ethiopia and linkages with REDD+. UN-REDD Programme report, Draft.

UNFCCC (2016) Ethiopia's forest reference level submission to the UNFCCC. Addis Ababa, Ethiopia.

USAID (2012) Ethiopia's Productive Safety Net and Household Asset Building Programs (2006–10): a synthesis of findings.

USAID (2017) Ethiopia development trends assessment. Ethiopia Performance Monitoring and Evaluation Service (EPMES).

Van Dusen, E (2005) Understanding the factors driving on farm crop genetic diversity: empirical evidence from Mexico. In: Cooper, J, Lipper, LM and Zilberman, D (eds). Agricultural Biodiversity and Biotechnology in Economic Development. Springer.

Van Eerdewijk, A, & Danielsen, K (2015) Gender matters in farm power. Amsterdam: KIT, CIMMYT and CGIAR.

Van Hoi, P, Mol, AP and Oosterveer, PJ (2009). Market governance for safe food in developing countries: The case of low-pesticide vegetables in Vietnam. *Journal of Environmental Management*, 91(2): 380–388.

Van Hoi, P, Mol, AP and Oosterveer, P (2013). State governance of pesticides use and trade in Vietnam. NJAS, *Wageningen Journal of Life Sciences* 67: 19–26.

Van Zyl, H (2015) The economic value and potential of protected areas in Ethiopia. Prepared for the Sustainable Development of the Protected Areas System of Ethiopia (SDPASE) project and the Ethiopian Wildlife Conservation Authority (EWCA).

von Braun, J and Kennedy, E (1994) Agricultural commercialization, economic development, and nutrition. Johns Hopkins University Press.

von Braun, J and Meinzen-Dick, R (2009) 'Land grabbing' by foreign investors in developing countries: Risks and opportunities. IFPRI. https://bit.ly/3563vjJ

Vuorinen, P, Tesemma, M, Laxen, J, Hamalainen, J, Pieper, G, Hailu, B, Roba, B and Bekele, M (2016) Study of causes of deforestation and forest degradation in Ethiopia and the identification and prioritization of strategic options to address those.

WFP (2012) Ethiopia Productive Safety Net Programme (PSNP). Quik Facts 2012.

Williamson, S, Ball, A and Pretty, J (2008). Trends in pesticide use and drivers for safer pest management in four African countries. *Crop Protection*, 27:1327

Woldeamlak, B (2002) Land cover dynamics since the 1950s in Chemoga watershed, Blue Nile basin, Ethiopia. *Mountain Research and Development* 22(3): 263–269.

Woldeamlak, B and Conway, D (2007) A note on the temporal and spatial variability of rainfall in the drought-prone Amhara region of Ethiopia. *International Journal of Climatology* 27: 1,467–1,477.

Woldemariam, Z (2017) Change and continuity in the indigenous institution of Qoollee deejjoo ritual practice and its role in forest resource management among the Kafecho: the case of Gimbo Woreda. *African Journal of History and Culture* 9(3): 15–26. https://bit.ly/3nF7IRQ

World Bank, Databank, https://databank.worldbank.org

World Bank, Ethiopia, https://data.worldbank.org/country/ET

World Bank, World Development Indicators, https://databank.worldbank.org/source/world-development-indicators

World Bank, Cereal production (Metric tons) — Ethiopia, https://data.worldbank.org/indicator/AG.PRD.CREL.MT?locations=ET

World Bank (2015) Ethiopia urbanization review: urban institutions for a middle-income Ethiopia. https://bit.ly/3fE0Dwu

World Bank (2016) Ethiopia: priorities for ending extreme poverty and promoting shared prosperity. https://bit.ly/3Kp3Wpv

World Bank data repository, Land under cereal production (hectares) — Ethiopia, https://bit.ly/32910fi

Yngstrom, I (2002) Women, wives, and land rights in Africa: situating gender beyond the household in the debate over land policy and changing tenure systems. *Oxford Development Studies* 30(1): 22–40.

# Sentinel

**Social and Environmental Trade-Offs in African Agriculture**

This contextual analysis has been carried out as part of the Social and Environmental Trade-offs in African Agriculture (Sentinel) project. This is a four-year research project that addresses the challenges of achieving Sustainable Development Goal (SDG) 2 (zero hunger), SDG 10 (reduced inequalities), and SDG 15 (ecosystem conservation) in sub-Saharan Africa.

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