COMPENDIUM OF ENVIRONMENT STATISETICS

ETHIOPIA

2016

(FIRST EDITION)

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

NATIONAL PLANNING COMMISSION

CENTRAL STATISTICAL AGENCY

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PREFACE

This is the first edition of 'Ethiopia Environmental Statistics 'publication produced by the collaborative effort between the Central Statistical Agency of Ethiopia and the Common Market for Eastern and Southern Africa (COMESA).

The report was compiled from data existing within Government Ministries, Authorities, Agencies and Non Governmental Organizations and data produced by the Central Statistics Agency. The data presented in this publication was adopted and followed the United Nations Framework for the Development of Environment Statistics (FDES, 2013), which was endorsed by the United Nations Statistical Commission in 2013, as a framework for strengthening environment statistics in countries, as a guideline. In this respect the Compendium covers a wide range of environmental issues that are grouped into six categories: Environmental Conditions and Quality; Environmental Resources and Their Use; Residuals; Extreme Events and Disasters; Human Settlements; and Environmental, Protection, Management and Engagements.

Since environment Statistics is a newly emerged statistical domain in Ethiopia, this publication is not exhaustive. However, as an initial step this Compendium is expected to be useful as advocacy materials for all who care about the environment, and reflects the collation of existing data sourced from the activities of both Government and non-Governmental entities that are involved in either monitoring, controlling or promoting awareness about issues affecting Ethiopian's environment.

Moreover, the delivery of this report supports the combined efforts of Common Market for Eastern and Southern Africa and the Central Statistics Agency to strengthen capacity and full implementation of the 2013 Framework for the Development of Environmental Statistics in Ethiopia.

Finally, CSA gratefully acknowledges the continued support of all subject area experts and stakeholders who committed to providing the statistical data and information needed to compile and publish this report.

Addis Ababa, September/2017

Central Statistical Agency of Ethiopia

Mr. Biratu Yegezu

DIRECTOR GENERAL

ABBREVIATIONS AND ACRONYMS

AAGR	Average Annual Growth Rate
ACBF	Africa Capacity Building Fund
AFOLU	Agriculture, Forestry and Land Use
AWD	Acute Water-Borne Diarrhea
BOD	Biochemical Oxygen Demand
Brrr	Ethiopian currency
CBD	Convention on Bio-diversity
COMESA	Common Market for Eastern and Southern Africa
CRGE	Climate Resilient Green Economy
CSA	Central Statistical Agency
EBI	Ethiopian Biodiversity Institute
E.C	Ethiopian Calendar
EFY	Ethiopian Fiscal Year
EWCA	Ethiopian Wildlife Conservation Authority
ENSO	El Niño Southern Oscillation
ERCA	Ethiopian Revenues And Customs Authority
ESSAT	Environment Statistics Self Assessment Tool
EWCA	Ethiopia Wildlife Conservation Authority
FDES	Framework for the Development of Environment Statistics
FDRE	Federal Democratic Republic of Ethiopia
FAO	Food and Agricultural Organization of the United Nations
FEWS NET	Famine Early Warning Systems Network
GDP	Gross Domestic Product
GSE	Geological survey of Ethiopia
GHC	Greenhouse Gas
GDP	Geographical Information System
GTP	Growth and Transformation Plan

ABBREVIATIONS… *Cont'd*

GTP I	**First Growth and Transformation plan**
GTP II	**Second Growth and Transformation plan**
HSTP	**Health Sector Transformation Plan**
INCFC	**Intergovernmental Negotiating Committee for Framework Convention on Climate Change**
LPG	**Liquefied Petroleum Gas**
LUCF	**Land-Use Change and Forestry**
MCF	**Methane Correction Factor**
MoANR	**Ministry of Agriculture and Natural Resources**
MoEFCC	**Ministry of Environment, Forest and Climate Change**
MoFED	**Ministry of Finance and Economic Development**
MoH	**Ministry of Health**
MoUDH	**Ministry of Urban Development And Housing**
MSW	**Municipal Solid Waste**
NAPA	**National Adaptation Programme of Action**
NDRMC	**National Disaster Risk Management Commotion**
NPC	**National Planning Commission**
NMA	**National Meteorology Agency**
NSOs	**National Statistical Offices**
NSS	**National Statistical Systems**
SNNPR	**Southern Nations, Nationalities, and Peoples' Region.**
NOAA	**National Oceanic and Atmospheric Administration**
IPCC	**Intergovernmental Panel on Climate Change**
ITCZ	**Inter-tropical Convergence Zone**
AOIs	**Representative areas of interests**
SNC	**Second National Communication**
SNNP	**Southern Nations, Nationalities and Peoples**
SDGs	**Sustainable Development Goals**
UNDP	**United Nations Development Programme**
UNEP	**United Nations Environment Programme**
UNFCCC	**United Nations Framework Convention on Climate Change**
WBISPP	**Woody Biomass Inventory and Strategic Planning Project**

UNIT OF MEASUREMENT AND STANDARD EQUIVALENTS

Kg = **kilogram**

GJ = **Gigajoule = 109 Joules**

g/ m^3 = **gram per meter cube**

ppm = **Parts per million**

g/t = **gram per tone**

GWh = **Giga Watt hour**

J = **joule**

L = **liter**

mm = **millimeters**

m^3 = **cubic meter**

m.a.m.s.l = **meters above mean sea level**

m.b.m.s.l = **meters below mean sea level**

m/s = **meters per second**

Mt = **million tons**

MW = **megawatt**

MWe = **megawatt electrical**

MWh = **megawatt-hour**

O^C = **degree Celsius**

Ppb = **Parts per billion**

t = **ton**

tC = **tons of carbon**

Wh/m^2 = **watt hours per square meter**

1 INTRODUCTION

1. INTRODUCTION

1.1 Background Information

Recently environmental issues such as climate change, loss of biodiversity, waste management and water pollution have begun to attract public attention both in the developed and developing countries. It is inevitable that economic development is the goal for most countries in the world which is inversely proportional to the environment quality. Economic development is having more negative impact on the environment than benefits. Along with growing economic development, the need for energy, land and natural resources also increased, thus, causing environmental degradation.

The overreaching development agenda of Ethiopia is to sustain the accelerated growth and to establish spring board for economic structural transformation and thereby realizing the national vision of becoming a lower middle-income country by 2025. As set forth in the Second Growth and Transformation Plan (GTP II), reaching this goal will require improve productivity, quality and competitiveness of domestic productive sector such as agricultural, manufacturing industries to speed up structural transformation

If Ethiopia were to pursue a conventional economic development path to achieve its ambitious targets, the resulting negative environmental impacts would follow the patterns observed all around the globe. Under current practices, greenhouse gas (GHG) emissions would more than double from 150 Mt CO_2 e in 2010 to 400 Mt CO_2 e in 2030. Its development path could also face natural resource degradation and pollution problems. Water contamination and other macro environmental impacts such as water logging, land degradation and desertification, are on rise. All this, in conjunction with rapid growth in population, have been instrumental to the expanding tentacles of poverty.

In order to avoid such negative impacts, the government has developed the second Growth and Transformation Plan (GTP) which is explicitly addresses the sustainability of growth: "Environmental conservation plays a vital role in sustainable development. Building a 'Green Economy' and ongoing implementation of environmental laws are among the key strategic directions to be pursued during the plan period."

As responsible member of the world, Ethiopia is also aware of the important role that developing countries play in fighting climate change, and has consequently taken on a constructive role in international climate negotiations. Ethiopia's ambition to become a "green economy front-runner" is an expression of its potential for and belief in a sustainable model of growth.

It is also believed that adopting a green economy development path would have benefits for the population, the environment, and the economy: it would improve public health through better air and water quality and accelerate rural development by increasing soil fertility, food security, and rural employment. Hence, moving our economy forward on the green pathway will require a transformational shift in current economic development practices will touch most sectors of its economy.

The Climate-Resilient Green Economy (CRGE) initiative follows a sectoral approach and has so far identified and prioritized more than 60 initiatives. It is estimated that the selected initiatives would reach up to two-thirds of the whole economy (by 2030), which could help the country achieve its development goals while limiting 2030 GHG emissions to around today's 150 Mt CO_2 e – around 250 Mt CO_2 e less than estimated under a conventional development path. Some of the initiatives also support the creation and growth of new business opportunities, e.g., the local production of efficient stoves.

The initiatives have the highest reach within agriculture by creating a green agricultural sector that generates increased output originating from higher yields rather than from an expansion of agricultural land or the cattle population. As initiatives have been identified for most of the industrial sub-sectors, a high share of these sub-sectors is also likely to be positively affected by the green economy. In addition, a smaller part of the service sector will also be reached by the green economy through initiatives identified in transportation and buildings.

Ethiopia's CRGE initiative therefore sets the goal of reaching middle income country status by year 2025 with net-zero greenhouse gas (GHG) emission growth while simultaneously building the resilience of the economy to climate shocks. In order to achieve these goals, it is necessary to monitor the utilization and management of the environment.

Environmental monitoring carried out by the environmental managers need information about the environment. Such information will portray the environmental conditions at certain time, both to evaluate the extent of damage that already occurred, improvements that had been made, and the steps that need to be prepared as an input for environmental planning in the future. Policy makers need to incorporate consideration on environmental factors in all of its activities, supported by information of the environment with great deal of accuracy, complete, timely and sustainable.

To obtain a clear picture of the problems that occurred in the environment, it needs to develop indicators that can measure the environment quality. Hence, statistics as a tool that is often used to look at the phenomenon and the behavior of the environment need to be constantly prepared and developed with a reliable methodology.

Environment statistics cover a wide range of information, among others the state and changes of environmental conditions, the quality and availability of environmental resources, the impact of human activities and natural events on the environment, the impact of changing environmental conditions, as well as the social actions and economic measures taken by societies to avoid or mitigate these impacts and to restore and maintain the capacity of the environment to provide the services that are essential for life and human wellbeing.

However, environment statistics' sources are dispersed over a variety of data collecting institutions, and similarly numerous methods are applied in their compilation. Thus, the Central Statistical Agency (CSA) of Ethiopia as one of the agencies concerned with and has the mandate to producing the national statistics by collecting, processing, analyzing and disseminating required environmental data through surveys, censuses and continuous registration and administrative recording systems.

Statistical data collection on Environment required coordination among government agencies. Hence, CSA is the Agency responsible for coordinating, monitoring and supervising the National Statistical Systems (NSS) in Ethiopia, and ensuring that international and national standards are adhered to.

Although a large number of Sectoral data are collected regularly as specified above it is rare that those data are coordinated, and standardized for publication in the form of aggregate

environmental compendium. So far not much progress has been made in the country on developing standardized concepts, definitions and classifications for statistical variables that describe environmental issues. Much work also remains to be done in promoting regular collection and processing of data in an integrated manner, and for analyzing the data needs of users in the field of environment. The ongoing efforts under the CSA will lead to the standardization and promote coordination among various government agencies in the development of national environmental statistics system.

1.2 Development of Environment Statistics in Ethiopia

Recognizing the importance of Environment Statistics as an emerging area, the Common Market for Eastern and Southern Africa (COMESA) Secretariat carried out an assessment of environment statistics in its member states in 2014. The results of the assessment revealed that environment statistics were inadequate and fragmented in several countries despite the availability of many of the indicators. The main challenges reported by the countries were: lack of financial resources, lack of human resources, lack of technical capacities, lack of tools/instruments for data collections and lack of institutional coordination. In this regard, COMESA Secretariat and the UNSD held a Workshop on Environment Statistics in support of the implementation of the revised 2013 Framework for the Development of Environmental Statistics (FDES 2013) in Balaclava, Mauritius from 26th to 29th January 2016. It was resolved at the Mauritius workshop that time and money should be invested at country level in order to build capacity and enhance coordination among environmental data producers.

Ethiopia being one of the member states that was represented at the Mauritius workshop took the initiative to hold a national workshop for the initiation of the FDES, 2013. To fulfill this need, the CSA and COMESA organized a national workshop held from the 13th to 17th of June, 2016 with financial support from the Africa Capacity Building Fund (ACBF). The aim of the workshop was to build capacity among stakeholders for effective implementation of the FDES 2013.

The workshop was very essential particularly for the primary data producers as they were made aware of the FDES and were trained how to use the tool for collection of environmental data. The FDES proved to stakeholders that it is one of the frameworks that can improve coordination in the compilation and dissemination of environment statistics. Therefore, the

participants representing institutions at the workshop were designated as steering committees for implementing the Framework for Development of Environment Statistics. Finally a way forward and road map was presented for the leading agency (CSA).

As per the recommendations of the first conference a multidisciplinary working group comprising of government Ministries and departments, quasi government institutions and research institutions was set up under the Chairmanship of Deputy Director General, CSA in the second meeting of the steering committees held in September 2016.

1.3 Compendium of Environment Statistics

Compared with social, demographic, and economic statistics, environment statistics that are needed to monitor the environment and to develop appropriate policies are not yet developed in Ethiopia. Consequently, the Central Statistical Agency of Ethiopia started working on the FDES in 2016 with the assistance from COMESA.

It is, therefore, the first Environment Statistics publication entitled "Compendium of Environment Statistics" that presents available data relating to the environment of the country. Although, the present coverage of information in the compendium may not be exhaustive with respect to the entire domain of the Environment or of the FDES, it does however a very good initial effort and provide a glimpse of the present scenario of the environment.

As indicated above, much of the information presented in this compendium is on demographic and socio-economic indicators. However, the Compendium needs to have a balanced coverage of physical environmental media (e.g., land, air, water), biological media (e.g., biodiversity), and economic sectors (e.g., human settlements, industry, energy) to show trends more readily. The coverage of biological indicators of water quality, and water pollution in rivers is poor; air quality data concerning estimates of national carbon monoxide and hydrocarbon emissions, lead emissions, CFC usage, and urban air quality are deficient. No data are available on Tourism, population exposure to noise from traffic, airports, and other sources. Wastewater treatment information is also needed to give the number of households connected to sewage schemes, capacity of treatment systems, and degree of treatment prior to disposal. The coverage of solid waste generation and management data is inadequate.

Chemicals and hazardous waste data are missing in terms of specifying volumes and sources (household, industrial, construction sites etc).

1.4 Objectives

The objectives of compiling the 2016 Environment Statistics of Ethiopia are:

I. To provide data concerning development of environment situation and condition in Ethiopia;
II. To provide data concerning environmental damage;
III. To provide data concerning natural resources in Ethiopia;

1.5 Organization of the Report

It is important to organize the contents of the compendium of environment statistics, 2016 into essentially eight sections. The first sections give a general introduction to environment, its degradation through different sources and their impact on human health, development of environment statistics in Ethiopia and the conceptual foundation and scope of the FDES 2013. Section two provides the methodology used for the compilation of the compendium. The remaining five Sections are on the components of the environment as described in the FDES 2013, namely Environmental conditions and quality, Environmental resources and their use, Residuals, Extreme events and disasters, Human settlements and environmental health, Environmental protection, management and engagement. Besides, statistical tables depicting environment data, suitable graphs and charts have also been added to make the publication more user friendly and comprehensive.

1.6 Framework for the Development of Environment Statistics

Compiling the Compendium on Environment Statistics of Ethiopia needed the use of the Framework for the Development of Environment Statistics (FDES 2013) which is recommended by the United Nation Statistics Division (UNSD). The FDES is a flexible, multi-purpose conceptual and statistical framework that is comprehensive and integrative in nature and marks out the scope of environment statistics. It provides an organizing structure to guide the collection and compilation of environment statistics at the national level. It brings together data from the various relevant subject areas and sources, covering the issues and

aspects of the environment that are relevant for policy analysis and decision making. It can be applied to inform about cross-cutting issues such as climate change.

The scope of the **FDES** covers biophysical aspects of the environment and those aspects of the human sub-system that directly influence and interact with the state and quality of the environment. The FDES 2013 has been designed to guide countries at early stages in the development of their environment statistics programmers. It is also relevant and recommended for use by countries at any stage of development.

The FDES 2013 is, particularly, useful for guiding the formulation of environment statistics programs in countries at the early stages of developing environment statistics as it: (i) identifies the scope and constituent components, sub-components and statistical topics relevant for them; (ii) contributes to the assessment of data requirements, sources, availability and gaps; (iii) guides the development of multipurpose data collection processes and databases; and (iv) assists in the coordination and organization of environment statistics, given the inter-institutional nature of the domain.

It also targets a wide user community including environmental statisticians in national statistical offices (NSOs), environmental ministries and agencies as well as other producers or users of environmental data and environment statistics in line ministries, sectoral authorities and other institutions.

The FDES marks out the roles of the different data producers, thus facilitating inter-agency coordination within countries. It can be used by inter-institutional collaborating committees/round-tables participating in the production and dissemination of environment statistics. It can also be used by international and regional institutions to organize and strengthen their production and dissemination of environment statistics.

The FDES 2013 organizes environment statistics into a structure composed of six components, each of these individual component is further broken down into its respective sub-components, statistical topics, and individual statistics using a multi-level approach. The six fundamental components of the FDES cover Environmental conditions and quality, Environmental resources and their use, the use of the environment as a sink for residuals and related human

activities, Extreme events and disasters, Human settlements and environmental health, Environmental protection, management and engagement.

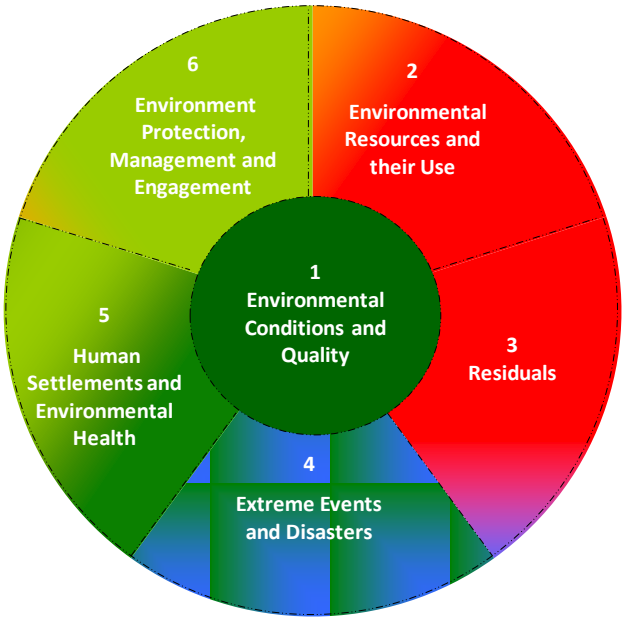


Figure 1: Components of the FDES

Source: - FDES, 2013

Figure 1 shows the six components of the FDES. Environmental conditions and quality (Component 1) are central to the FDES. The other five components have been established based on their relationship to the central Component 1. The dotted lines separating the components indicate the continuous interactions among them. These interactions exist between and among all the components of the FDES

The FDES 2013 sets out a comprehensive, though not exhaustive, list of statistics (the Basic Set of Environment Statistics) that can be used to measure the statistical topics. The Basic Set is organized into three tiers, based on the level of relevance, availability and methodological development of the statistics.

Within this scope, a Core Set of Environment Statistics has been identified as Tier 1. Hence, the key objective of the Core Set is to serve as an agreed, limited set of environment statistics that are of high priority and relevance to most countries. It is recommended that countries consider producing them in the short-term. However, as national priorities require and data

availability and resources permit, the scope may be widened gradually to include the statistics in Tiers 2 and 3.

Table 1: Component and Sub-Component in FDES

Component 1:- Environmental Conditions and Quality	**Sub-component 1.1: Physical Conditions** **Sub-component 1.2: Land Cover, Ecosystems and Biodiversity** **Sub-component 1.3: Environmental Quality**
Component 2:- Environmental Resources and their Use	**Sub-component 2.1: Mineral Resources** **Sub-component 2.2: Energy Resources** **Sub-component 2.3: Land** **Sub-component 2.4: Soil Resources** **Sub-component 2.5: Biological Resources** **Sub-component 2.6: Water Resources**
Component 3-: Residuals	**Sub-component 3.1: Emissions to Air** **Sub-component 3.2: Generation and Management of Wastewater** **Sub-component 3.3: Generation and Management of Waste** **Sub-component 3.4: Release of Chemical Substances**
Component 4:- Extreme Events and Disasters	**Sub-component 4.1: Natural Extreme Events and Disasters** **Sub-component 4.2: Technological Disasters**
Component 5:-Human Settlements and Environmental Health	**Sub-component 5.1: Human Settlements** **Sub-component 5.2: Environmental Health**
Component 6:- Environnent Protection, Management and Engagement	**Sub-component 6.1: Environment Protection and Resource Management Expenditure** **Sub-component 6.2: Environmental Governance and Regulation** **Sub-component 6.3: Extreme Event Preparedness and Disaster Management** **Sub-component 6.4: Environmental Information and Awareness**

Source:- FDES, 2013

2 METHODOLOGY

2. METHODOLOGY

2.1 Methods of Data and Information Collection

Data for the 2016 Ethiopian Environment Statistics were obtained from results of the surveys or censuses conducted by the Central Statistical Agency of Ethiopia, and the annual reports or publications from institutions that related to environment at the federal and regional level.

Literatures on related subject areas' were reviewed to strengthen the 2016 Compendium of Environment Statistics of Ethiopia as references hereinafter dummy tables were designed based on the FDES 2013 that was used before collection of the data. The first step to collect environmental data and information for this compendium is identified and listing of the elevate institutions that will be visited to collect the required data. Finally, data collection activities were carried out from September to mid November 2016.

2.2 Sources of Data and Information

Data presented in this publication are mainly taken from data compilation or annual report of institutions that related to environment either in federal or regional level. Some of these institutions are Ministry of Environment, Forestry and Climate Change, National Meteorology Agency, Ministry of Agriculture and Natural Resources, Geological Survey of Ethiopia, Ethiopian Revenues and Customs Authority, Ministry of Transport, Ministry of Water Irrigation and Energy, Ministry of Urban Development and Housing, Institute of Biodiversity, National Planning Commission, National Disaster Risk Management Commotion and Ministry of Health. Some other data was also obtained from the survey or censuses results conducted by the Central Statistical Agency of Ethiopia.

2.3 Method of Data Processing and Presentation

Data processing was done by compiling secondary data. Collected data that match the required tables was entered directly onto available dummy tables. Data and information were presented according to the framework which is Environmental Conditions and Quality, Environmental Resources and their Use, Residuals, Extreme Events and Disasters, Human Settlements and Environmental Health, and Environmental Protection, Management and Engagement. In order to give a clear interpretation of data, each chapter was preceded by summary texts which are completed with analysis of figures.

2.4 Concepts and Definitions

The concepts and definitions used in this publication are taken from several sources, including Central Statistical Agency of Ethiopia, Ministry of Environment Forestry and Climate Change, National Meteorology Agency, Geological Survey of Ethiopia, Ministry of Water Irrigation and Energy, Institute of Biodiversity, Ministry of Urban Development and Housing. Each term and definition may appear under each section and accompanied by an explanation in order to enrich the statistical explanation presented in the compendium and considered useful for further understanding.

However, the definitions presented here are the Legal definitions given by the Laws of the Federal Democratic Republic of Ethiopia based on the institutional Establishment and Proclamation No.

- **Environment: -** The Legal Definition of Environment in Ethiopia is based on Environmental Pollution Control Proclamation No. 30012002 and on Environmental Protection Organs Establishment Proclamation No. 29512002.

Therefore, Both proclamation defines Environment as: "The totality of all materials whether in their natural state or modified or changed by humans, their external spaces and the interactions which affect their quality or quantity and the welfare of human or other living beings, including but not restricted to, land, atmosphere, weather and climate, water, living things, sound, odor, taste, social factors, and aesthetics;"

- **Forest:-** According to the Forest Reference Level Definition of the country submitted to the UNFCCC in 2016, Ethiopia adopted a new forest definition as follows:

''Land spanning at least 0.5 ha covered by trees and bamboo), attaining a height of at least 2m and a canopy cover of at least 20% or trees with the potential to reach these thresholds in situ in due course". This forest definition differs from the definition used for international reporting to the Global Forest Resources Assessment (FAO) and from the forest definition used in the National Forest Inventory which both applied the FAO forest definition with the thresholds of 10% canopy cover, a 0.5 ha area and a 5 m height.''

3 ENVIRONMENT CONDITIONS AND QUALITY

3. ENVIRONMENTAL CONDITIONS AND QUALITY

3.1 Background Information

This section presents data on Environmental that have physical, biological, and chemical characteristics and their changes over time. Changes in the condition and quality of the environment is the result of the combined and cumulative impact of natural and human processes, which indirectly linking the changes to the individual events and activities. This is section, therefore, contains two sub- sections that cover Physical Condition, Ecosystems and Biodiversity.

3.2 Physical Conditions

Physical Conditions, is designed to capture those physical aspects of the environment which change relatively slowly due to human influence. It contains statistics on meteorological, hydrographical, geological, geographical conditions and soil characteristics.

Statistics on these general physical conditions are important as they help determine the scope of and influences on the environmental resources of a country. Without information on these baseline conditions, it is difficult for governments to judge the need for and efficacy of policies.

3.2.1 Atmosphere, Weather and Climate

- **Atmosphere**

Atmosphere is a layer of gas that surrounds a planet, including earth, of the planet's surface to deep space. Earth's atmosphere consists of nitrogen (78.17%) and oxygen (20.97%), with little argon, carbon dioxide, water vapor, and other gases (https://id.wikipedia.org). The atmosphere protects life on earth by absorbing ultraviolet radiation between day and night.

- **Weather**

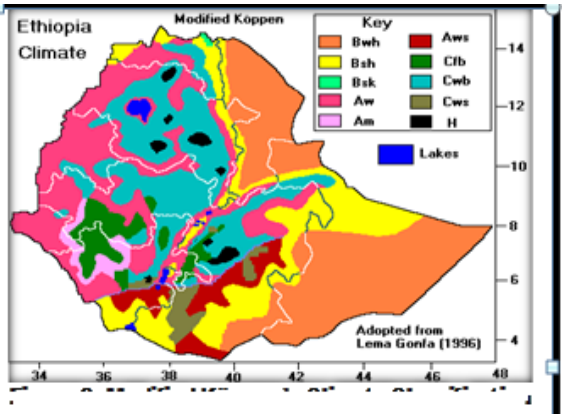
Weather is the state of the air in a relatively short time and place that is relatively narrow. While climate is the average weather condition based on the length of time for a given location on earth or another planet.

Climate of Ethiopia

The climate of Ethiopia is largly influenced by altitude and latitude as well as topographic features of the country such as water bodies, highlands and valleys. The country lies near the equator in a zone where the maximum heat of the sun is received. Due to the position of the ITCZ thet Sun is overhead twice a year in all parts of the country. The first is from April to May when ITCZ extends to the northern extreme. Where as the second is from July to August when ITCZ returns back to Equator.

Based on this methodology the climate of Ethiopia has ten categories (Lemma Gonfa, 1996). These are:

- Bwh: Hot arid climate;
- Bsh: Hot semi-arid climate;
- Bsk: Cool semi-arid climate;
- Aw: Tropical rainy climate;
- Am: Tropical rain forest climate;
- Cwb: Warm temperate rainy climate I (dry months in winter);
- Cfb: Warm temperate rainy climate II (all months having some amount of rainfall);
- Aws: Tropical climate (criteria for both summer and winter dry is met);
- Cws: Warm Temperate climate (criteria for both winter and summer dry is met); and
- H: Highland climate. (Figure 1.3.3a).



With this classification a large portion of the Lowlands in the Northeast and Southeast fall under hot arid & semi-arid climates (Bwh & Bsh). Most of western Ethiopia as well as the Highlands of the South and the East have tropical rainy climate (Aw); while the Highlands in Southwest have warm & tropical rainy climates (Am, Cwb & Cfb).

Figure 2: Modified Kop pen's Climate Classification
Source: National Metrological Agency (NMA)

Precipitation

Based on the mean annual and mean monthly rainfall distributions, the rainfall regimes are delineated so that the types of seasons in Ethiopia identified as:-

- **Bega (Dry) season** that cover from October to January. During this season the south, some part of somali and south western parts of the country get rain fall .
- **Belg (Short rainy) season** that cover from February to May. During this season the south western, southern and eastern part of the country get rainfall
- **Kiremt (Main rainy) season** which cover from June to September. Hence, most part of the conutry get rain fall during this season.

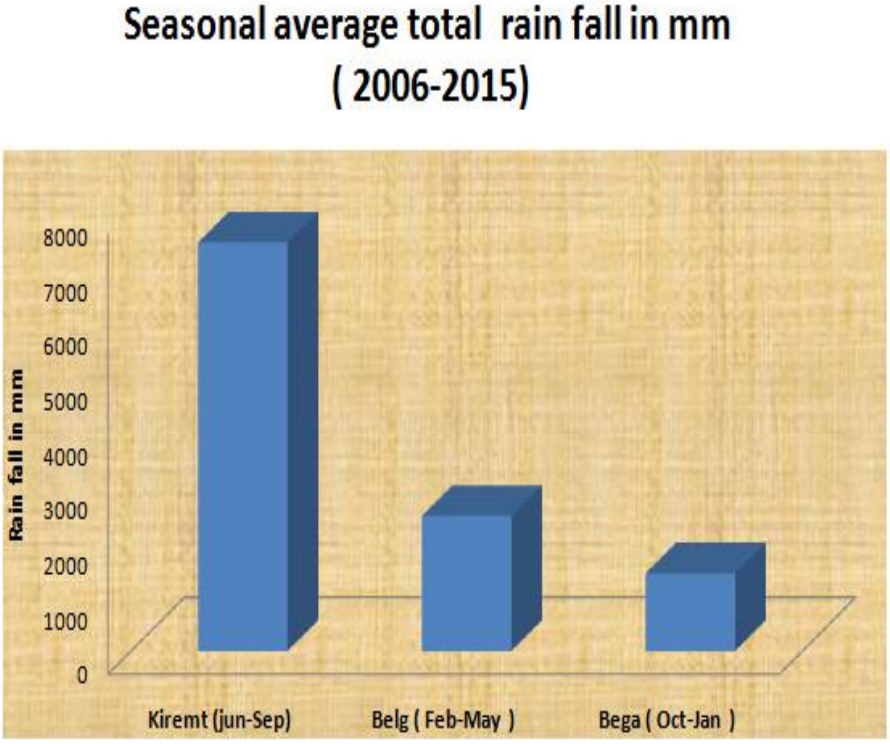


Figure 3: Amount of Rainfall in Different Seasons in Ethiopia (2006-2015)
Source: National Metrological Agency (NMA)

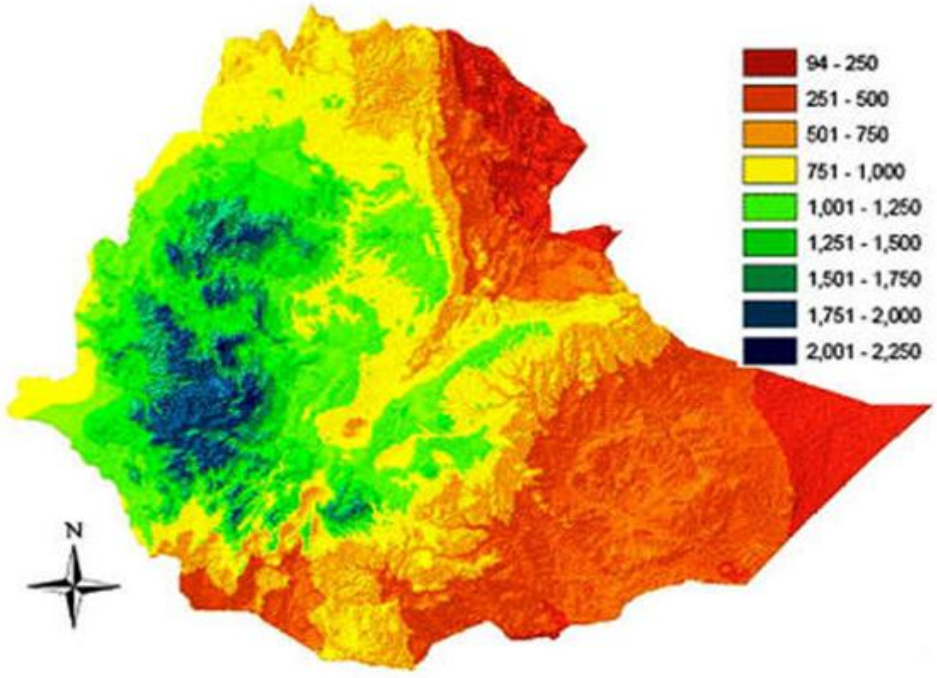
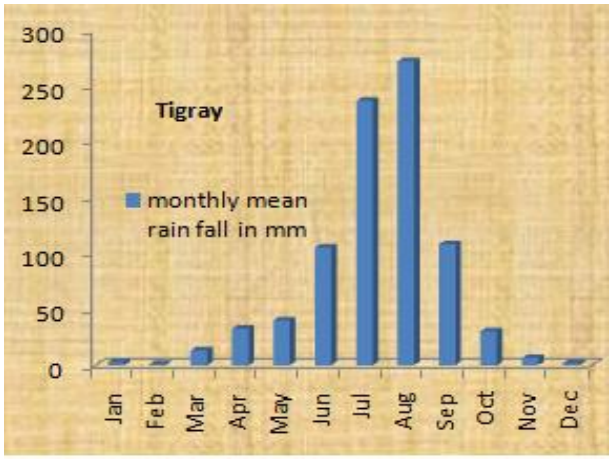
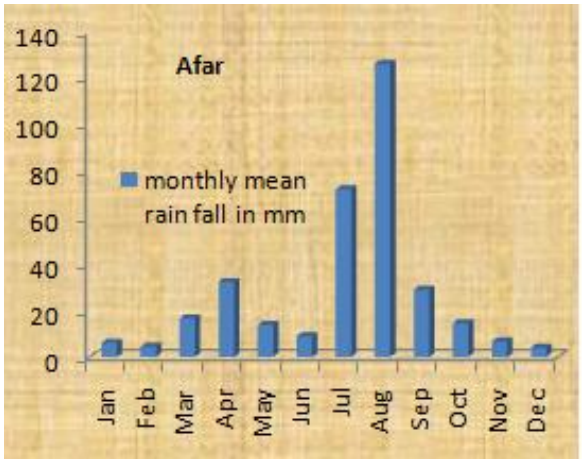
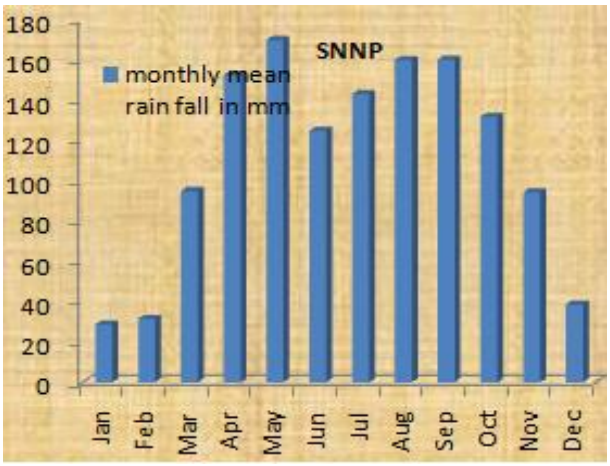


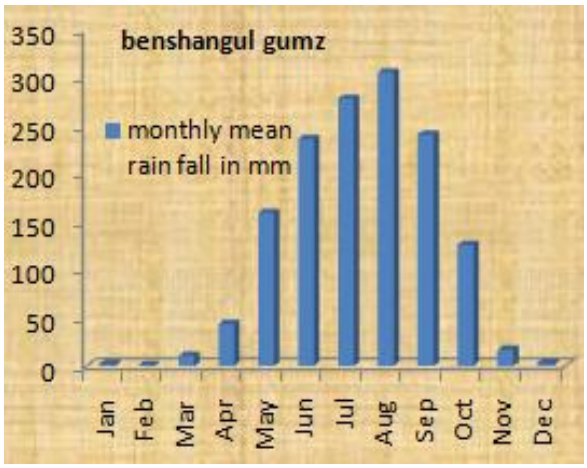
Figure 4 : Mean Annual Rainfall in Ethiopia in mm
Source: - National parks world wide.info

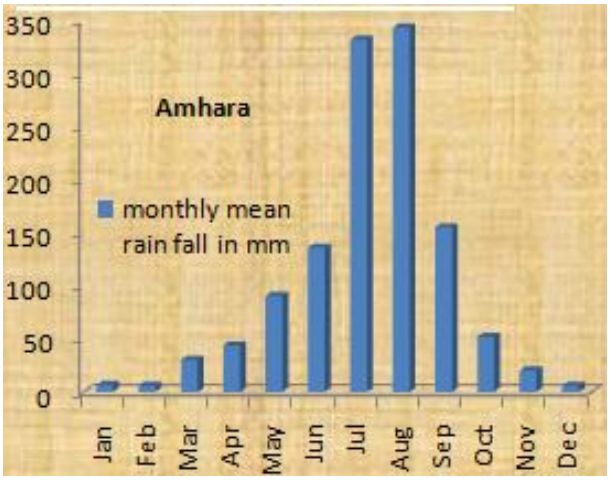
Monthly Regional Mean Rain Falls in mm (2006 to 2014)

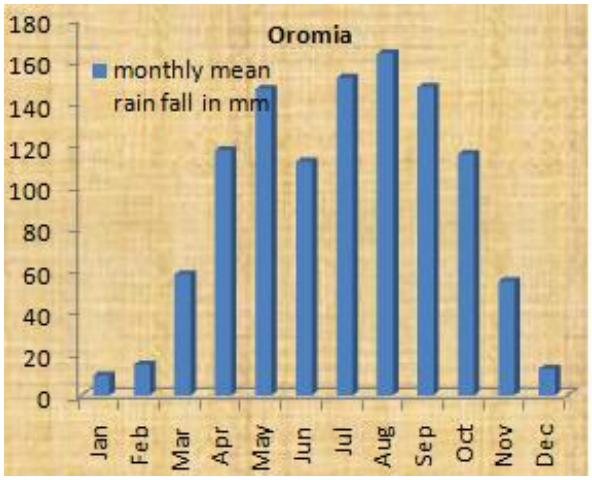


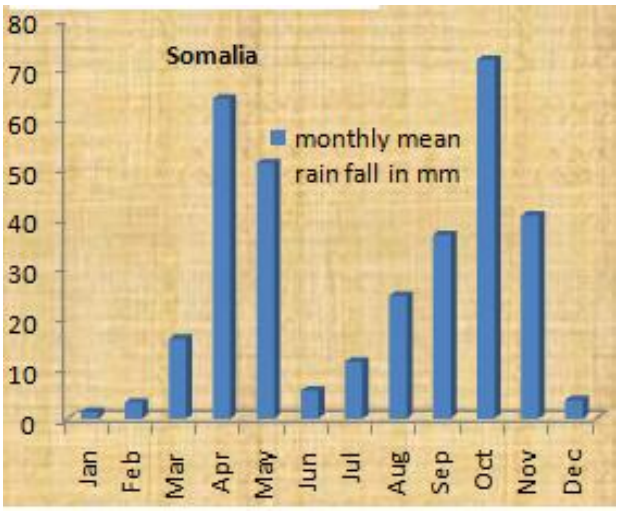


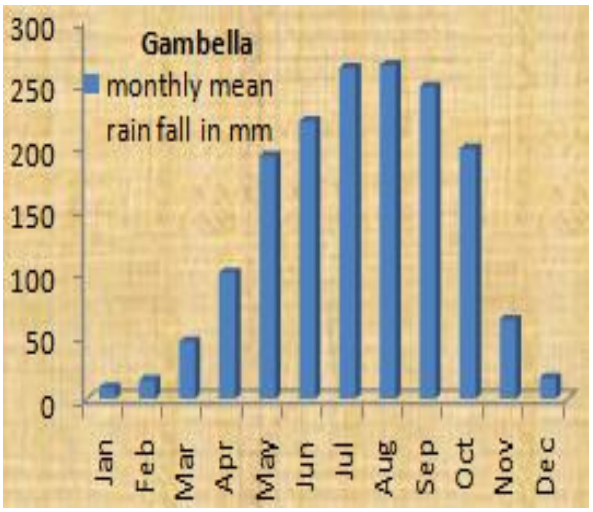


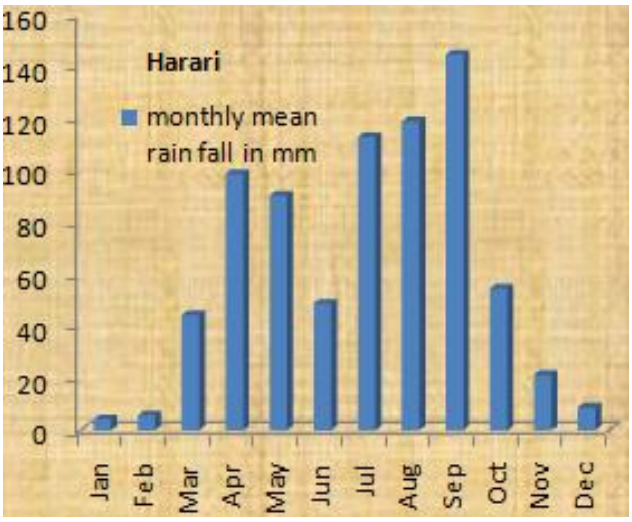


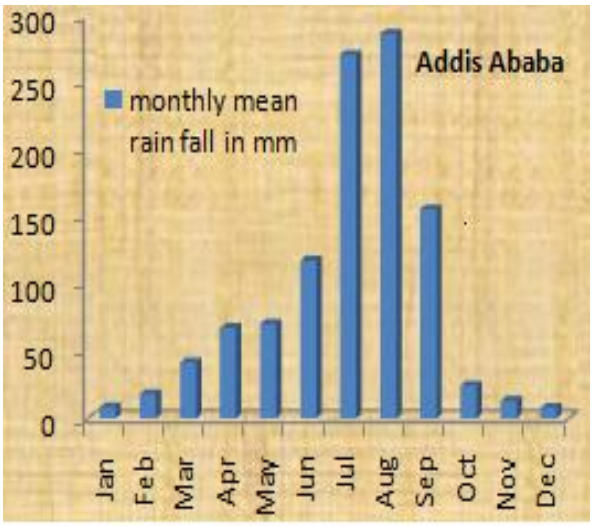












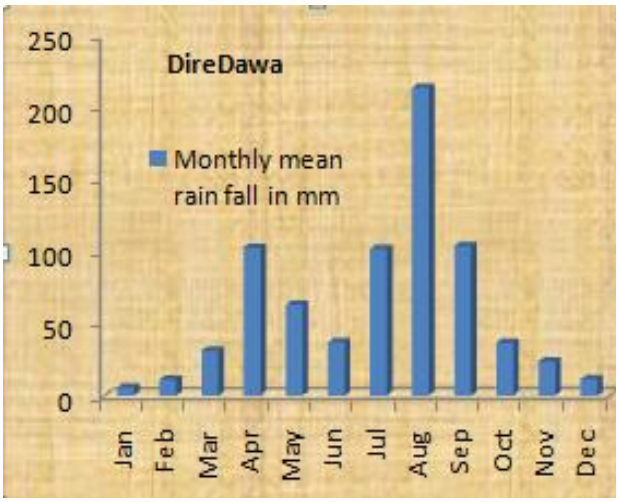


Figure 5: Monthly Mean Total Rainfall by Regions,

Source: National Metrological Agency (NMA)

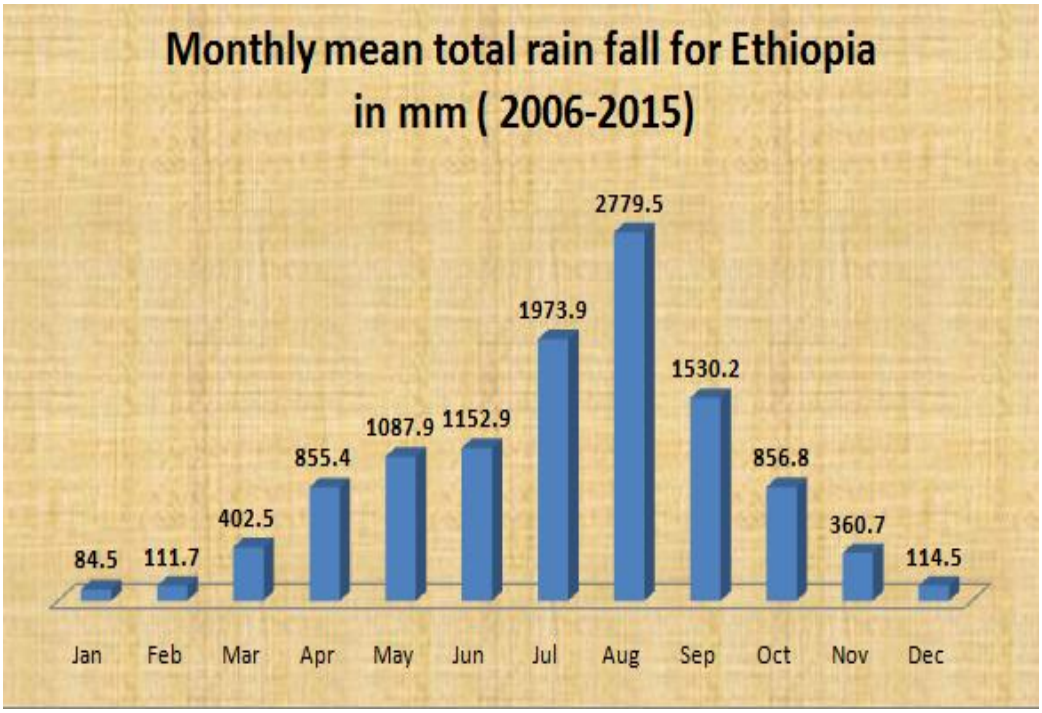


Figure 6: Monthly Mean Total Rainfall by Regions,
Source: National Metrological Agency (NMA)

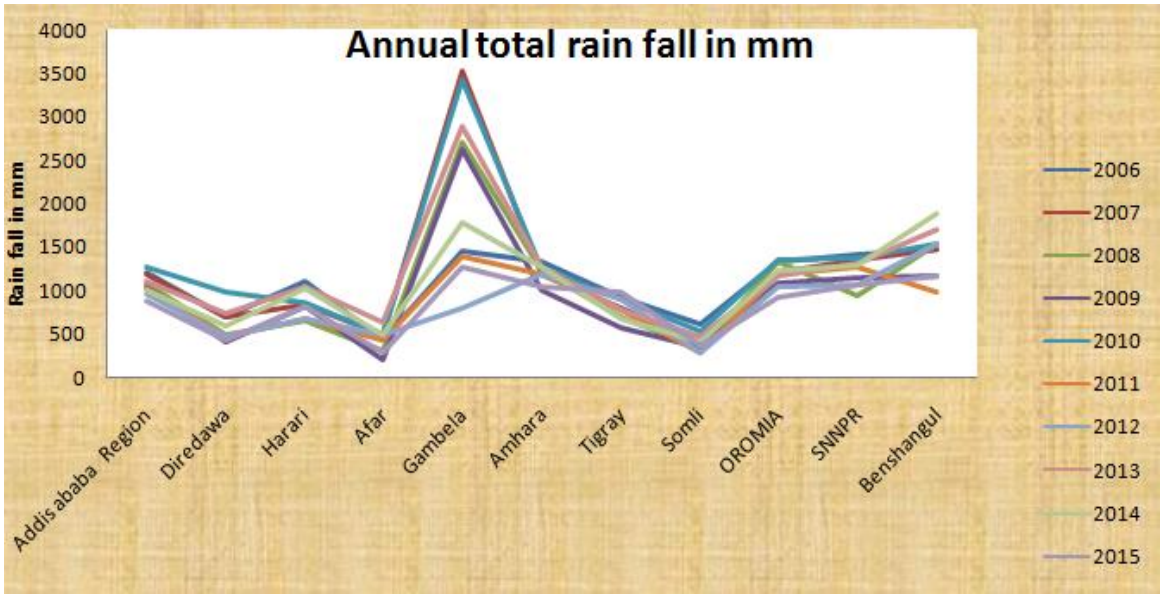


Figure 7: Annual Total Rainfall by Region (2006-2015)
Source: National Metrological Agency (NMA)

Temperature

The mean maximum temperature varies spatially and temporally. The lowest mean maximum temperature (10°C) occurs over the northwestern and central highlands, whereas the highest mean maximum temperature (45°) is found over the Dankil Depression.

In January and February, the highest mean maximum temperature (40°C) occurs over the dallol while in the high land over Mt. Ras Dashan records the lowest maximum temperature (10°C). However, maximum temperatures of 35°C to 40°C dominate the western and southeastern lowlands. The lowest mean minimum temperature mostly occur over the highlands of the country. Most of the highlands experience mean minimum temperature as low as 0°C from November to January while the highest mean minimum temperature is observed over the northeast, southeast and western lowlands of the country (NMSA, 1996).The highest temperatures of the year prevail between March and May especially over central and northern Ethiopia and December to January over southern and southeastern Ethiopia. Below freezing point (less than 0°C) is at times observe during night and early mornings in the months of October to January over southern, southeastern, central, eastern northeastern, and northwestern parts of the country. The daily range of temperature is high throughout the year. The annual range of temperature is low in the highlands, but high in the lowland areas. The annual range as a whole doesn't exceed 10°C whereas the diurnal range can be as much as 35°C (NMSA Vol. 1, 1996).

Table 2: Mean Temperature for Ethiopia (2006- 2015)

Year	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	23.9	25.5	25.3	25.4	25.3	25.4	24.4	23.2	23.8	24.2	22.7	22.2
2007	22.6	24.1	26.2	25.4	25.8	24.8	23.7	23.2	23.6	23.1	22.5	21.8
2008	23.1	23.4	25	25.5	25.5	24.9	23.5	23.3	24	23.4	22.5	21.9
2009	22.3	23.8	25.1	25.3	25.8	25.9	23.7	23.2	23.8	22.9	22.6	22.4
2010	22.4	24.2	24.5	24.2	25.9	25.1	23.3	22.8	22.7	23.7	22	21.9
2011	22.5	23	24	24.1	24.8	24.4	24.4	23.6	23.8	23.7	23.3	22.3
2012	22.6	24.3	25.2	26	26.1	25.3	23.9	23.5	24.3	23.7	23.5	21.5
2013	23.5	25.1	26.6	25.5	25.2	24.2	23.1	22.9	23.9	23	22.5	21.9
2014	23	24.1	25.4	26	24.6	25.8	24.6	23.9	24.3	24.2	23	21.4
2015	22.4	24.9	26.2	24.6	26.1	25	24.5	24.2	24.6	24.5	23.9	22.4

Source: National Meteorology Agency

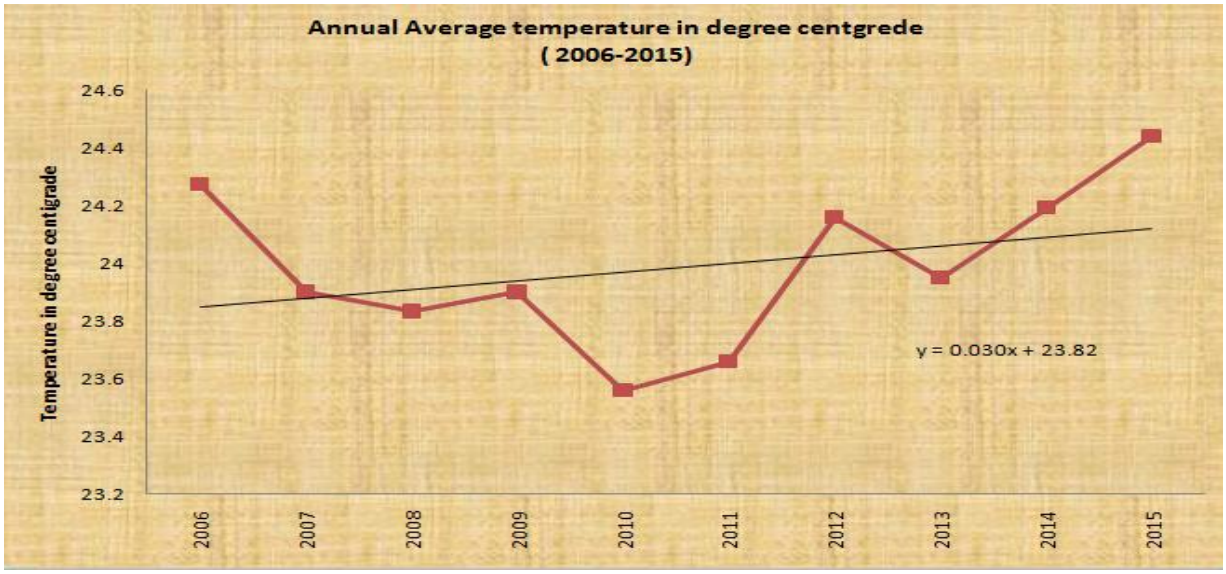


Figure 8 : Annual Average Temperature Between2006 and 2015
Source: *National Meteorology Agency*

NB: ***The lowest average temperature records in 2010. While starting 2013 the average temperature increase linearly 0.3 degree per year on average***.

Table 3: Monthly Average Maximum and Minimum Temperature by Regions (2006- 2015)

Months	Regions																					
	Addis Ababa		AFAR		Benshangul		DireDawa		Gambella		Harari		SNNPR		Tigray		Somli			Oromia	Amhara	
	Monthly average maximum and minimum temperature																					
	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem	Min Tem	Max tem
Jan	9.2	25	17.4	32.9	19.9	32.6	14.8	29.6	18.7	35.5	11.3	25.1	12.6	28.4	9.9	26.1	14.6	31	11.2	27.2	9.8	25.6
Feb	10.4	26.3	19.5	34.1	21.7	34.7	16.3	31.6	19.1	36.7	12.3	26.9	13.4	29.2	11	27.9	15.9	32.9	12.6	28.6	11	27.2
Mar	11.5	26.7	20.3	36.7	23.6	35.4	18.7	33.3	19.3	36.9	13.4	27.5	14	29	12.8	28.9	17.1	33.7	13.6	29.1	12.1	27.6
Apr	12.6	26.6	21.9	38.3	23.7	35	20.9	34.3	19.6	35.2	14.2	26	14.2	27.3	14.1	29.2	19	32.8	14.4	28.3	13	27.8
May	13	26.4	23.3	39.8	21.3	31.8	22.3	35.4	17.8	32.1	15.6	24.5	14.3	26.3	14.2	29.5	19.6	32.3	14.4	27.5	13.4	27.1
Jun	12.2	24.8	25.9	40.6	20.6	29	22.9	36.3	19.5	31.7	14.3	25	14.1	25.6	14.3	28.7	20.5	32.1	14.1	26.6	13.1	25.6
Jul	12.2	22.5	24	38.1	19.1	26.8	21.3	34.2	19.5	31.7	13.7	23.7	13.9	24.6	13.7	24.9	19.8	31	13.9	24.8	12.5	22.8
Aug	12.2	22	23.1	38	18.8	26.7	20.6	33	18.4	30.2	13.6	23.9	13.9	24.8	13.5	24.1	20	31.3	13.8	24.3	12.3	22.2
Sep	11.9	23.2	23.3	38.4	20.3	27.8	21	35.6	19	31.1	13.4	24.5	13.9	25.5	12.5	25.9	20	32.3	13.7	25.3	11.9	23.3
Oct	10.4	24.7	21.1	36.5	20.1	28.7	18.8	33.7	19.1	32.2	12.4	25.4	13.7	26.3	11.3	26.6	18	31.7	12.6	25.9	11	24.5
Nov	9.4	24.5	19.3	34.6	20.1	30.7	16.5	31.5	18.9	32.3	11.9	25	12.8	26.7	10.8	26.1	16	31.2	11.6	26	10.1	25
Dec	8.3	24.1	17.7	32.9	18.5	31	14.5	29.5	18.3	33.5	11.5	24.1	12.2	27.3	9.6	25.5	14.2	30.9	10.7	26	9.3	24.9

Source: National Meteorology Agency

NB: The average minimum temperature is between 13.2º and 17.4º Celsius. Maximum temperatures around noon are highest and average between 26.8º and 31.3º Celsius and exceed 40. º Celsius in Afar region in June.

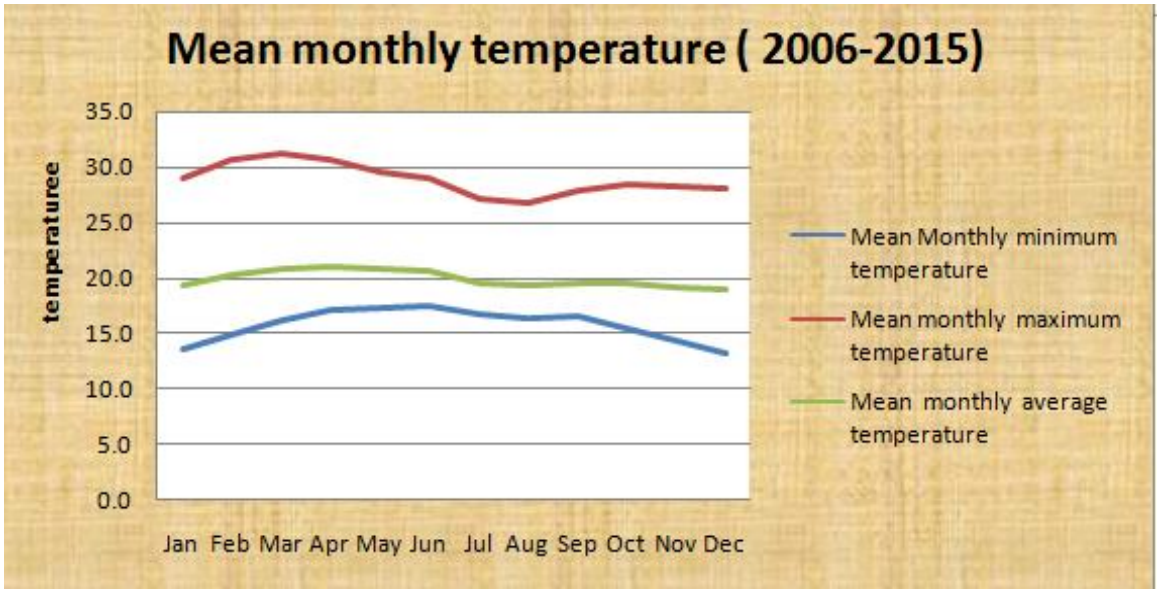


Figure 9: Average Monthly Temperature for the Country

Source: ***National Meteorology Agency***

Table 4:- Mean Monthly Temperature (Maximum, Minimum and Average)

Month	Minimum	Maximum	Average
	Temperature		
January	13.6	29.0	19.3
February	14.8	30.6	20.3
March	16.0	31.3	20.8
April	17.1	30.7	21.0
May	17.2	29.7	20.9
June	17.4	29.0	20.6
July	16.7	27.2	19.5
August	16.4	26.8	19.2
September	16.4	28.0	19.5
October	15.3	28.4	19.4
November	14.3	28.3	19.2
December	13.2	28.1	18.9

Source: ***National Meteorology Agency***

Humidity

In Most of the country the relative humidity recorded more than 50 %. Benshangul gumze has a high humidity. An ambient humidity between 70 to 80 percent is quite normal in Benshangul whereas Diredawa has lowest humidity having between 45 to 50% (Figure 10).

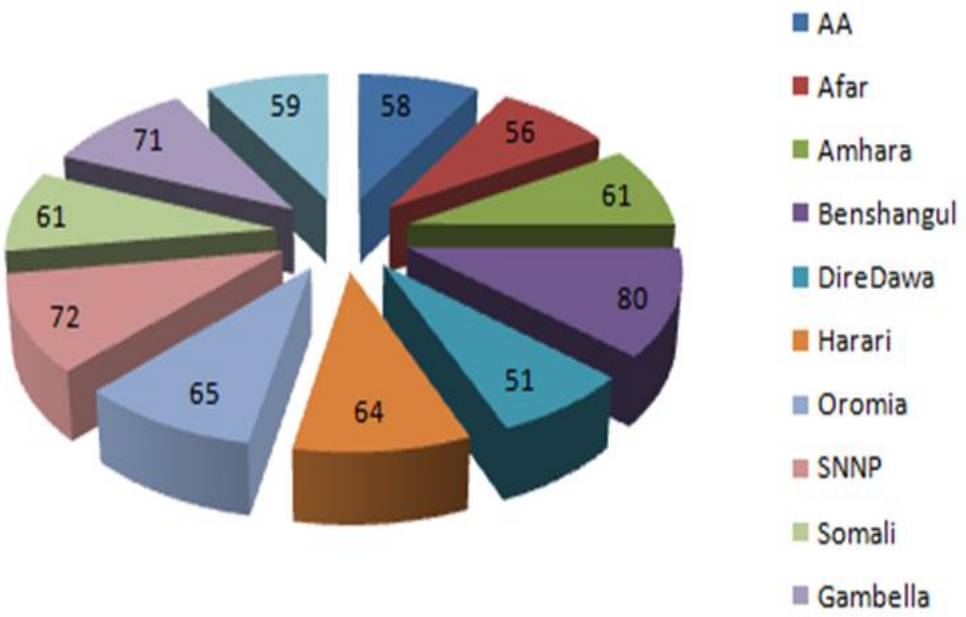


Figure 10: Average Regional Relative Humidity in (%) from 2005-2015
Source: ***National Meteorology Agency***

Sunshine

The sun is shines throughout the year, because Ethiopia is found in the equator and has a tropical climate. The average number of hours per day can be between 7 to 8 hours.

Occurrence of El Niño and La Niña

Among weather systems that can have a big influence upon the weather in Ethiopia are the Inter Tropical Convergence Zone (ITCZ) Somali Jet, and the El Niño and La Niña phenomenon. La Niña is sometimes referred to as the *cold phase* of ENSO where as El Niño as the *warm phase* of ENSO. These deviations from normal surface temperatures can have large-scale impacts not only on ocean processes, but also on global El Niño and La Niña episodes typically during the last 9 to 12 months of 2015, but some prolonged events may last for years. While their frequency can be quite irregular, El Niño and La Niña events occur on average every two to seven years. Typically, El Niño occurs more frequently than La Niña. As showen in Figure 11 below 2015 was strong el nion year, almost all regions in Ethiopia have got insufficient rain fall that was below the mean total rain fall.

Table 5: Occurrence of El Niño and La Nina Years and Their Intensities

El Niño				La Niña		
Weak	Mod	Strong	Very Strong	Weak	Mod	Strong
1951-52	1963-64	1957-58	1982-83	1950-51	1955-56	1973-74
1952-53	1986-87	1965-66	1997-98	1954-55	1970-71	1975-76
1953-54	1987-88	1972-73	2015-16	1964-65	1998-99	1988-89
1958-59	1991-92			1967-68	1999-00	
1968-69	2002-03			1971-72	2007-08	
1969-70	2009-10			1974-75	2010-11	
1976-77				1983-84		
1977-78				1984-85		
1979-80				1995-96		
1994-95				2000-01		
2004-05				2011-12		
2006-07				2016-17		

Source: - ggweather.com/enso/oni.htm

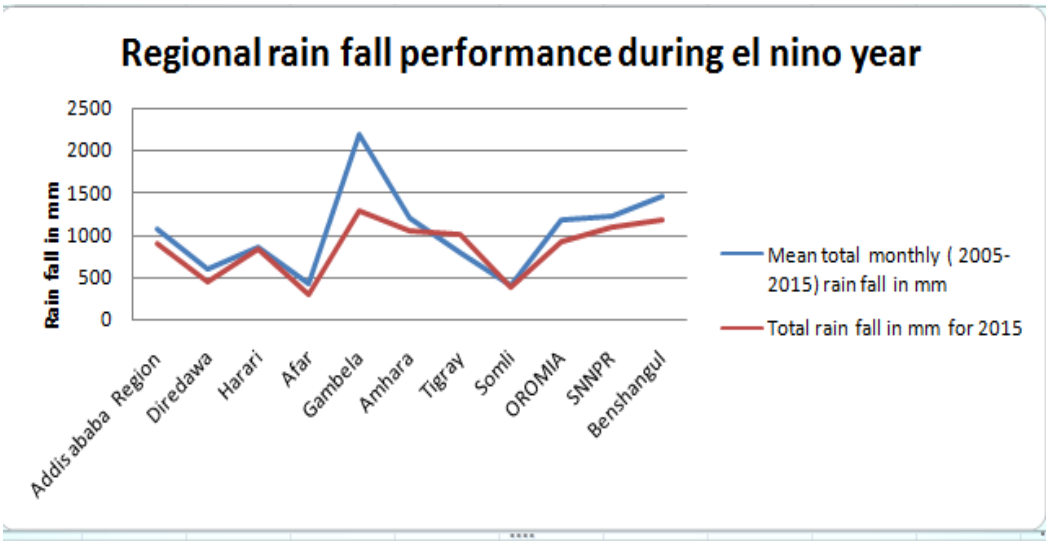


Figure 11: The Effect of Eli Niño Inrain Fall Perforance in Ethiopia
Source: National Meteorology Agency, 2015

3.2.2 Hydrographical Characteristics

This topic includes hydrographical information on the extent, location and characteristics of lakes, rivers and artificial reservoirs and watersheds. This information is best presented in map and Tables forms.

- **River Basins**

Ethiopia has nine major rivers and twelve big lakes. The overall land mass of the country is hydro-logically divided into 12 Basins. Eight of these are River Basins, one Lake Basin and three are Dry Basins. The basin is characterized by High Level of Spatial and Temporal Variability. Between 80-90% of Ethiopia's water resources is found in Abbay, Tekeze, Baro-Akobo and

Omo-Gibe basins in the west and south-western part of Ethiopia where the population is no more than 30-40%. On other hand, the water resources available in the east and central river basins are only 10-20% whereas the population in these basins is over 60%. The country's annual renewable freshwater potential is 122 billion m^3, only 3 percent of this amount remains in the country. It is estimated that 54.4 billion m^3 of surface runoff and 2.6 billion m^3 of groundwater can be developed for utilization.

Table 6: The Salient Features of Water Resources Potential in All River Basins of Ethiopia

River Basin	Source	Length (Km)	Area (Km)	Run off (Bm^3)	Estimated Ground water potential (Bm^3)	Direction of flow	Terminal
Tekeze	North Wollo HL	608	82,350	8.2	0.2	West	Meditranian sea
Abbay	West,south west HL	6,695	199,812	54.8	1.8	West	Meditranian sea
Baro-Akobo	Western HL	-	75,912	23.6	0.28	West	Meditranian sea
Omo-Gibe	Centeral,Western HL	-	7900	16.6	0.42	South	Rudolph Lake
Rift valley	Arsi and Centeral HL	-	52,793	5.6	0.1	South	Chew bahir
Mereb	Adigrat HL	440	5,900	0.65	0.05	West	Swamp in Sudan
Denakil	North Wollo HL	-	74,002	0.86	-	NF	Internal
Awash	Central HL	1,200	112,696	4.9	0.14	North east	Internal
Ayisha	No flow	-	2,223	-	-	NF	Internal
Ogaden	No flow	-	77,121	-	-	NF	Internal
Wabi-Shebelle	Bale HL	1,820	202,697	3.16	0.07	East	Indian Ocean
Genalle-Dawa	Bale HL	858	171,042	5.88	0.14	East	Indian Ocean
Total			I,I35,494	124.4	2.86		

Sources: Ministry of water, irrigation and energy
-Unknown

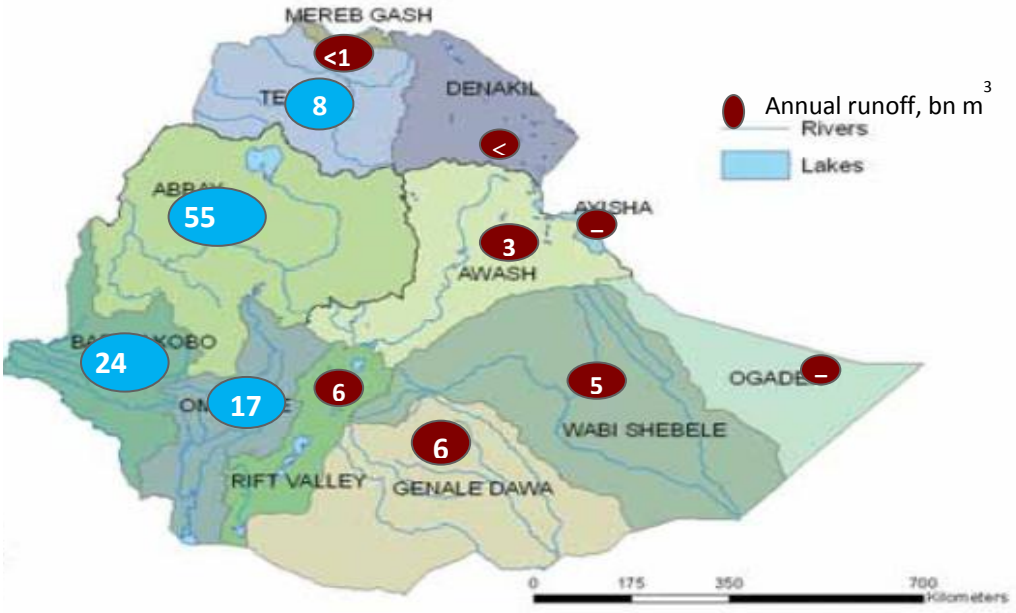


Figure 12: Spatial Variability of Ethiopian Water Resources
Sources: Ministry of water, irrigation and energy

Lakes and Artificial Reservoirs

The country has numerous lakes and marshes. Out of the important lakes 11 are fresh water, 9 are saline and four are crater lakes. Beside this the country has fifteen artificial reservoirs that serve for hydropower generation as well as for irrigation. Table 7 and 8 below lists the hydrographic characteristics of natural lakes and artificial reservoirs.

Table 7: Hydrographical Characteristics of Natural Lakes

Name	Location		Drainage Area (km^2)	Surface Area (Km^2)	Maximum Depth (m)
	Longitude	Latitude			
Tana	$37^0$23'	$11^0$36'	15,319	3,000	14
Ziway	$38^0$45'	$07^0$54'	7,380	440	8.9
Langano	$38^0$81'	$07^0$32'	2,000	230	47.9
Abiyata	$38^0$35'	$07^0$33'	10,740	180	14.2
Shalla	$38^0$35'	$07^0$03'	2,300	370	266
Awassa	$38^0$27'	$07^0$07'	1,300	92	22
Abayya	$37^0$50'	$06^0$15'	16,342	1,140	24.2
Chamo	$37^0$38'	$05^0$50'	18,575	317	14.2
Chew-Bahir	36056'	$04^0$45'	-	308	-
Haik	$39^0$43'	$11^0$21'	83	22.5	23
Ardibo	$39^0$46'	$11^0$14'	53.5	14.9	64
Ashenge	$39^0$31'	$12^0$34'	129	20	25
Beseka	39053'	08054'	420	30	7
Abhe	$41^0$45'	$11^0$10'	-	320	-
Gamari	$41^0$40'	$11^0$30'	-	63	-
Bishoftu	$8^0$44'42	$38^0$59'6			38

***Sources:** Ministry of water, irrigation and energy*
-Unknown

Table 8: Hydrological Characteristics of Artificial Reservoirs

Name of Reservoirs	Location by basin	Dam height (m)	Total storage (million m^3)	Purpose
Finchaa	Abay	22.2	406	Hydropower
Amerti neshi	Abay	35	448	Hydropower
Koka	Awash	23.8	1,850	Hydropower
Melkawakena	Wabi-Shebelle	38	763	Hydropower
Gilgelgibe-I	Omo-Gibe	41	839	Hydropower
Tekeze	Tekeze	185	9,293	Hydropower
Gibe-III	Omo-Gibe	243	14,000	Hydropower
Genale-Dawa	Genale-Dawa	110	2,570	Hydropower
Rib	Abbay	73.3	234	Irrigation
Megech	Abbay	77.1	185	Irrigation
Gidabo	Rift valley	25.8	63	Irrigation
Arjo-Deddessa	Abbay	42	1900	Irrigation
Tendaho	Awash	53	1.8 billion m^3	Irrigation

***Sources:** Ministry of water, irrigation and energy*

3.2.3 Geological and Geographical Information

Ethiopia is located in the horn of Africa, bordering Eritrea in the North, Djibouti and Somalia in the East, Kenya in the South, and Sudan and South Sudan in the West. The country stretches from 3^{o}N of the equator to 15^{o}N latitude and from 33^{o}E to 48^{o}E longitude, and has an area of 1,127,127 km^2.

Ethiopia is a country of great geographic diversity. Erosion, volcanic eruptions, tectonic movements and subsidence have occurred for centuries in the country and still continue to occur accentuating the unevenness of the surface. As a result, Ethiopia is subjected to wide altitudinal and physio-geographic variations. The altitudinal variation of the country ranges from 126 meters below sea level in the Danakil Depression to the highest peak of 4,620 meters above sea level (m.a.sl) on Mount Ras Dashen. Due to these physio-geographic variations, the Macro- and micro-climatic conditions of the country are highly variable.

Because of the combined effects of the above factors Ethiopia is endowed with diverse ecosystems. As a result, the country has 10 ecosystems, and 18 major and 49 minor agro-ecological zones that are inhabited by amazingly great diversity of plant, animal and microbial genetic resources.

- **Administrative Regions and Population**

Ethiopia is comprised of nine regions and two city administrations (Figure 13). Over eighty distinct languages having about 200 dialects are spoken in the country, making Ethiopia one of bio-culturally rich countries. Amharic is the working language of the Federal Government. English is used in academic and research institutions.

Ethiopia is the second most populous country in Africa, next to Nigeria, having a total population of over 87.9 million (CSA, 2014a). About 83% of the people live in rural areas. The annual population growth rate of the country is 2.6%, so that Ethiopian population will exceed 136 million by 2029 (CSA, 2014a).

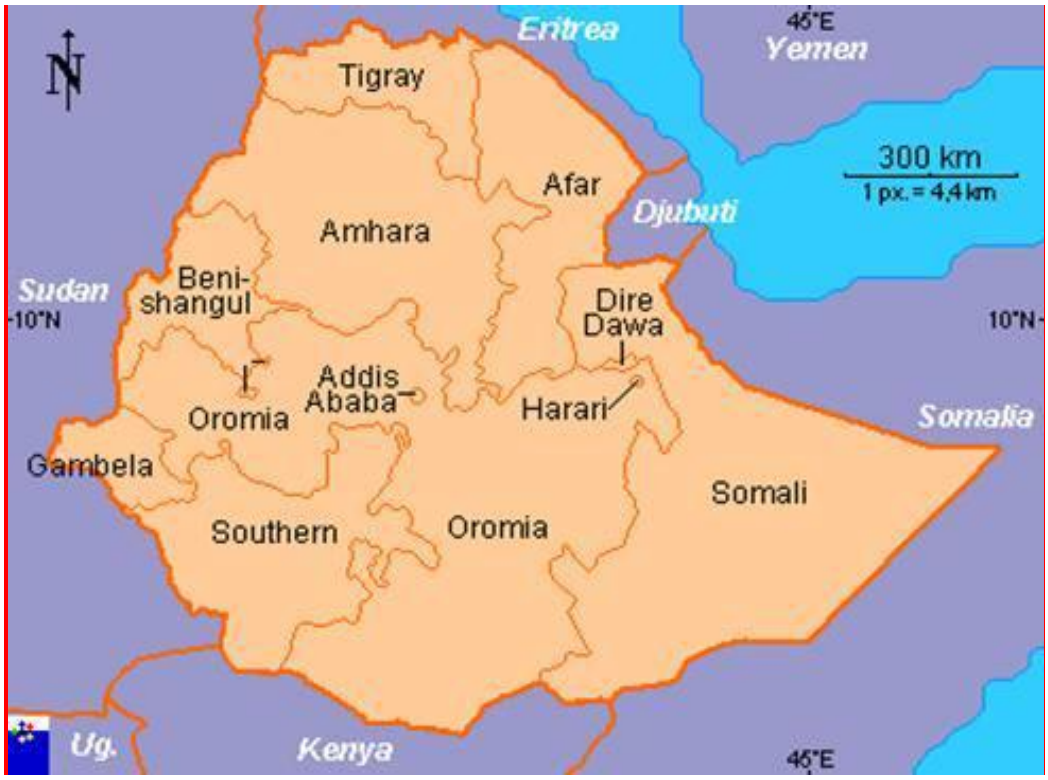


Figure 13 Administrative Setup of the Federal Democratic Republic of Ethiopia

The Physio-geographic Features

As indicated above Ethiopia has divers' physio-geographic features which composed of high and rugged mountains, flat-topped plateaus, deep gorges, incised river valleys and rolling plains. The Great East African Rift Valley runs from Northeast to Southwest of the country and separates the Western and Southeastern highlands. Overall, Ethiopia has different land forms, rich in biodiversity and natural resources, the basic land forms and minerals are discussed as follows.

Plains

Most of the Ethiopian peripheries belong to flat lowlands or plains. Hence, the major plains occur to the southeast, at the lower course of Wabe Shebele, Ganale and Dawa rivers. In the northern parts, the Afar rift, lower course of Awash River and the Danakil depression belong to flat lowlands. Similarly, plain lands occur in the south and southwest of the country. These include the Sagan plain, the Omo-Turkana plain and the Akobo-Baro plains. Moreover, many areas in the western part of the country, bordering Sudan, characterized by flat lowlands. These cover the lower courses of Abay and Angreb rivers and areas in west Gojam and Gonder belongs to plain landscape.

Hills

Hilly landscape is common on northern, western, north-western, south-western, southern part of the country. It is also common in south-eastern and eastern part of Ethiopia. Younger (Plio-Pleistocene) central eruption in the rift valley, also show hilly landscape, especially in the Main Ethiopian Rift and Afar Rift.

Plateau

Most of the older flood basalt lava flows are fissure in nature and covered many parts of the country forming flat table land. This landscape which covers relief between 1700 m to 3000 m. above mean sea level occurred prior to the formation of the Main Ethiopian Rift (MER) and Afar Rift. However, the formation of plateau surfaces took place to the west, northwest, to the west and southwest of the MER. It is also formed to the east and southeast of the MER. Moreover, plateau landscape observed much in Arsi-Bale and Harar areas and parts of Sidamo and SNNP.

Mountains

The plateau are at places covered by high rising volcanic mountains (more than 3000 m) related to younger central volcanic activity, some of which are pre-rift in age. The highest mountain in Ethiopia, Ras Dashen (4623 m), occurs in northern Gonder zone, Semens massif. Also Guna mt (4231 m) occur in southern Gonder region. In northern Amhara region (Wollo zone) also occur mt Abune Yosef (4193), Abuye Meda (4000 m) and Amba Farit (3975 m). There is also mount Oti (3352 m), Jerjertu (3117 m), In central Gojam the highest peak is known as Choke mt (4100 m) and Aba Mineos mt near Merto Lemariam (more than 3000 m). In Wolega zone the highest peak is Tulu Wollel (3300 m) To the east of the MER mt Gololcha (3625 m), Mt Chilalo (4000 m), Bada (4136 m) Kaka (3800-4000 m), and mt Batu (4310 m) occur.

Faults

Much of the faults in the country are related to older lines of weakness in the Precambrian, rejuvenated in geologic times. These meridional faults are clustered in the Precambrian terrain and in the rift zones. The Main Ethiopian Rift faults are normal faults with north-easterly trend. The western escarpment show down throw to the east and the eastern escarpment show down throw to the west. The MER rift and Afar rift join at the Lake Abe. From here the fault trend deviates to northwest direction, parallel to the Red Sea faults. The maximum length of the faults

is approximately 15 or more k. m., but the minimum length varies from a microscopic size to one or two k.m.

Volcanoes

The plateau of Ethiopia (north-western, south-western, western and eastern plateau), at places are covered by high rising volcanic mountains. There are also minor hills from vent or central eruption. Younger Pliocene to Quaternary volcanic mountains to the east of Addis Ababa forming Yerer, Ziquala and other smaller hills around Debrezeit. Many scoria cones and trachytes volcanoes occur to the east of MER. Characteristic volcanic mountain occurs in the Main Ethiopian Rift and Afar rift. These are mostly related younger central volcanic outpourings. Most of them are basalt volcano, but are related to scoria cone and trachyte-rhyolite eruption.

Lakes

In Ethiopia some parts of the plateaus are covered by Quaternary lakes. These include Lake Tana, Lake Ashanghi, Lake Chomen, crater lakes of the Bishoftu area, like L. Hora, L. Babo Gaya, and L. Cheleleka. Within the Ethiopian Rift, starting from south, the lakes include, northern Lake Turkana (Rudolf), Chew Bahir, Lake Chamo, Lake Abaya, Lake Awasa, Lake Shala, L. Abiyata, L. Langano, and L. Ziway. In the Afar rift lakes include, L. Abe, L. Afambo, L. Asal and L. Afrera.

Area by Rock Type

High grade metamorphic rocks occur in western, south-western, southern and eastern part of Ethiopia. The low grade rocks are dominantly exposed in northern part of the country. Minor exposures also occur in the southern, western and eastern parts of the country. Mesozoic age sedimentary rocks occur in south-eastern, northern, central and north-western parts of Ethiopia. In the south-eastern part of the country sedimentation continued even during lower Tertiary.

Soil Characteristics

The wide ranges of topographic and climatic factors, parent material and land use have resulted in extreme variability of soil. In different parts of the country, different soil forming factors have taken precedence. According to the Ministry of Agriculture and natural resource about 19 soil types are identified throughout the country. The large proportion of the country's landmass is

covered by lithosols, nitosols, cambisols and regosols in order of their importance (see Table 9). Complexes of soil forming factors have primarily influenced the distribution of the soil types.

Table 9: Soils Type and Distribution in Ethiopia

Soil type	Area (km^2)	Percent
Acrisol	55,726.50	5
Cambisol	124,038	11.1
Chernozems	814	0.07
Rendzinas	16,348	1.5
Gleysols	5,273.50	0.47
Phaeazems	32,551	2.9
Lithosol (Leptosols)	163,185	14.7
Fluvisols	88,261.50	7.9
Luvisols	64,063.50	5.8
Nitosols	150,089.50	13.5
Histosols	4,719.50	0.42
Arenosols	9,024	0.81
Regosols	133,596	12
Solonetz	495	0.04
Andosols	13,556	1.2
Vertisols	116,785	10.5
Xarosols	53,171	4.8
Yermosols	34,950	3.1
Solonchaks	47,217.50	4.2

Source: Ministry of Agriculture and Natural Resources, 2016

3.3 Ecosystems and Biodiversity

This sub-section organizes environment statistics on ecosystems and biodiversity, as well as their recordable time across locations. Ecosystems can be broadly defined as a community of organisms, together with their physical environment, viewed as a system of interacting and interdependent relationships. Biodiversity is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems. It is also a measure of ecosystem health. Biodiversity is a fundamental characteristic of ecosystems, while variability among ecosystems is a fundamental driver of biodiversity.

3.3.1 Ecosystems Diversity in Ethiopia

The diversity of ecosystems of Ethiopia has been described in a number of reports and has been syndicated that Ethiopia has 10 distinct ecosystems (IBC, 2009). Classification of these ecosystems is based on vegetation types, which describe dominant plant species composition. These ecosystems are geographically located in different altitudes, and harbor unique and diverse biological resources. Table 10 provides detailed description of the ecosystems found in Ethiopia.

I. Afro alpine and Sub Afro Alpine Ecosystem

Afro alpine and Sub afro alpine Ecosystem areas are found between mountain ranges of 3,200 and 4,620 m.a.sl. They include mountain slopes and tops of highest mountains such as Bale and Semien Mountains, and Menz-Guassa and Mount Guna (IBC, 2005).

II. Montane Grassland Ecosystem

Montane Grassland Ecosystem is found between 1,500 and 3,200 m.a.sl. It occurs on the uplands of Central, North and Western Shewa, Arsi, Bale and Borena highlands, Western and Eastern highlands of Harerge and Gojam, Southern and Northern highlands of Gonder and Wello; Eastern highlands of Tigray, and highlands of Sidama and Gamo Gofa.

III. Dry Evergreen Montane Forest and Evergreen Scrub Ecosystem

Dry Evergreen Montane Forest and Evergreen Scrub Ecosystem is situated between altitudinal ranges of 1,500 and 3,200 masl. It covers much of the highland areas and mountainous chains of Oromia (Shewa, Arsi, Bale, Borena and Harerge), Amhara (Gojam, Wello and Gonder), Tigray (East and West Tigray) and SNNPRS (Sidama and Gamo Gofa).

IV. Moist Montane Forest Ecosystem

Moist Montane Forest Ecosystem is found mostly on the Southwestern and Southeastern plateaus with altitudinal range between 800 and 2500 masl, and comprises the high forests of the country.

V. Acacia-Commiphora Woodland Ecosystem

Acacia-Commiphora Woodland Ecosystem is found between 900 and 1,900 masl, and covers mainly parts of Southern, Eastern and the Rift Valley of Oromia, Afar, Harari, Somali, and Southern Nations, and Nationalities Peoples' (SNNP) regional state.

VI. Combretum -Terminalia Woodland Ecosystem

Combretum-Terminalia Woodland Ecosystem occurs between 500 and 1,900 masl. It is found in different parts of all regions of the country. The vegetation in this ecosystem has developed under the influence of fire and many of the trees have thick corky barks.

VII. Lowland Tropical Forest Ecosystem

Lowland Tropical Forest Ecosystem is situated in the lowlands of the Eastern Gambella region in Abobo-Gog 'woreda', and adjacent areas of South Sudan border.

VIII. Desert and Semi-desert Scrubland Ecosystem

Desert and Semi-desert Scrubland Ecosystem is found in Northeastern, Eastern and Southern lowlands of Ethiopia. It occurs in the Afar Danakil Depression, Ogaden, around Lake Chew Bahir and Omo valley.

IX. Wetland Ecosystem

Wetland Ecosystem consists of areas of swamps, marshes, flood plains, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water depth of which at low tide does not exceed six meters (Ramsar, 1971). Wetlands deliver a wide range of ecosystem services that contribute to human well-being such as food, feed, construction materials, water supply, water purification, climate regulation, flood regulation and eco-tourism. According to estimates by Forum for Environment (2009) Ethiopia has a wetland area of 22,600km^2.

X. Aquatic Ecosystem

Aquatic in literal meaning refers to water. As an ecosystem, widely taken, it includes freshwater (rivers, reservoirs and lakes), marine (oceans and seas) and estuarine (coastal, bays, tidal) ecosystems. The Ethiopian aquatic ecosystem has high diversity areas such as major rivers and lakes that are of great national and international importance. The country is well known for its richness in water potential. As indicated above there are numerous lakes and marshes that are located in different ecological zones of the country. These lakes are situated at altitudes ranging from about 150 m below sea level high up to 4000 m. The surface area of the lakes vary considerably from less than 1 km² to over 3600 km² and mean depths range from few meters to over 260 meters.

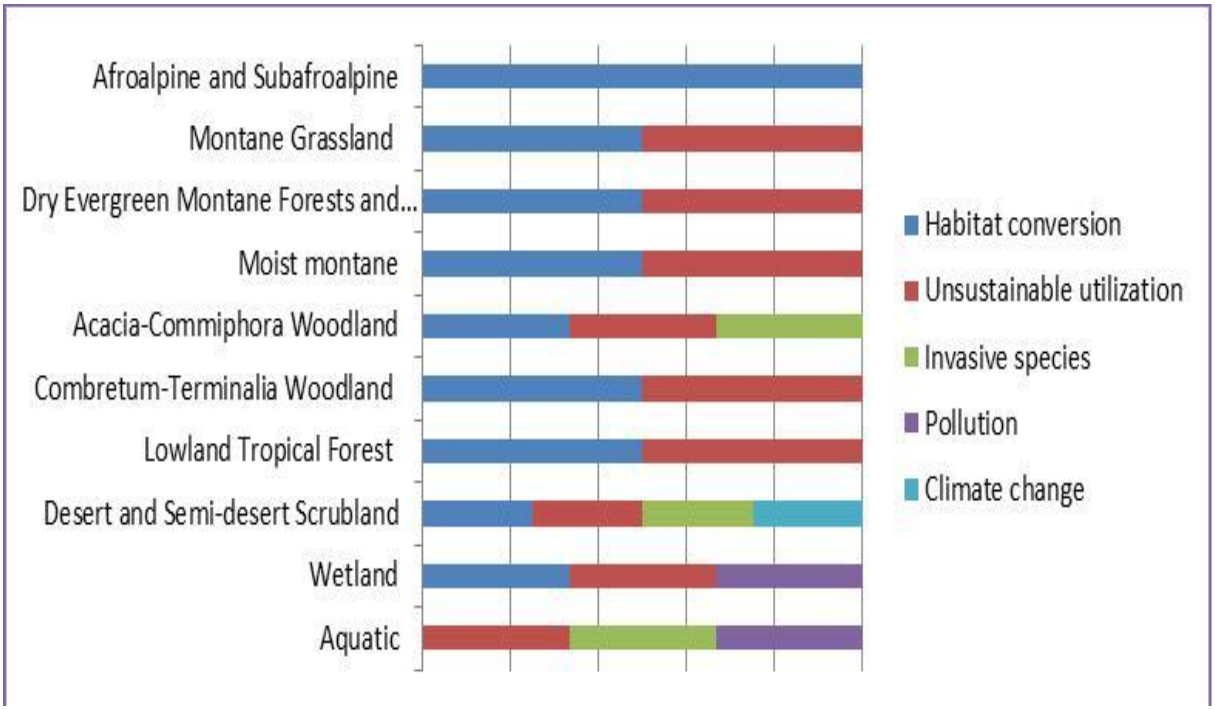


Figure 14: Summary of Relative Importance of Major Direct Threats by Ecosystems
Source: Ethiopia Biodiversity Institute 2016

Table 10: Summary of Eco-system in Ethiopia

N0.	Name	Altitude/Mountain range	Area
I	**Afroalpine and Subafroalpine Ecosystem**	**3,200 and 4,620 masl.**	**NA**
II	**Montane Grassland Ecosystem**	**1,500 and 3,200 masl**	**NA**
III	**Dry Evergreen Montane Forest and Evergreen Scrub Ecosystem**	**1,500 and 3,200 masl**	**NA**
IV	**Moist Montane Forest Ecosystem**	**800 and 2500 masl**	**NA**
V	**Acacia-Commiphora Woodland Ecosystem**	**900 and 1,900 masl**	**NA**
VI	**Combretum-Terminalia Woodland Ecosystem**	**500 and 1,900 masl**	**NA**
VII	**Lowland Tropical Forest Ecosystem**	**NA**	**NA**
VIII	**Desert and Semi-desert Scrubland Ecosystem**	**NA**	**NA**
IX	**Wetland Ecosystem**	**NA**	**22,600km2.**
X	**Aquatic Ecosystem**	**150 m below sea level high up to 4000 m.**	**from < 1 km² to over 3600 km²,mean depths range from few ms to over 260 meters**

Source: Ethiopia Biodiversity Institute 2016

Table 11: Forest In-situ Sites in Ethiopia

Sr. No.	Name	Area (Hectare)	Region	Zone	Woreda
1	Abogedam	184.45	Amhara	South Gonder	Kemekem
2	Das-Gundo	59.63	Amhara	North Gonder	Metema
3	Gechi	65.16	Amhara	West Gojam	Sekela
4	Gelawdios	140.07	Amhara	Awi	Dangila
5	Quandisha	167.6	Amhara	Awi	Dangila
6	ShelkoMedhayalem	280.93	Amhara	South Gonder	Fogera
7	Shello Forest	76.69	Amhara	South Gonder	Farta
8	Zabezi	64.32	Amhara	West Gojjam	Merawi
9	Abobo	229.39	Gambela	Zone 1	Gambela
10	Bishangari	310.54	Oromia	Arsi	Munessa
11	SigmoSetema	103.89	Oromia	Jimma	Setema
12	Sof-Oumer	726.94	Oromia	Bale	Ginir
13	Tirobother-Becho	74.44	Oromia	Jimma	LimuKosa
14	Bonga	141.51	SNNP	Kaffa	Menjiwo
15	Masha	12.36	SNNP	Shaka	Masha
16	Dedebit	485.34	Tigray	Western Tigray	AsegedeTsimbela
	Total	*3123.24*			

Source: Ethiopia Biodiversity Institute, 2016

Table 12: Field Gene Bank and Botanical Garden (EX-situ) Sites in Ethiopia

Sr. No.	Name of Ex-situ sites	Region	No. of Accessions	No. of Species	Area (Ha)
1	Wondogent medicinal field gene bank	SNNP	557	295	2.7
2.	Goba medicinal field gene bank	Oromia	312	307	3.7
3.	Adulala	Oromia	27	27	15
4.	Lepies field gene Bank	Oromia	47	38	14.3
5.	Deber tabor	Amhara	53	53	8.4
6.	Shashemene Botanical Garden	Oromia	27	27	19
7.	GobaGarenogoreta	Oromia	12	12	6.5
8.	Jima Botanical Garden	Oromia	19	19	7
9.	Mandura field gene Bank	Benshangul G.	25	25	2.4
10.	Assosa field gene Bank	Benshangul G.	44	44	17
11.	Sherkole field gene Bank	Benshangul G.	10	7	9
12.	Dolomena field gene Bank	Oromia	41	41	1.9
13.	Yabelo field gene Bank	Oromia	-	-	-
14.	EBI field gene Bank	Addis Ababa	55	13	0.4
Total			**1129**	**908**	**115.3**

Source: Ethiopia Biodiversity Institute, 2016

3.3.2 Globally Threatened Species in Ethiopia

The main factors that govern the climate of Ethiopia are the proximity to the Equator in the southern border and the complexity of the topography. These factors have induced the variability in seasons and climatic variations across Ethiopia. The presence of immense geographic diversity is also further depicted by the existence of huge ecosystem diversity, cultural diversity and mosaic environmental and climatic variations in the country.

- **Faunal Diversity**

The diverse ecosystems have favored the country to possess high biological diversity that includes flora, fauna and microorganisms. Though the identification of wild faunal species of the country is not exhaustive, there are 6,454 faunal diversity, (mammals, birds, reptiles, amphibians, fish and insects). About 8 percent of these faunal diversities are endemic species to Ethiopia. Almost all the major domestic animals of the world (cattle, sheep, goat, chicken, camel, horse, donkey and mule) found in all physico-geographic, climatic and socio-cultural variations of the country. In addition to its diverse ecology, Ethiopia has served as one of a historic gateway to domestic animals from Asia (believed to be centre of origin for most of the domestic animals) to Africa which favored diversification of animal genetic resources.

- **Domestic Faunal Diversity**

Ethiopia is endowed with large domestic animal population and huge within species and within breed diversity. Based on the 2014 FAO estimate, Ethiopia ranked 1st in Africa and 5th in the world in cattle population with 54 million heads following Brazil, India, China, and United States of America that have 212, 189, 114, and 89 million, respectively (FAO, 2015a). World rank of Ethiopia in other domestic animals population is 1$^{st\ in}$ donkey, 5th in mule 3rd in bee hives, 6th in camel and 9th in small ruminants. The diversity of domestic animals with in species has represented by number of breeds in each species type. Although the characterization process of species is not exhaustive in the country so far 28 breeds of cattle, 9 breeds of sheep, 8 breeds of goat, 7 breeds of camel, 6 breeds of donkey, 8 breeds of horse, 2 breeds of mule and 7 breeds of chickens breeds identified (EBI, 2016).

Most of the breeds (more than 98%) in Ethiopia are indigenous to the country (CSA, 2015), evolved over centuries, managed in a remarkable environments (highland, dry mountain,

lowlands, arid and forest), and they are often expected to possess unique genetic traits that enable their survival in those diverse range of production environments and developed specific necessary features to deal with harsh environments such as severe feed and water scarcity, resistance to diseases, extreme hot and cold environmental conditions and unpredictable long drought periods etc. In domesticated mammals, the hump of the Zebu and the tails of fat-tailed and fat-rumped sheep are striking examples of selection for fat deposition. Within species differences to extreme environments also exist. Great variation in the hair and coats of most domestic animal species also observed.

Table 13: Domestic Animal Species and Breed Diversity

Sr. No.	Domestic animal species	Number of Breeds	Remark
1	Cattle	28	Sheko, fogera and Irob breeds threatened
2	Sheep	9	
3	Goat	8	
4	Camel	7	
5	Donkey	6	
6	Horse	8	
7	Chicken ecotypes	7	Kundudo Horse breed highly threatened
8	Honey bee ecotypes	6	

Source: Ethiopia Biodiversity Institute, 2016

Table 14: Number of Diversity of Animals in Ethiopia by Type

Sr. No.	Birds Diversity in Ethiopia	Number	Remark
1	Bird fauna species	926	
	Endemic bird fauna species	26	
	Endangered	5	
	Near threatened	14	
	Vulnerable	12	
	Data deficient	5	
	Least Concern	27	
2	Mammals Diversity in Ethiopia		
	Mammal fauna species	320	
	Endemic mammal fauna species	36	
	Threatened	33	Worldbank, 2014
3	Reptiles Diversity in Ethiopia		
	Reptile fauna species	202	
	Endemic reptile fauna species	17	
4	Amphibians Diversity in Ethiopia		
	Known amphibian fauna species	73	
	Endemic amphibian fauna species	30	
	Threatened amphibian species	11	

Table 14: Number of Diversity of Animals …Cont'd

Sr. No.	Birds Diversity in Ethiopia	Number	Remark
5	**Fish diversity in Ethiopia**		
	Known fish fauna species	200	
	Endemic fish fauna species	40	
	Vulnerable	8*	*Out of the 40 endemic fishes
	Endangered	4*	*Out of the 40 endemic fishes
6	**Domestic animal diversity in Ethiopia**		
	Cattle	28	
	Exotic cattle	7	
	Sheep	9	
	Exotic sheep	7	
	Goat	8	
	Exotic goat	3	
	Horse	8	
	Chicken	7	
	Exotic chicken	14	
	Camel	7	
	Donkey	6	
	Mule	2	

Source: Ethiopia Biodiversity Institute, 2016

Microbial Biodiversity

Ethiopia is believed to harbor a wide diversity of microbial resources. However, the diversity of microbial are hardly explored, collected, identified, characterized and conserved. Among the little known are those that are used in the fermentation processes in traditional foods and beverages, diseases control, biological pest control, soil fertility, reduction of post-harvest losses, improving human and animal health, improving environmental safety, reduction of wastes and/or its bioconversion into useful products. Researches on microbes have been going on for the last four decades. So far EBI has identified and conserved 756 microbial species (bacteria, fungi and microalgae) in its gene bank. Table 15 shows the number of microbial species by type of species and year of identification.

Table 15: Summery for Number of Indentified Microbial Species in Each Year

Year of Identification	Number of Identified Microbial Species		
	Bacteria	Fungi	Microalgae
2007/08	85		
2008/09	61	25	
2009/10	67		
20010/11	33	10	
20011/12	37	29	
20012/13	76	32	
20013/14	28	5	
20014/15	79	44	4
20015/16	71	43	9
20016/17	15	3	
Sub-total	552	191	13
TOTAL			**756**

Source: Ethiopia Biodiversity Institute, 2016

Protected Area

Ethiopia has established different types of protected areas (PAs). These include national and regional parks, sanctuaries, reserves, rescue centers, controlled hunting areas, botanical gardens, national forest priority areas and biosphere reserves. There are also other types of protected areas which include lands protected by religious institutions and scientific research projects in forest and plants. At present, the size of the protected areas is estimated at 14% of the country's area. Several protected areas such as Alatish, Omo, Maze and Chebera Churchura have been gazetted at regional levels (Young, 2012) while seven national parks have been gazetted at federal level.

All the important ecosystems in the country are not represented in the existing protected areas. This is a major drawback for conservation of threatened endemic and unique species protected wildlife areas of Ethiopia, with their size are presented in Table 16-22.

Table 16 : List of National Parks in Ethiopia

Sr. No.	Name of the National parks	Location	Year of Establishment (E.C)	Area in km^2
1	Awash	Oromiya & Afar(F)	1958	756
2	Simian Mountains	Amhara R. S(F)	1959	412
3	Alatish	Amhara R. S(F)	1997	2666
4	Bahir Dar Blue Nile river Millennium	Amhara R.S	2008	4729
5	Borena saynt	Amhara R.S	2001	4325
6	Bale Mountains	Oromiya R.S(F)	1962	2200
7	Abijata lakes	Oromiya R.S(F)	1963	887
8	Omo	S.N.N.P R.S(F)	1959	3566
9	Nech sar	S.N.N.P R.S(F)	1966	514
10	Mago	S.N.N.P R.S	1974	1942
11	Chebera churchura	S.N.N.P R.S	1997	1190
12	Maze	S.N.N.P R.S	1997	202
13	Yangudi-rassa	Afar R.S(F)	1969	4731
14	Gambela	Gambela R.S(F)	1966	5061
15	Geraile	Somali R.S	1998	3558
16	Dati Wolel	Oromia R.S	1998	431
17	Yabello	Oromia R.S	1978	2500
18	Gibe Sheleko	S.N.N.P R.S	2001	248
19	Loka Abaya	S.N.N.P R.S	2001	500
20	Kafeta Shiraro	Tigray R.S(F)	1999	5000

Source: Ethiopia Biodiversity Institute 2016

Table 17 : Wildlife Sanctuaries

Sr. No.	Name of the Sanctuaries	Location	Year of Establishment (E.C)	Area In (km^2)
1	Babile elephant	Oromiya & Somali R.(F)	1962	6987
2	Senkele	Oromiya & S.N.N.P R.S(F)	1964	54
3	Deara	Oromiya R.S	1986	19.4

Source: Ethiopia Biodiversity Institute 2016

Table 18: Wildlife Reserves

Sr. No.	Name of the Wildlife reserve	Location	Year of Establishment (E.C)	Area (km^2)
1	Tama	S.N.N.P R.S	-	1,665
2	Chelbi	S.N.N.P R.S	-	4,212

Source: Ethiopia Biodiversity Institute 2016
-Unknown

Table 19: Controlled Hunting Areas

Sr. No.	Name of the Control hunting areas	Location	Year of Establishment (E.C)	Area (km^2)
1	Abasheba Demero	Oromiya R.S	1994	210
2	Areba-Gugu	Oromiya R.S	1995	341
3	Dindin	Oromiya R.S	-	280
4	Besemena-Odobulu	Oromiya R.S	1993	350
5	Munessa-Kukie	Oromiya R.S	1993	111
6	Shedem Berbere	Oromiya R.S	1988	170
7	Hanto	Oromiya R.S	1991	190
8	Bilen Hertalie	Afar R.S	-	1,090
9	Chifera	Afar R.S	1998	510
10	Telalak-Dewe	Afar R.S	-	457
11	Murullie	S.N.N.P R.S	-	690
12	Wilshet-Sala	S.N.N.P R.S	2000	350
13	Sororo-Torgam	Oromiya R.S	2000	78
14	Haro Abadiko	Oromiya R.S	2000	200
15	Urgan Bula	Oromiya R.S	2000	78
16	Hurfa Soma	Oromiya R.S	2000	215
17	Adaba-Dodola	Oromiya R.S	2000	736

Source: - Ethiopian Wildlife Conservation Authority (EWCA)

-Unknown

Table 20: Open Hunting Areas

Sr. No.	Name of the Open hunting areas	Location	Year of Establishment (E.C)	Area (km^2)
1	**Gara Gumbi**	**Oromiya R.S**	**-**	**140**
2	**Gara Miti**	**Oromiya R.S**	**-**	**240**
3	**Alluto**	**Oromiya R.S**	**-**	**280**
4	**Sinana**	**Oromiya R.S**	**-**	**15**
5	**Jibat**	**Oromiya R.S**	**-**	**100**
6	**Debre Libanos**	**Oromiya R.S**	**-**	**31**
7	**Gelila Dura**	**Afar R.S**	**-**	**140**
8	**Gelila Dura**	**Afar R.S**	**-**	**140**

Source: - Ethiopian Wildlife Conservation Authority (EWCA)

-Unknown

Table 21: Community Conservation Areas

Sr. No.	Name of Community Conservation areas	Location	Year of Establishment (E.C)	Area (km^2)
1	**Simien Gibe**	**S.N.N.P R.S**	**2001**	**49**
2	**Garameba**	**S.N.N.P R.S**	**2001**	**25**
3	**Guassa**	**Amhara R.S**		

Source: - Ethiopian Wildlife Conservation Authority (EWCA)

Table 22: Protected Area Systems of Ethiopia

Sr. No.	Types of protected area systems	Total (No.)
1	National parks	21
2	Wildlife sanctuaries	2
3	Wildlife reserves	3
4	Controlled hunting areas	20
5	Community conservation areas	6
6	Wild life rescue centers	2
7	Community managed ecotourism and hunting areas	2
8	Open hunting areas	6
9	Commercial ranches	3
10	Botanical gardens and herbariums	2
11	Biosphere reserves	4
12	National priority forest areas	80
13	Municipal parks	3
14	Land occupied by research centers, governmental institutions	36

Source: - Ethiopian Wildlife Conservation Authority (EWCA)

3.3.3. Forests

The Second National Communication (SNC) of Ethiopia reported in 2015 to the United Nations Framework Convention on Climate Change (UNFCCR) shows that the forest cover increased from 7 per cent from the late 1990s to 14 per cent in 2013. As mentioned on the report, it is a challenge to get a reliable estimate on forest cover and change in Ethiopia, due to limited and conflicting data sources, partly attributable to the use of different definitions of forest in the country. However, the report mentioned that the total forest cover of Ethiopia has increased in size as a result of large-scale reforestation campaigns launched all over the country since the last decade (See also http://unfccc.int/resource/docs/natc/ethnc2.pdf)

- **Forest Cover in Ethiopia 2013-Classwise**

According to the information reported by the Second National communication of Ethiopia, 2015; the natural vegetation of Ethiopia is influenced by five main biomes namely: Savannah,

Mountane, Tropical Thickets and Wooded Steppe and Desert biomes. The vegetation can be assigned to eight major types that range from Afro-alpine formations through dense high canopy montane forest to savannah, scrubland and desert.

Forest Reference level of 2016 submission by Ethiopia mentioned that MEFCC has created a map of land use/land cover for the year 2013 using a supervised classification and maximum likelihood classifier on Landsat data. An accuracy assessment was carried out in order to produce statistics for the 2013 land use/land cover categories. An accuracy assessment combines the map data, the 2013 land use/land cover map, with higher quality reference data to produce adjusted area estimates for each land use/land cover class.

According to the submitted report, sixteen land use/land classes were identified and descriptions were prepared based on past mapping experiences of the Woody Biomass Inventory Strategic Planning Project (WBISPP) and the prevailing ground situation of the country from the forest inventory (Table 23). Representative areas of interests (AOIs) were collected for each of the LULC classes using Google Earth. The AOIs were uniquely identified with the code incorporating name of the region, name of the grid and Land use/land cover type. Moreover, the relation between Path and Row of each of the scenes and AOIs were predefined to ease the classification.

Geometric and radiometric corrections were applied to the Landsat images. The AOIs served as training data and were used to classify the satellite data using the Maximum Likelihood algorithm. The library of radiometric signatures for the Landsat scenes was iteratively edited to harmonize the scenes. The classified scene maps were mosaicked to form the thematic land cover/land use map for Ethiopia.

Table 23: Description of the Land Use/ Land Cover Classes in 2013

LULC Code	LULC Name	Description
1	Agriculture	Arable and fallow land that grow annual crops (wheat, maize, sorghum, "teff", Cotton, sugar cane, "enset", coffee on the small scale or commercial level by rain fed or irrigation schemes
2	Grassland	Land covered with the natural growth of graminea and herbaceous vegetation or a land sown with introduced grass and leguminous for the grazing of livestock.
3	Scrubland	Low bushes and stunted trees, mostly spiny either deciduous or evergreen. More than half of the surface of the ground is bare of vegetation.
4	Shrubland	Land with shrubs/bushes canopy cover combined cover of bush, and bushes are woody perennial plants, 2 m in height at maturity in situ.
5	Open Woodland	Land covered by natural growth of graminea and herbaceous vegetation, with some scattered trees (tree canopy cover less than 3% . it is composed of a canopy of grass wooded ecosystem of Combretum-Terminalia and Accacia-Comiphora that can both tolerate burning and temporary flooding with the tall grass stratums, in case of the former one.
6	Dense Woodland	A continuous stand of trees with a crown density of between 20 - 80%. Mature trees are usually single storied, although there may be layered under-stories of immature trees, and of bushes, shrubs and grasses/forbs. Maximum height of the canopy is generally not more than 20 meters, although emergent may exceed this. Dense woodland has more than 400 stems per hectare, whilst open woodland hasbetween 150 and 400 stems per hectare.
12	Saltpan	Dry Salt Flats occurring on the flat-floored bottoms of interior desert basins which do not qualify as Wetland.
13	Wetland	Wetlands are those areas dominated by wetland herbaceous vegetation or are non-vegetate where the water table is at, near, or above the land surface for a significant part of most years. These wetlands include, brackish and salt marshes and non-vegetated flats and also freshwater meadows, wet prairies, and open bogs.
14	Bamboo	Naturally regenerated/planted forest predominantly composed of bamboo vegetation, fulfilling the area, canopy cover and height riteria mentioned at number 7.
15	Riverine	Are forests which fulfill the definition explained in no 7 and grow along with the major river banks and spans 20m to 50m buffer from the river. Predominantly it consists of common families of Moraceae, Spidandaceae, mimosaceae etc
16	Water body	Area occupied by major rivers of perennial or intermittent (width ≥ 15m), lakes, ponds and reservoirs.

SOURCE: Forest Reference level Ethiopia's Submission of 2015 to the UNFCCC

Forest Area Change According to the Reference Level Submission of Ethiopia, 2016

The results of the forest area change detection are provided in the figures 15 and 16 below. The primary results from the accuracy assessment are adjusted area estimates calculated by combining sample and map area estimates and their associated confidence intervals. The adjusted area estimate for forest loss is 1.1 million ha +/- 0.91 million ha and for forest gain is

0.4 million ha +/- [RS experts to fill] over the period 2000-2013 which corresponds to an annual forest loss of approximately 70,000 ha/yr and annual forest gain of approximately 30,000 ha/yr.

The relatively high annual forest area gain in the Dry Afromontane biome gives some evidence that Ethiopia is already implementing several mitigating actions which aim to restore forest resources. The on-going mitigation actions reducing emissions are watershed management, agricultural intensification, trees on farm for fuel wood, declining livestock (due to stall-feeding, diseases, lack of own fodder and livestock raids), non-wood and alternative energy sources, and controlled migration. There is an on-going trend of farmland intensification (except in Gambella, Afar, Somali) through agro-forestry practices, various small-scale irrigation systems, fertilizers and other kinds of farming improvements allowing reduction of the total farmland area extent up to 3 per cents a year in some woredas.

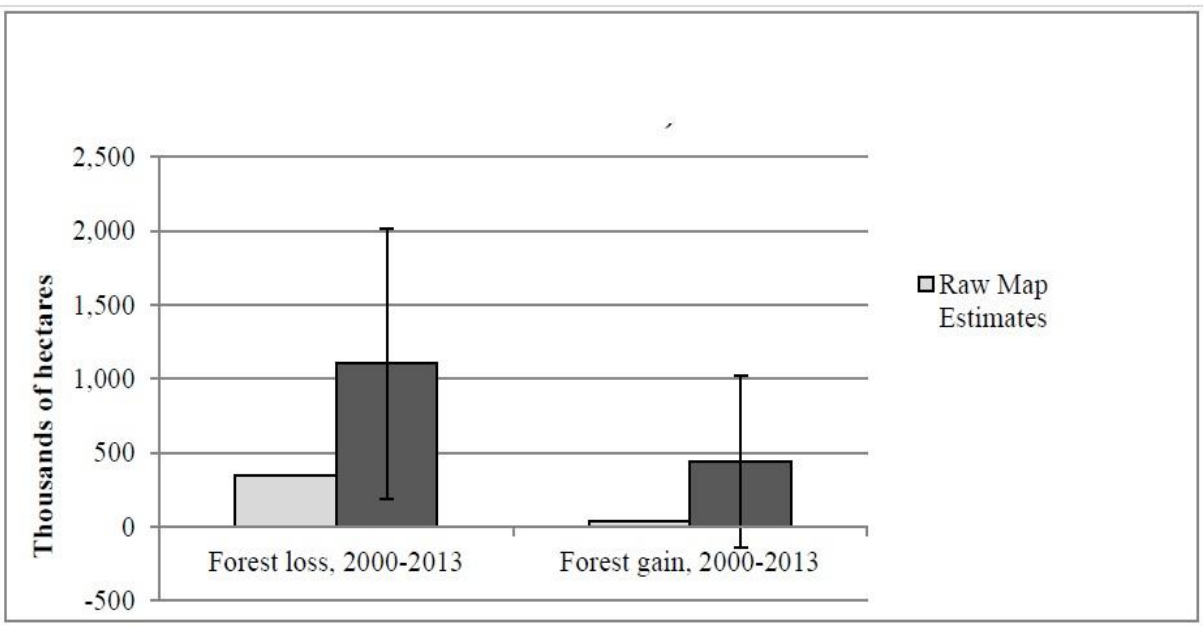


Figure 15: National Forest Loss 2000-2013 Area Estimates (1000 hectares)

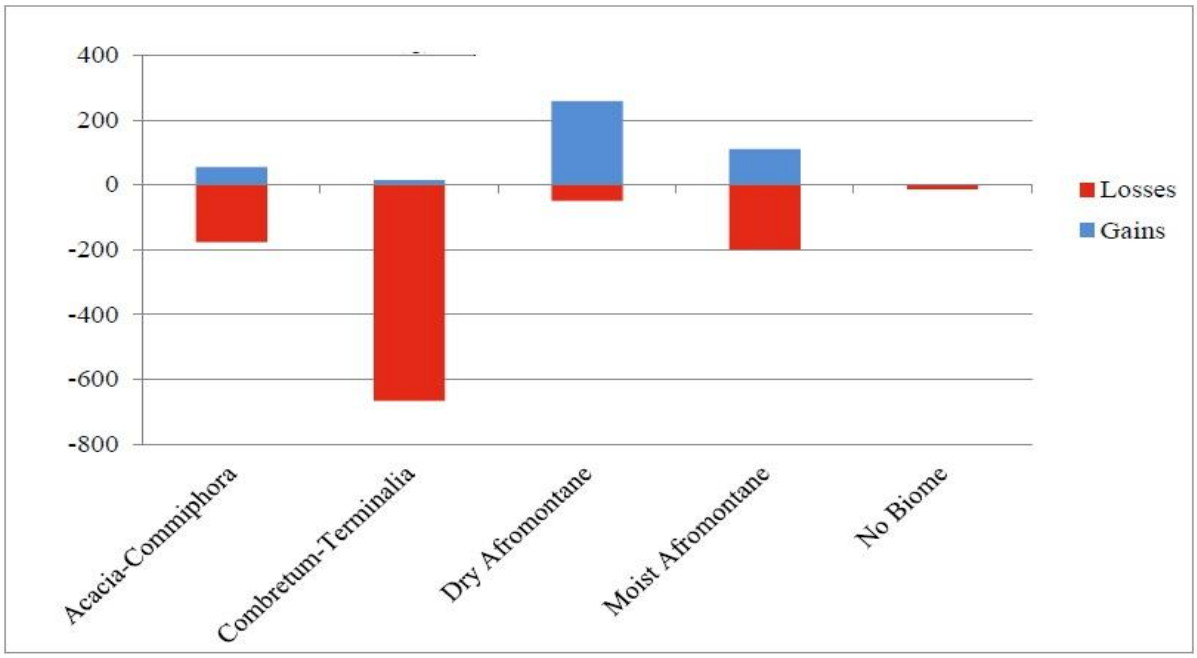


Figure 16: Results of the National Forest Area Change Detection 2000-2013 by Biome
Source: Forest Reference Level 2016 submission of Ethiopia for UNFCCC

4 ENVIRONMENTAL RESOURCES AND THEIR USE





4. ENVIRONMENTAL RESOURCES AND THEIR USE

4.1 Background Information

Environmental resources are the naturally occurring living and non-living components of the Earth, together comprising the biophysical environment, provide benefits to humanity. Environmental resources include natural resources (such as sub-soil resources (mineral and energy), soil resources, biological resources, and water resources) and land. They can be naturally renewable (e.g., fish, timber or water) or non-renewable (e.g., minerals).

Environmental resources are used as important inputs in production and consumption. They contribute to the provision of shelter, food, health care, infrastructure, communication, transportation, defense and virtually every other aspects of human activity. Consequently, statistics documenting their availability and quality over time are necessary for policy makers to enhance informed decision makings. to avoid shortage or restriction of use, to determine import dependence and other risks. Furthermore statistical data regarding the availability of environmental resources and their use are important in order to sustainably manage current and future use of these resources.

4.2 Mineral Resources

Minerals are elements or compounds that are a concentration of naturally occurring solid, liquid, or gaseous materials in or on the earth's crust. Minerals are vital for the construction, manufacturing and energy industries. Mineral resources are not renewable, so their depletion reduces its availability in the environment over time.

4.2.1. Stocks and Changes of Mineral Resources

The country's stock of different minerals by type of minerals (metal ores including precious metals and rare earths, coal, oil, gas, stone, sand and clay, chemical and fertilizer minerals, etc.) are shown in the following tables (Table24-29). The figures in the table does not show the country's total potential. It covers only those areas that are explored.

Table 24 : Stock of Different Minerals by Types of Deposit

Sr. No.	Type of Deposits	Mineral (m.tones)
1	Bentonite	141.5
2	Clay	19.1
3	Diatomite	45.1
4	Dolomite	129.9
5	Feldspar	0.5
6	Graphite	16.66
7	Granite	6.25
8	Gypsum	56.42
9	Kaolin	0.59
10	Kyanite	10
11	Limestone	242.46
12	Marble	92.4
13	Phosphate	737.5
14	Potash	605.7
15	Quartz	0.53
16	Talc	0.12
17	Salt	290.168
18	Silica Sand	216.4
19	Soda Ash	460
20	Sulfur	0.0028
21	Vein quartz	0.3
22	Construction Materials (lgnibrite, Basalt, clay etc.)	Very large

Source: Geological survey of Ethiopia, 2016

Table 25: Coal, Oil shale and Natural Gas Resource

Sr. No.	Type of Deposits	Mineral (m.tons)
1	Coal	265.88
2	Oil shale	120.007
3	Natural Gas	4.7 trillion cubic gas and 13.6 million barrels associated liquid

Source: Geological survey of Ethiopia, 2016

Table 26 :- Iron ore Resources Category and Tonnage

Comment and Reserve (Mt)	Region	Status of Exploration
Ore contains on average, 30% limonite, 40% magnetite and 30% silicates 238.8Mt	Oromiya	Government
71.6% total iron (0.15 to 0.2 Mt)	Oromiya	Not Explored
66.95 % total Iron (0.25Mt)	Oromiya	Not Explored
12.1Mt	Oromiya	Not Explored

Source: Geological survey of Ethiopia, 2016

Table 27: Major Gold Deposits and Occurrences Grade and Reserves (Gold and base metal)

Grade and Reserve	Region	Status of Exploration
(C1+C2) 1588.22kg and 1127.1 kg of gold, at 0.3 and 0.1g/t cut-off grade, respectively	Benishangul	Detailed integrated
o.1-17.1 ppm with average value of 6.5ppm	Benishangul	Reconnaissance
Max.210g/t Average 5.6 g/t	Oromiya	Detailed integrated
Up to 23.83g/t of gold	Oromiya	Detailed integrated
Up to 65 grain of gold	Tigray	Detailed integrated
Up to 4 grains of gold	Tigray	Detailed integrated

Source: Geological survey of Ethiopia

Table 28: Primary Gold Deposits and Occurrences Grade and Reserves

Grade and Reserve[1]	Region	Status of Exploration
20 tones	Oromiya	Detailed integrated
62 tones, at average grade of 4g/t	Oromiya	Detailed integrated
Up to 23.83g/t of gold	Somale	Detailed integrated
Up to 65 grain of gold	Benishangul	Detailed integrated
Greater than 10 tones gold grains	Benishangul	Detailed integrated

Source: Geological survey of Ethiopia, 2016

Table 29: Placer Gold Deposits and Occurrences Grade and Reserves

Grade and Reserve	Region	Status of Exploration
2328.3kg with 0.25 – 1.8 g/m^3	Oromiya	Detailed exploration
2566.6 kg, with 0.3-0.7 g/m^3	Oromiya	Detailed exploration
8486.8kg, with 0.2-0.8g/m^3	Oromiya	Detailed exploration
3600kg, with 0.07-0.5 g/m^3	Gambela	Detailed exploration
0.7 ton at a grade of 0.42g/m^3	Benishangul	Detailed exploration
289.6kg, with 0.2-0.4g/m^3	Oromiya	Detailed
49.6kg of gold	Oromiya	Detailed

Source: Geological survey of Ethiopia, 2016

4.2.2. Production and Trade of Minerals

Every person uses products made from minerals every day. The salt that we add to our food is the mineral, the cars that we drive, the roads that we travel, the buildings that we live in, and the fertilizers used to produce our food are all made using minerals.

When we say minerals based on the definition of Geologists "***Mineral***" is a substance must meet five requirements, these are: naturally occurring, inorganic, solid, definite chemical composition and ordered internal structure. Minerals can occur in solid, liquid and gas form in or on the earth. Ethiopia is one of the richest countries of minerals in the world; the country has Gold, Tantalum, Salt, Opal, Gypsum, Marble, Limestone and some other minerals. The following table below (Table 30-36) shows the production, value, import and export of minerals and mineral products by type and year.

Table 30: Gold Production by Year (in Kg)

Years	Company Produced	Artisanal miners production	Total
2006/07	-	2512.24	2,512.24
2007/08	-	715.4	715.4
2008/09	-	425.93	425.93
2009/10	-	2,865.90	2,865.90
2010/11	4376.04	7,296.30	11,672.34
2011/12	3983.72	8,327.73	12,311.45
2012/13	4151.36	8,386.84	12,538.21
2013/14	3262.42	7,599.69	10,862.11
2014/15	3214.4	5,548.38	8,762.78
2015/16	4068.51	4,175.54	8,244.05

Source: Ministry of Mining, petroleum and natural gas -Unknown

Table 31: Production and Value of Different Mining Minerals

Sr. No.	Mineral Type	Description	Unit	2013/14	2014/15	2015/16
1.1	MIDROC Pure Gold(Dore) Produced	Quantity	Kg	4667.87	3214.40	4397.49
		Price (per unit)	Birr	822305.42	630989.50	660964.19
		Total value (Birr)	Birr	3838414783.82	2028252658.76	2906580000.00
1.2	Alluvial Gold	Quantity	Kg	7599.69	5548.38	4175.55
		Price (per unit)	in Birr	769047.52	724701.67	787000.00
		Total value (Birr)	in Birr	5844522763.56	4020920259.85	3284568000.00
1.3	Tantalum (companies)	Quantity	Kg	54270.00	51110.00	6630.00
		Price (per tones)	in Birr	1212193.46	1498758.15	876000.00
		Total value (Birr)	in Birr	65785739.14	76598531.52	5811000.00
1.4	Tantalum (Artisanal)	Quantity	Kg	33636.00	56990.00	87021.00
		Price (per tones)	in Birr	755233.05	1258982.64	804000.00
		Total value (Birr)	In Birr	25403018.86	71749420.69	69933000.00
1.5	Platinum (companies)	Quantity	Kg	0.04	-	-
		Price (per unit)	Birr	484860.00	-	-
		Total value (Birr)	Birr	19394.40	-	-
1.6	Platinum (Artisanal)	Quantity	Kg	4.64	3.88	-
		Price (per unit)	Birr	178365.25	117547.42	-
		Total value (Birr)	Birr	827079.64	456083.98	-
1.7	Rough Opal	Quantity	Kg	4545.85	4372.95	8146.67
		Price (per unit)	in Birr	45081.24	40447.90	17000.00
		Total value (Birr)	in Birr	204932556.33	176876641.98	136316000.00
1.8	Polished Opal	Quantity	Kg	114.46	194.53	238.32
		Price (per unit)	in Birr	616373.66	508795.38	404000.00
		Total value (Birr)	in Birr	70550128.74	98975965.26	96345000.00
1.9	Gemstone (Non Opal)	Quantity	Kg	29774.48	62235.26	729936.17
		Price (per unit)	in Birr	331.58	936.92	60.00
		Total value (Birr)	in Birr	9872498.55	58309652.70	41658000.00
1.10	Salt	Quantity	Kg	-	71988100.00	54534000.00
		Price (per tonne)	Birr	-	130.42	130.42
		Total value (Birr)	in Birr	-	9388328.06	7112000.00
1.11	Silca Sand	Quantity	Kg	-	5785000.00	119813250.00
		Price (per tones)	Birr	-	150.00	150.00
		Total value (Birr)	in Birr	-	867750.00	17971987.50
1.12	Soda Ash	Quantity	Kg	-	2915850.00	4326150.00
		Price (per tones)	Birr	-	74.00	74.00
		Total value (Birr)	in Birr	-	215772.90	320135.10

Source: Ministry of Mining, Petroleum and Natural Gas
-Unknown

Table 32: Production and Value of Different Quarrying Minerals

Sr. No.	Mineral Type	Description	Unit	2013/14	2014/15	2015/16
2.1	Marble	Quantity	M^3	354.114	6,527.82	23137.98
		Price (per unit)	in Birr	26,414.76	17,261.58	17825.2812
		Total value	in Birr	9,353,835.89	112,680,480.84	412441000
2.2	Pumice	Quantity	Tone	-	11,584.73	672132.55
		Price (per unit)	Birr	-	70	70
		Total value	in Birr	-	810,931.10	47049278.5
2.3	Limestone	Quantity	Tone	-	1,054,348.28	4120281.4
		Price (per unit)	Birr	-	10	10
		Total value	in Birr	-	10,543,482.80	41202814
2.4	Basalt	Quantity	Tone	-	2,120.73	246,656.24
		Price (per unit)	Birr	-	699.98	699.98
		Total value	in Birr	-	1,484,468.59	172,654,434.88
2.5	Gypsum	Quantity	Tone	-	3,125.54	80555.6
		Price (per unit)	Birr	-	75.43	75.429
		Total value	in Birr	-	235,756.36	6076228.352
2.6	Clay	Quantity	Tone	-	10,528.36	109579.6
		Price (per unit)	Birr	-	70	70
		Total value	in Birr	-	736,985.20	7670572

Source:-Ministry of Mining, Petroleum and Natural Gas
-Unknown

Table 33: Imports of Minerals and Mineral Products, Ethiopia, 2006/07 – 2015/16

Year	Minerals and Mineral products (volume in Tones)			
	Salt; Sulfur; Earths and Stone; Plastering Materials, Lime and Cement	Ores, Slag and Ash	Mineral Fuels, Mineral Oil, Bituminous Substance and Mineral Waxes	Natural or Cultural Pearls, Precious and Semi-precious Stone, Precious Metals
2006/07	81,708.65	6.62	1,745,014.48	511.17
2007/08	911,471.10	21.45	1,373,269.10	217.17
2008/09	949,808.15	2.97	2,324,574.79	2,388.06
2009/10	1,464,048.89	804.85	2,162,863.00	670.57
2010/11	265,659.47	361.91	2,472,872.08	1,265.09
2011/12	796,697.79	1,897.32	2,197,664.30	1,951.55
2012/13	336,020.34	1,135.37	2,741,053.38	1,075.10
2013/14	27,726.10	38.86	1,683,979.80	999.06
2014/15	22,191.97	792.57	3,162,486.17	-
2015/16	26,279.97	4,098.35	2,876,493.79	445.52

Source: Ethiopian Revenues and Customs Authority
-Unknown

Table 34: Imports of Minerals and Mineral Products, Ethiopia, 2006/07 – 2015/16

Year	Minerals and Mineral Products *(FOB Value in '000 (ETB)*			
	Salt; Sulfur; Earths and Stone; Plastering Materials, Lime and Cement	Ores, Slag and Ash	Mineral Fuels, Mineral Oil, Bituminous Substance and Mineral Waxes	Natural or Cultural Pearls, Precious and Semi-precious Stone, Precious Metals
2006/07	102,070,900	106,365	8,976,985,330	21,035,524
2007/08	1,260,270,778	608,191	7,135,046,219	7,503,275
2008/09	102,071	106	8,976,985	21,036
2009/10	1,260,271	608	7,135,046	7,503
2010/11	1,586,510	507	19,772,061	143,152
2011/12	2,008,014	1,616	15,357,870	84,886
2012/13	597,235	2,400	23,517,131	125,497
2013/14	1,390,162	12,470	27,595,852	254,469
2014/15	861,492	8,982	42,930,009	102,074
2015/16	210,094	1,326	23,635,309	87,883

Source: Ethiopian Revenues and Customs Authority

Table 35: Exports of Minerals and Mineral Products, Ethiopia, 2006/07 – 2015/16

Year	Minerals and Mineral products (volume in tones)			
	Salt; Sulfur; Earths and Stone; Plastering Materials, Lime and Cement	Ores, Slag and Ash	Mineral Fuels, Mineral Oil, Bituminous Substance and Mineral Waxes	Natural or Cultural Pearls, Precious and Semi-precious Stone, Precious Metals
2006/07	917.33	-	1.17	9.19
2007/08	2,483.21	303.87	17.5	4.42
2008/09	602.97	184.42	18	5.32
2009/10	1,808.18	267.52	40	7.38
2010/11	140.48	647.55	-	12.02
2011/12	458.55	317.59	-	26.04
2012/13	1,840.77	241.08	60.71	25.09
2013/14	26,693.57	248.9	18.02	26.48
2014/15	162,755.16	415.25	0.9	45.56
2015/16	149,251.62	436.02	0.05	257.11

Source: Ethiopian Revenues and Customs Authority
-Unknown

Table 36: Exports of Minerals and Mineral Products, Ethiopia, 2006/07 – 2015/16

Year	Minerals and Mineral products (FOB Value in '000 (ETB))			
	Salt; Sulfur; Earths and Stone; Plastering Materials, Lime and Cement	Ores, Slag and Ash	Mineral Fuels, Mineral Oil, Bituminous Substance and Mineral Waxes	Natural or Cultural Pearls, Precious and Semi-precious Stone, Precious Metals
2006/07	3,290.57	-	10.67	449,194.91
2007/08	3,131.53	73,337.12	670.44	535,792.90
2008/09	559.09	5,201.60	74.25	79,673.21
2009/10	406.17	9,242.35	12.41	90,993.70
2010/11	947.44	15,504.66	-	178,022.30
2011/12	267.27	25,462.37	-	130,753.82
2012/13	8,080.00	275,907.95	922.35	3,254,326.28
2013/14	56,398.11	37,529.46	103.39	3,122,005.98
2014/15	318,106.88	223,162.93	49.42	3,263,659.57
2015/16	268,808.39	133,457.18	0.33	3,243,141.92

Source: Ethiopian Revenues and Customs Authority

-Unknown

4.3. Energy Resources

4.3.1. Stocks and Changes of Energy Resources

Energy can be produced from non-renewable or renewable sources. Non-renewable energy resources are the minerals used for energy production. These environmental resources cannot be renewed in any human timescale, so their extraction and use in the economy depletes the resource, limiting its availability for future generations. Statistics on the magnitude of their stocks through time are required to assist in the sustainable management of these resources.

Stocks of non-renewable energy resources are defined as the amount of known deposits of mineral energy resources. They include fossil fuels (e.g., natural gas, crude oil and natural gas liquids, oil shale, natural bitumen and extra heavy oil, coal and lignite), peat, and uranium and thorium ores. Classes of known mineral energy deposits include commercially recoverable deposits; potential commercially recoverable deposits; and non-commercial and other known deposits.

Ethiopia has a variety Potential of energy resources. The country has an estimated haydropower potential of 45,000MW, geothermal potential of 10,00MW, solar energy potential 5.5kwh/sq.m/day with an annual daily irradiation, 135GW wind energy within average wind speed greater than 7meter/second at 50m above ground level and an annual exploitable 1,120 million ton of woody biomass and other potential sources such as coal and agro-waste.

4.3.2. Production, Trade and Consumption of Energy

Ethiopia has been impleneted a development stratagy which mainly tied to build climate resilience green economy. The main focus of the develpment stratagy is a carbon neutral growth pathway to reach middle income country by 2025. The country energy policy promotes the utilization of the country's hydro, wind, solar and geothermal resources, and reduces the role of hydrocarbon fuels in industry and transport. Regarding energy consumption, the country energy consumption is predominantly based on traditional energy resources. In 2015, traditional fuels /Biomass energy sources (primary and derived)/ are the predominant, representing 90 percent of total energy sources,while modern fuels contributed about 11% of total energy consumed in 2015, of which, 9% Hydrocarbon products (light petroleum products 3% and heavy petroleum products 5% and Coal 1%) and 2% electricity. The total energy production, energy requirement(suupply) and consumption patterns by diffrent end users is shown in the table below (See Tables 37-41).

Total primary energy requirement also known as Total Primary Energy Supply, is obtained as the sum of indigenous production (Fuel wood, Hydro and Charcoal) and Imports of fossil fuel product (MGR, Diesel/ Gasoil, Jet Fuel, Kerosene, Heavy and Light Fuel Oil HFO & LFO). Final energy consumption is the total amount of energy required (including biomass, petroleum and electricity) by end user as a final product. End users are mainly categorized into four sectors, namely Industry and construction, Transportation, Household and Service sector. Table 42-46 presents the consumption of energy by type of energy supply and year.

Table 37: Energy Production and Trade for the Year 2010/11 (2003 EFY)

Unit: ktone

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Production of primary energy	10					426	31001		31437
Imports	18	772	1313	80	9				2192
Exports									
Stock changes[1]	-3	1	0						-2
Total energy requirements	25	773	1313	80	9	426	31001		33627
Energy converted		-6	-1			3	-2666	906	-1764
Electric power plants		-6	-1			3			-4
Other conversion industries							-2666	906	-1760

Source: Ministry of Water, Irrigation and Energy

Table 38: Energy Production and Trade for the Year 2011/12 (2004 EFY)

Unit: ktone

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Production of primary energy	6					540	31896		32442
Imports	100	750	1350	162	6				2368
Exports						-29			-29
Stock changes[1]	2	181							183
Total energy requirements	108	931	1350	162	6	511	31896		34964
Energy converted		-2				1	-2762	939	-1824
Electric power plants		-2				1			-1
Other conversion industries							-2762	939	-1823

Source: ***Ministry of Water, Irrigation and Energy***

Table 39: Energy Production and Trade for the Year 2012/13 (2005 EFY)

Unit: ktoe

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Production of primary energy						652	32766		33418
Imports	159	895	1485	48	5				2592
Exports						-48			-48
Stock changes[1]		32							32
Total energy requirements	159	927	1485	48	5	604	32766		35994
Energy converted		-3				1	-2856	971	-1887
Electric power plants		-3				1			-2
Other conversion industries							-2856	971	-1885

Source: **Ministry of Water, Irrigation and Energy**

Table 40: Energy Production and Trade for the Year 2013/14 (2006 EFY)

Unit: ktoe

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Production of primary energy						**747**	**33645**		**34392**
Imports	**207**	**1006**	**1719**	**112**	**8**				**3052**
Exports						**-82**			**-82**
Stock changes[1]		**4**	**-9**						**-5**
Total energy requirements	**207**	**1010**	**1710**	**112**	**8**	**665**	**33645**		**37357**
Energy converted						**1**	**-2950**	**1003**	**-1946**
Electric power plants			**0**			**1**			**1**
Other conversion industries							**-2950**	**1003**	**-1947**

Source: ***Ministry of Water, Irrigation and Energy***

Table 41: Energy Production and Trade for the Year 2014/15 (2007 EFY)

Unit: ktoe

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Production of primary energy						**818**	**34489**		**35307**
Imports	**287**	**1106**	**1880**	**0**	**8**				**3281**
Exports						**-61**			**-61**
Stock changes[1]		**-6**	**-26**						**-32**
Total energy requirements	**287**	**1100**	**1854**		**8**	**757**	**34489**		**38495**
Energy converted		**-1**				**0**	**-3039**	**1034**	**-2006**
Electric power plants		**-1**				**0**			**-1**
Other conversion industries							**-3039**	**1034**	**-2005**

Source: ***Ministry of Water, Irrigation and Energy***

Table 42: Energy Consumption for the Year 2010/11 (2003 EFY)

Unit: ktoe

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Consumption by energy sector						-1			-1
Losses in transport and distribution						-98			-98
Statistical differences[2]	0	0	-33		-7	0	1	0	-39
Final consumption	25	791	1279	80	9	330	28337	906	31757
By industry and construction	25	37	99	80		120			361
Other industry and construction	25	37	99	80		120			361
By transport		498	1180				5		1683
Road		160	1180				5		1345
Rail									
Air		338							338
By households and other consume.		256			9	210	28332	906	29713
Households		256			9	127	28130	888	29410
Agriculture									
Other consumers /Commercial/						83	202	19	304

Source: *Ministry of Water, Irrigation and Energy*

Table 43: Energy Consumption for the Year 2011/12 (2004 EFY)

Unit: ktoe

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Consumption by energy sector						-1			-1
Losses in transport and distribution						-133			-133
Statistical differences[2]	0	-134	29	0		-17	-1		-123
Final consumption	108	793	1379	162	6	362	29132	939	32881
By industry and construction	108	39	114	162		137			560
Other industry and construction	108	39	114	162		137			560
By transport		500	1265				5		1770
Road		163	1265				5		1433
Rail									
Air		337							337
By households and other consume.		254			6	225	29127	939	30551
Households		254			6	136	28916	920	30232
Agriculture									
Other consumers /Commercial/						89	211	20	320

Source: Ministry of Water, Irrigation and Energy

Table 44: Energy Consumption for the Year 2012/13 (2005 EFY)

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Consumption by energy sector						-1			-1
Losses in transport and distribution						-150			-150
Statistical differences[2]	0	-5	46			0	2	-21	22
Final consumption	159	918	1530	48	5	454	29912	971	33997
By industry and construction	159	41	127	48		167			542
Other industry and construction	159	41	127	48		167			542
By transport		590	1403				4		1997
Road		196	1403				4		1603
Rail									
Air		394							394
By households and other consume.		287			5	287	29908	971	31458
Households		287			5	184	29688	951	31115
Agriculture									
Other consumers /Commercial/						103	220	20	343

Source: Ministry of Water, Irrigation and Energy

Table 45: Energy Consumption for the Year 2013/14 (2006 EFY)

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Consumption by energy sector						-4			-4
Losses in transport and distribution						-142			-142
Statistical differences[2]		-42	-32			0	1		-73
Final consumption	207	968	1678	112	8	520	30696	1003	35192
By industry and construction	207	40	122	112		175			656
Other industry and construction	207	40	122	112		175			656
By transport		653	1556				4		2213
Road		220	1556				4		1780
Rail									
Air		434							434
By households and other consume.		275			8	345	30692	1003	32323
Households		275			8	204	30463	982	31932
Agriculture									
Other consumers /Commercial/						141	229	21	391

Source: Ministry of Water, Irrigation and Energy

Table 46 : Energy Consumption for the Year 2014/15 (2007 EFY)

Item	Hard coal, lignite and peat	Light petroleum products	Heavy petroleum products	Other petroleum products	LPG and refinery gas	Electricity	Primary biomass energy	Derived biomass energy	Total energy
Consumption by energy sector						-1			-1
Losses in transport and distribution						-184			-184
Statistical differences[2]		11	52		0	1	1	0	65
Final consumption	287	1112	1906		8	573	31450	1034	36370
By industry and construction	287	42	131	0		220			680
Other industry and construction	287	42	131	0		220			680
By transport		742	1775				5		2522
Road		256	1775				5		2036
Rail									
Air		485							485
By households and other consume.		328			8	353	31445	1034	33168
Households		328			8	222	31207	1019	32784
Agriculture									
Other consumers /Commercial/						131	238	15	384

Source: Ministry of Water, Irrigation and Energy

4.4. Agricultural Land Use

In Ethiopia the majority (more than 90%) of the agricultural production and practices comes from the small holder agricultural holders. The land use systems of small holder farmers comprises cultivated land, fallow lands, grazing, wood/ forest land and other land uses. In these subsistence agricultural practices most of the agricultural land holding of small holder farmers allocated for cultivating crops.

Agricultural Land Use Categories and Area

According to the annual agricultural sample survey results, on average 80.1 percent of the land holding allocated to cultivated land, 10.4 percent grazing land and the remaining 9.5 percents accounted for wood land and other land uses. Figure 17 shows the land use of pattern of small agricultural holders by type of land use category and area for the year 2006/07-2015/16 production year. As indicated in the figure the total cropped area increased from 11.8 million hectares to 14.5 million hectares in the last ten years.

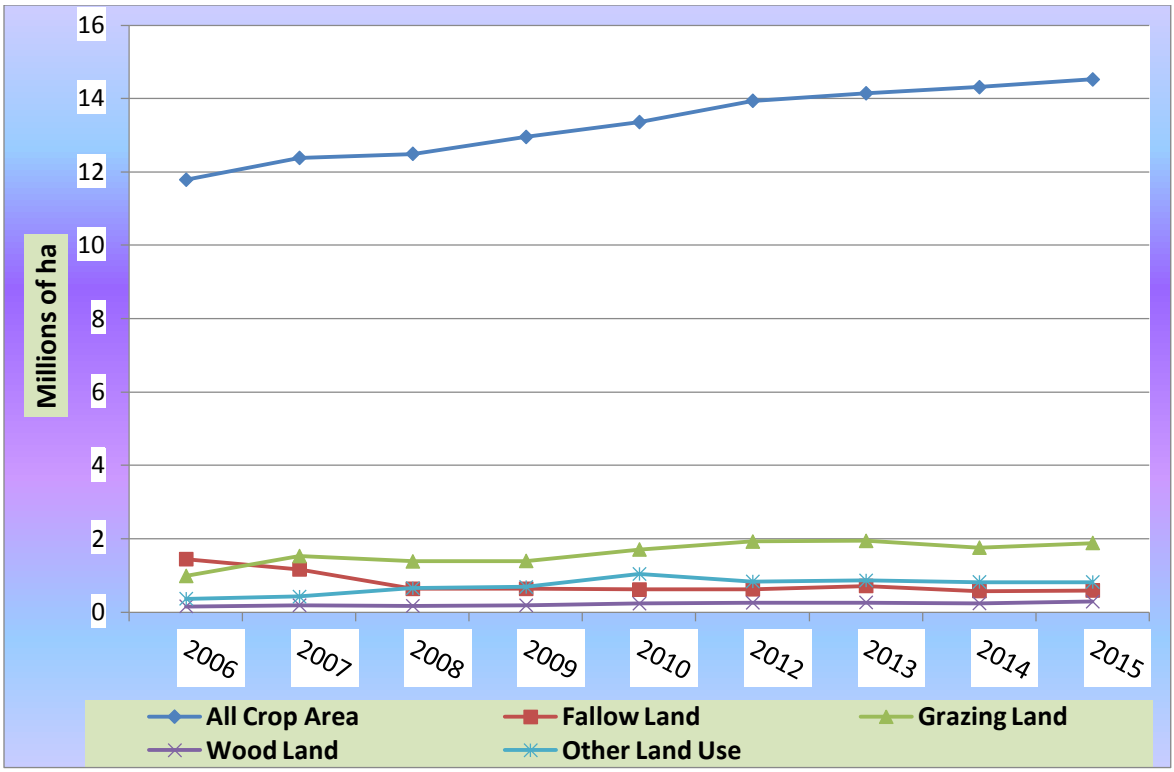


Figure 17: Land Use Area and Category by Year
Source: AgSS main season reports of CSA 2006/07-2015/16

Area of Land Under Irrigation

Irrigation enables to reduce risk associated with climatic variations and improving crop production. By reducing climate risk it can also help to induce the use of modern inputs such as fertilizers and improved seeds, thereby further enhancing agricultural productivity.

Ethiopian agriculture is mostly rain fed. The performance of the sector primarily depends on the availability of rain and its distribution. The country is endowed with enormous sources of water for agricultural development. The area under modern irrigation schemes in Ethiopia is very small and mainly practiced by commercial private and state farms. The irrigation practice by small holder farmers is very minimal.

Figure 18 describes the irrigated land area by small holder farmers from the year 2006/07-2015/16 production year. During these years on average about 166 thousand hectares of land were under irrigation. The result of the annual AgSS shows more than half of the irrigated land area (about 60%) allocated to cereal crops and the remaining 40% of irrigated land covered with other (mainly cash crops).

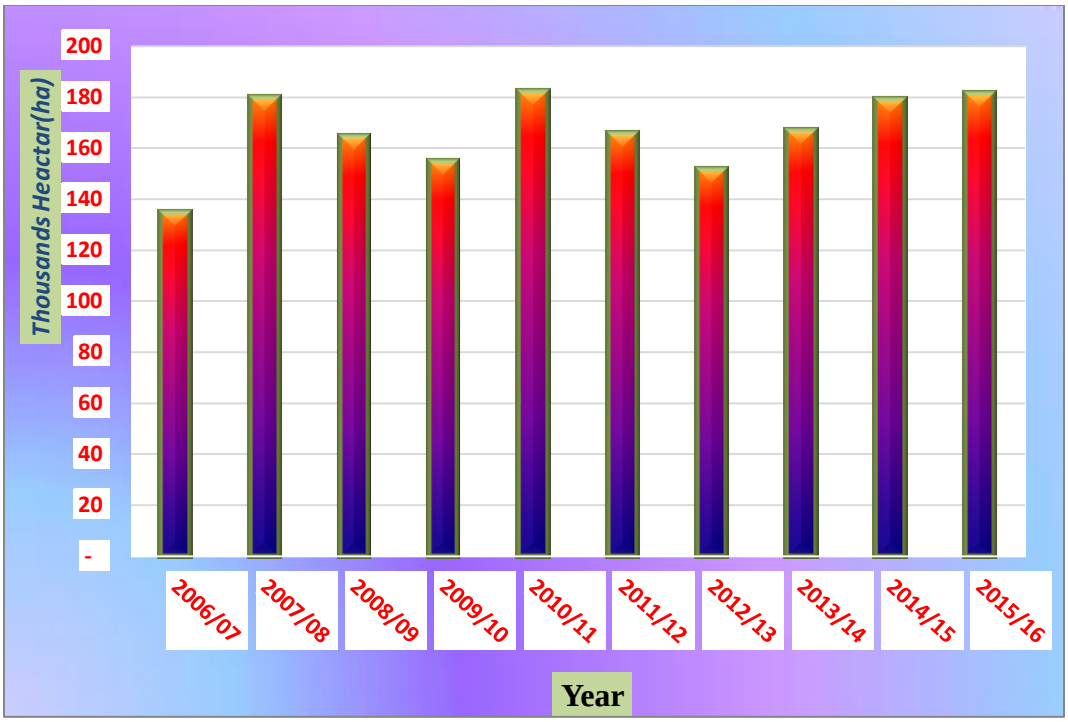


Figure 18: Irrigated Land Area[2]

Source: AgSS main season reports of CSA 2006/07-2015/16

4.5. Aquatic Resources

Ethiopia has only inland freshwater capture fisheries. It has no significant aquaculture development. The inland capture fishery comprises Rift Valley lakes; rivers; reservoirs and small water bodies. There is fishing on all these water bodies. Table 47 & 48 provides descriptive statistics on the production and trade of fish for the last five years, respectively.

Table 47: Fish Production by Water Body by Year in Tonnes

Year	Water body			
	Lakes	Rivers	Reservoirs	small water bodies
2010/11	14,055	275	3,480	248
2011/12	201,623	302	3,594	198
2012/13	23,812	302	4,634	203
2013/14	32,245	302	5,439	385
2014/15	40,233	302	8,010	1,574
2015/16	36,783	372	9,493	3,500

Source: - Ministry of Livestock and Fishery (2010/11-2015/16)

[2] The irrigated land area described in the figure covers only for small agricultural holding.

Table 48: Import, Export and Trade Balance of Fish and Fish Product by Year

YEAR		2011/12	2012/13	2013/14	2014/15	2015/16
Import	Net.Wt. (Metric Tons)	545.49	620.71	723.97	745.74	932.70
	FOB Value ('000 USD)	1,573.02	2,004.78	2,043.32	2,409.99	2,739.30
Export	Net.Wt. (Metric Tons)	824.80	926.86	768.01	789.06	644.43
	FOB Value ('000 USD)	7,145.78	471.02	386.86	389.43	328.51
Trade Balance	FOB Value ('000 USD)	(5,572.76)	1,533.76	1,656.46	2,020.56	2,410.79

Source: - Ethiopian Revenues and Customs Authority (2011/12-2015/16)

4.6. Main Annual and Perennial Crops

The agricultural sector, which constitutes about more than 13 million smallholder farmers, produces more than 95% crop output. As the stated in the previous section, the country is very rich in biodiversity. A great variety of food and cash crops grows in different parts of the country. The domestic production of food crops constitutes the production of grain crops (cereals, pulses& oilseeds), root crops, vegetables and perennial crops.

Among grain crops cereals which accounted the almost the majority (more than 80%) of the annual total major crop production represent the most important food source in the country and have been given due attention in the country's agricultural development policy's and strategies. The following section provides the trends in total cultivated land and crop production in Ethiopia.

4.6.1. Trends of Cultivated Area of Land

The cultivated area of land under grain crops are shown by a gradual positive change for the last ten consecutive years (see Figure 19). The area covered under grain crops increase from 10,592,756 hectares in 2006/07 (1999 E.C) to 12,486, 271 hectares in 2015/16 (2008 E.C). However, these additional cultivated areas of land under grain crops are very few in ten years period with compare to the country's cultivable land potential area. The remaining crops (Cash, Root, vegetables and fruit) cover the cultivated area of less than one million hectare for each year.

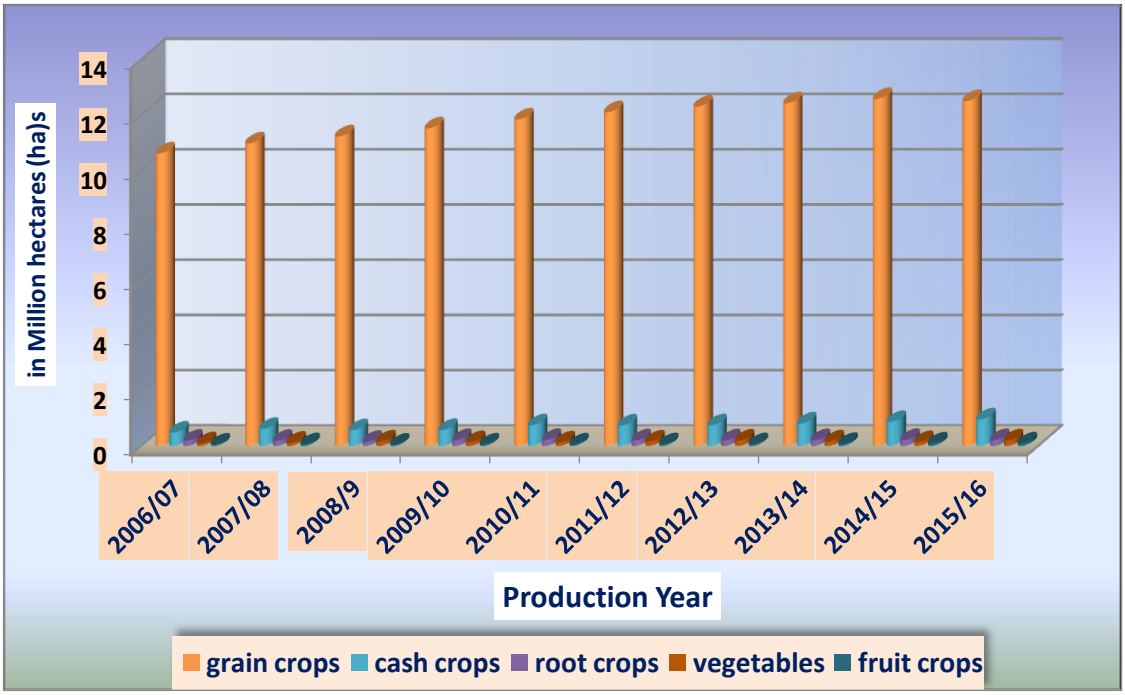


Figure 19: Trends of Cultivated Area (in ha) of Land during Main Season
Source: AgSS main season reports of CSA, 2006/07-2015/16

4.6.2. Trends of Production of Various Crops

The grain crop production shows a remarkable enhancement in amount of production during each production period. It increases from 149,554,981 quintals in 2006/07 (1999 E.C) to 266,828,807 quintals by 2015/16 production year. This significant positive change in grain crops production is not only due to the increments of cultivated area of land size but also due to the enhancements of grain crops productivity. The additional 117273826.1 quintals are produced after ten years by private peasant holdings during the main season production period at national level in Ethiopia.

Root crops are the second mostly produced in Ethiopia during the last ten years (see Figure.20). The change of root crop production is also around three times of the 2006/07 (1999 E.C) production. That is from 14,095,463 quintals in 2006/07 (1999 E.C) to 39,985,663 quintals in 2015/16 (2008E.C). The cash crops namely chat; Coffee, Hops and Sugar cane productions have also increased the last ten years. However, the amount of cash crop productions is not significantly changed as compared to the grain and root crops within the same period of production year. Vegetables and fruit crops production almost remains constant for the last ten years during the main season production period at national level.

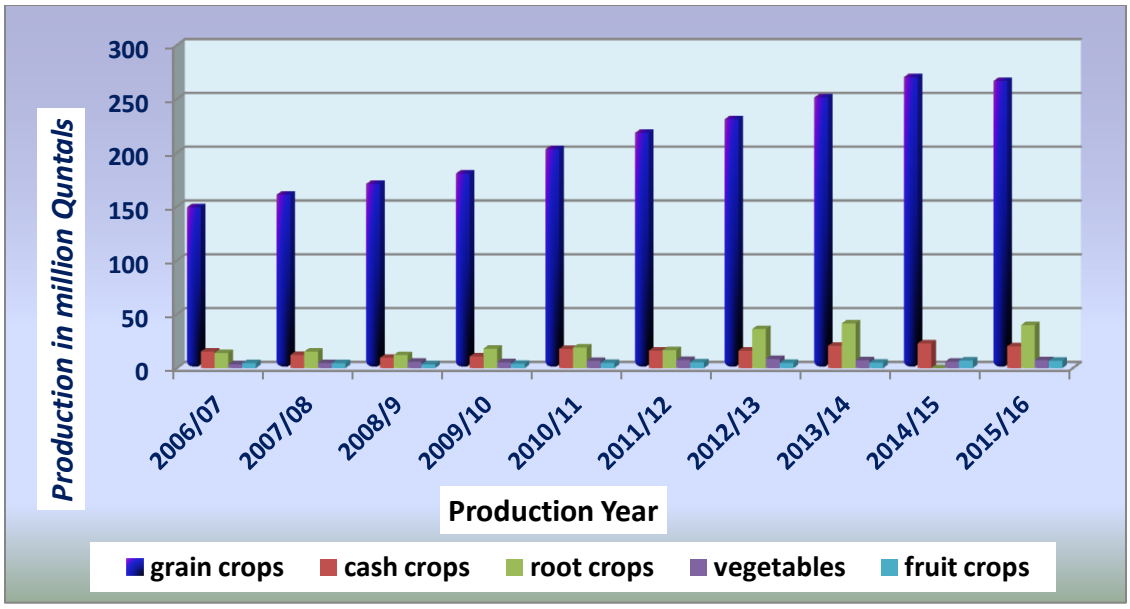


Figure 20: Trends of Production of Various Crops in Quintal by Year
Source: AgSS main season reports of CSA 2006/07-2015/16

4.6.3. Trends of Major Grain Crops Productivity/ Crop Yield

Cereal Crops

Cereal crops productivity was increased at decreasing rate from 2006/07(1999 E.C) to 2009/10 (2002 E.C) and increase at increasing rate from 2010/11 (2003 E.C) to 2015/2016 (2008 E.C). Of all cereal crops productivity, maize shows a tremendous change in productivity for the last six main season production period. Figure 21 presents the trend of yield of the five major cereal crops by year.

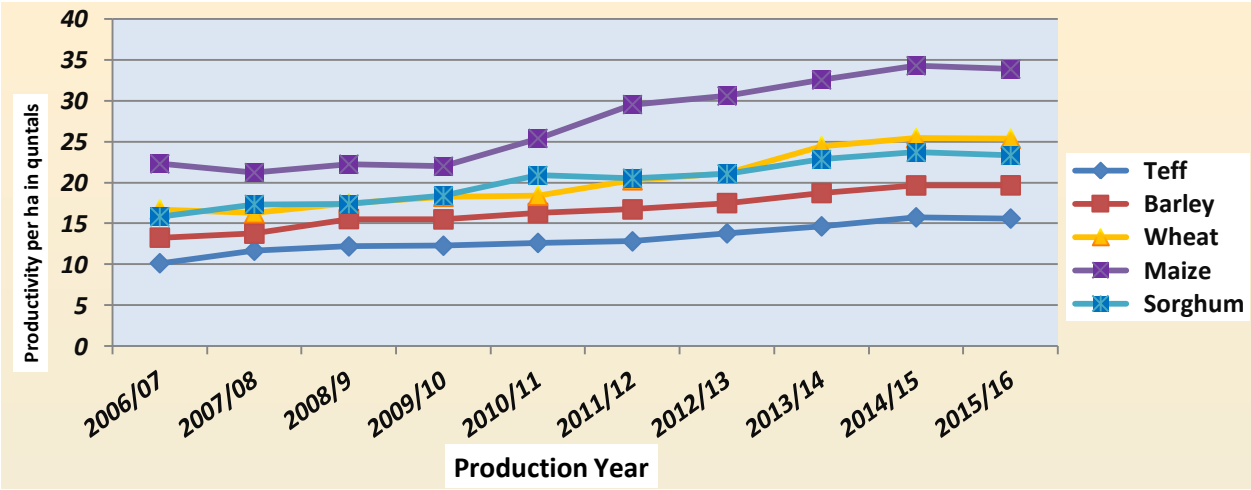


Figure 21: Trends of Major Grain Crops Productivity / Yield (Qt/ha)
Source: AgSS main season reports of CSA 2006/07-2015/16

Oil Seeds

The oil seeds productivity for the last ten years shows very fluctuating trends. This fluctuation in productivity of oil seed crop arises from the improper and low usage of chemical fertilizer inputs by private peasant holdings. For instance, during the period of 2014/15 (2007 E.C), out of the total chemical fertilizer that the private peasant holdings used, only 1.5 percent is applied for oil seed crop production. Sesame is the only crops that its productivity is declining for the last five years at national level.

The Neug crop productivity trend is also varies from year to year during the last ten years. It was increased at initial period then kept constant for three years and it start increasing until the current production period.

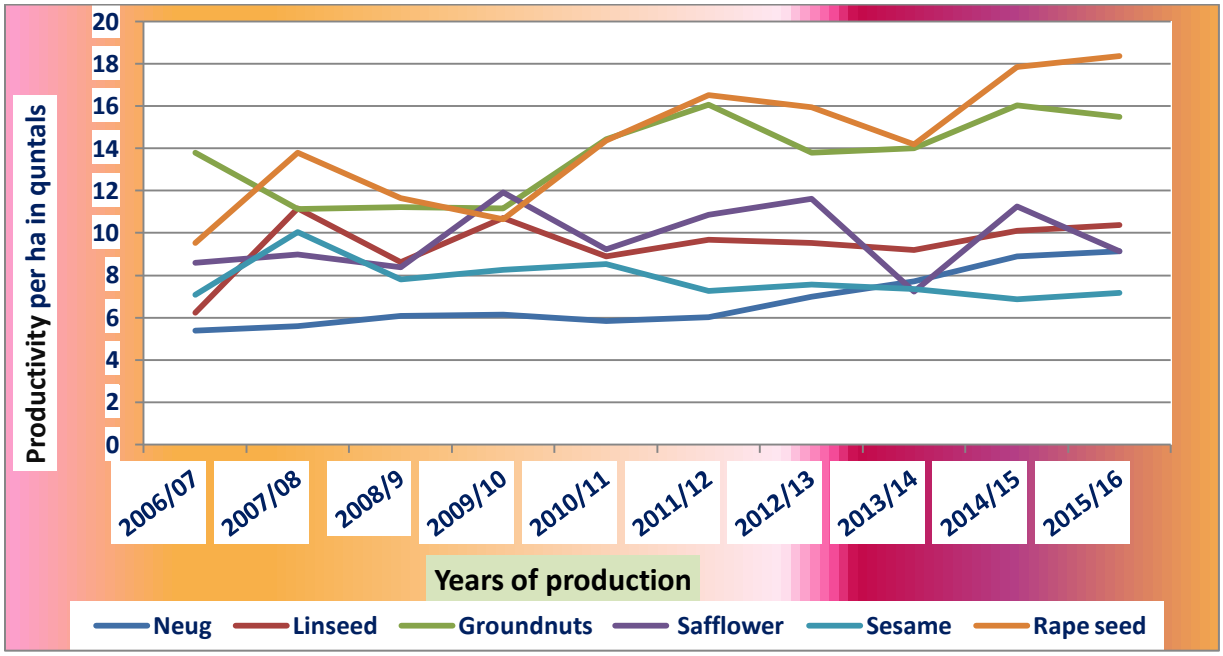


Figure 22: Oil Seeds Productivity/ Yield (Qt/ha)
Source: AgSS main season reports of CSA 2006/07-2015/16

4.6.4. Inputs

Agricultural inputs plays pivotal role to improve agricultural productivity and production. The government of Ethiopia has been given a priority in the use of new agricultural input technologies with the aim of improving the agricultural sector performance. In this regard a lot of efforts were made to enhance the use of agricultural inputs by farmers through supplying agricultural inputs.

Fertilizer

Fertilizers are mineral or organic substances, natural or manufactured, which are applied to soil, irrigation water or a hydroponic medium, to supply plants with nutrients or to enhance plant growth. There are two types of fertilizers (Natural and Chemical). The Natural fertilizer consists of the farmyard manure, compost, wood ashes... etc. While the chemical type consists of DAP, UREA and NPS. The chemical fertilizer often called inorganic fertilizer (FAO, 2010).

Inorganic Fertilizers

Fertilizer consumption in Ethiopia is still very low. The use of chemical fertilizer increased from 405 thousand tons (in 2006/07) to 859 thousand tons (in 2015/16). The average annual chemical fertilizer consumption during these periods was about 580 thousand tons. This was about 119 kg/ ha. It is considerably lower than the recommended rate of 150-200 kg/ha.

The quantity of chemical fertilizer consumed per annum had shown increasing trend & the fertilizer consumption grew with an average rate of 9.2 percent per annum between 2006/07 and 2015/16 (Figure 23). The area of cultivated land covered with inorganic fertilizer shows an increasing trend (See Figure 25).

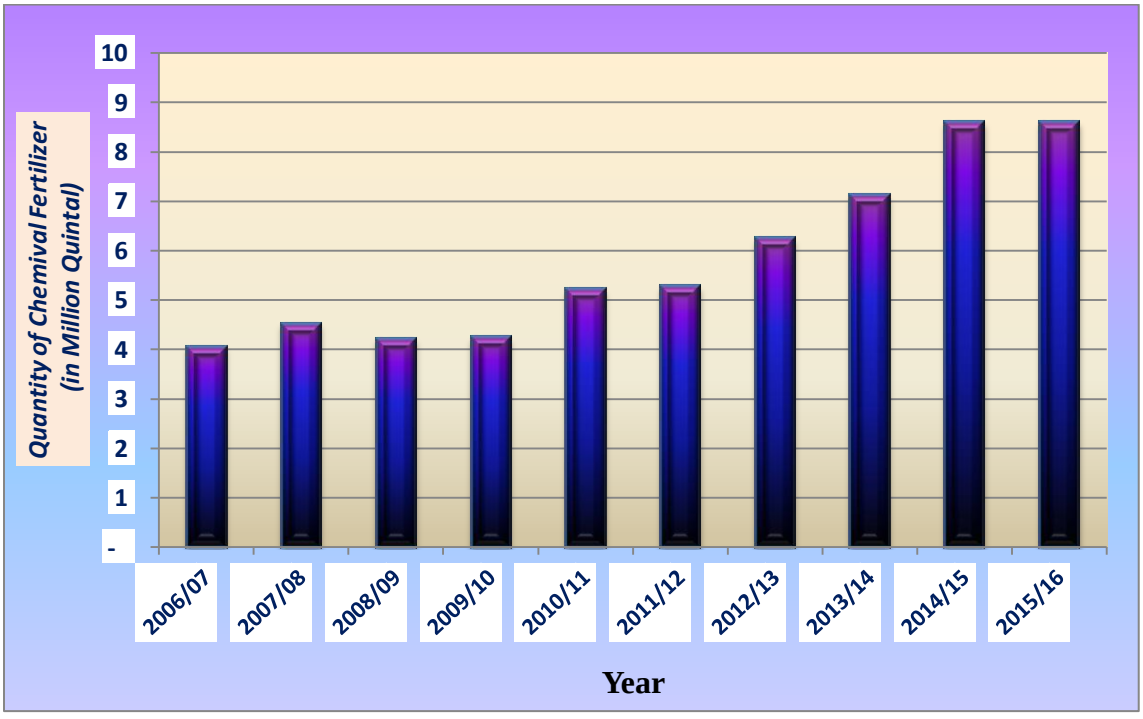


Figure 23: Quantity of Chemical Fertilizer Used in Quintal (Qt) by Year
Source: AgSS main season reports of CSA 2006/07-2015/16

Area of Land Under Organic Fertilizer

Organic fertilizer is fertilizer prepared locally from cow dung, house thrashes etc and used to improve soil fertility and thereby increase productivity. These natural fertilizers mostly use by small holder farmers. The result of the annual agricultural sample survey shows that the total cultivated land area under organic fertilizer reached more than 1.7 million hectares on average in the last ten years. Figure 24 presents the total cultivated land area applied organic fertilizer by year.

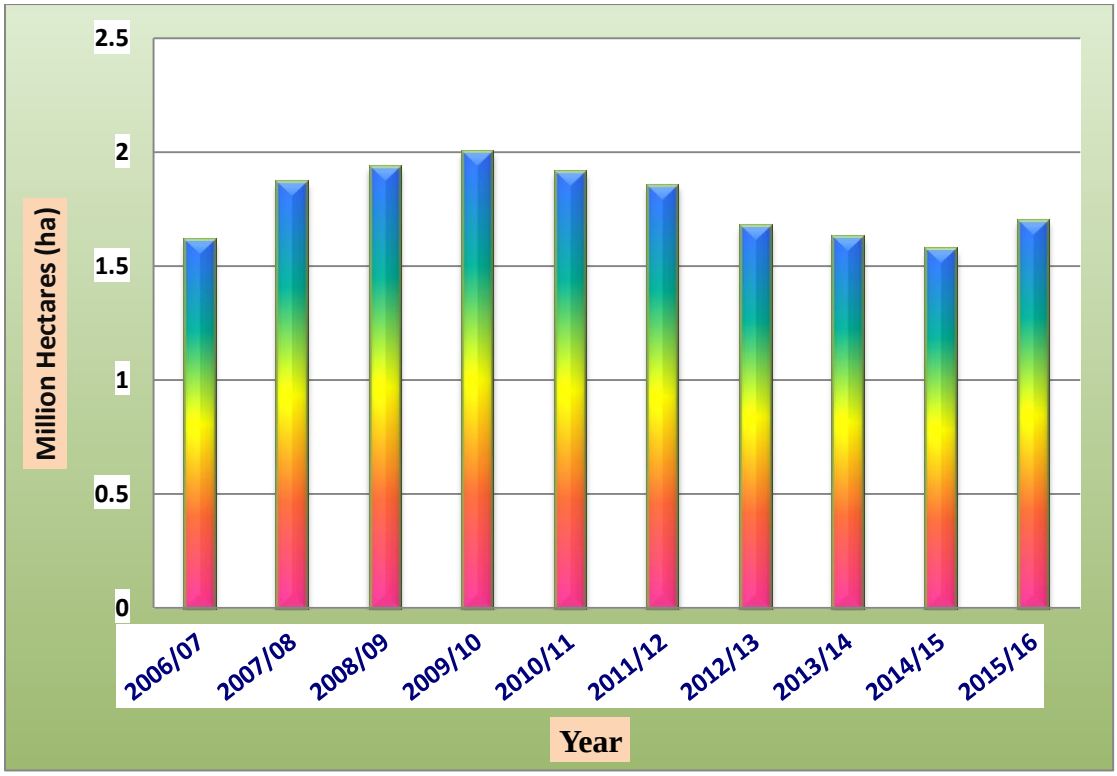


Figure 24: Area of Land under Organic Fertilizer

Source: AgSS main season reports of CSA 2006/07-2015/16

Pesticides

Pesticides are chemicals that are useful for the control, mitigation or elimination of pests, which are detrimental to crops. Pesticides include insecticides and herbicides. The total pesticide applied cultivated land area for small holder farmers shows increasing trend from the year 2006/07 to 2015/16. On average 2.4 million hectares of cultivated land was pesticides applied (Figure 25).

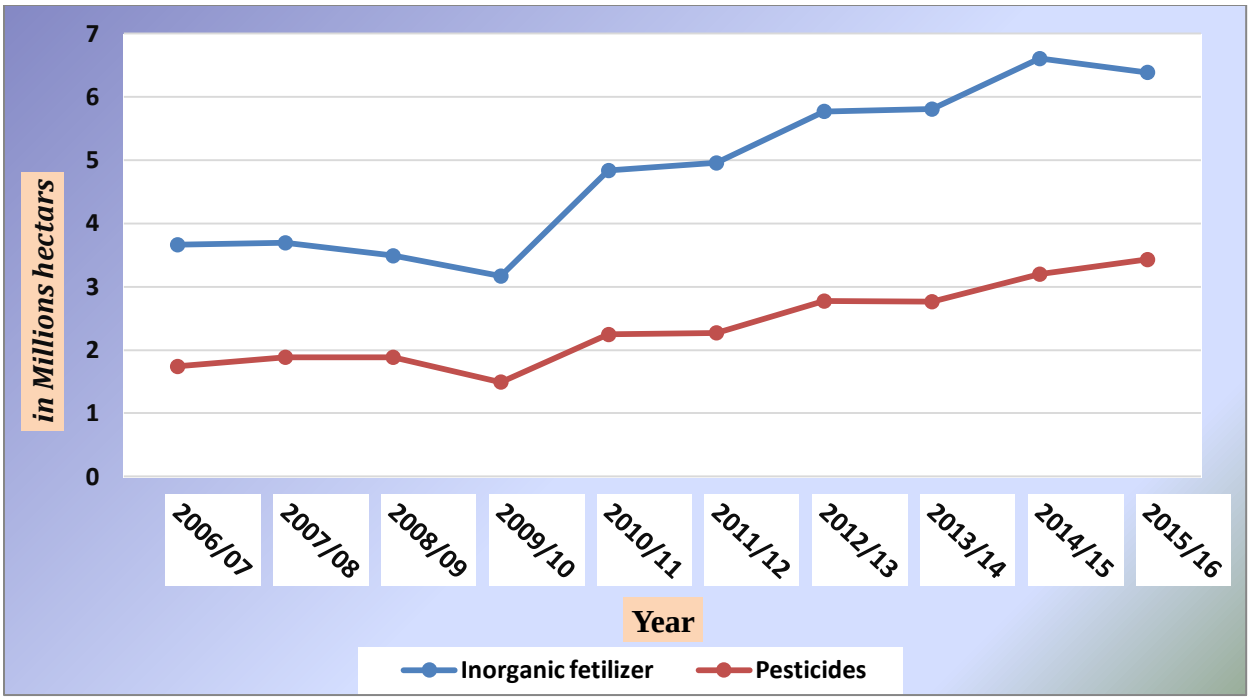


Figure 25: Trends of Cultivated Land under Pesticide & Inorganic Fertilizer (2006/07-2015/16

Source: AgSS main season reports of CSA 2006/07-2015/16

Table 49: Imports of Crops, Processed & Semi-processed Crop/Food Products in Ethiopia, 2006/07-2015/16

Year	live trees &other plant ;bulbs, roots, and like ;cut flowers & ornamental foliage	Coffee ,tea, mate spice and cereals	product of milling industry; malt; starches; inulin; wheat gluten	oil seeds & oleaginous fruits; miscellaneous grain, seed and fruit	Animal or vegetable fats and oils and their cleavage products prepared edible fat	sugars and sugar confectionery	cocoa and cocoa preparation	preparation of cereal ,flour, starch or milk ;bakers' wares	miscellaneous edible preparations	tobacco and manufactured tobacco substitute
2006/07	40,286	363,417	46,654	6,573	89,084	66,094	617	40,536	4,478	1,783
2007/08	33,001	434,273	35,356	1,652	115,226	99,465	611	19,293	4,721	2,407
2008/09	30,862	1,411,909	72,835	87,984	172,177	168,624	402	72,920	5,510	1,824
2009/10	48,300	1,220,376	132,391	8,846	223,900	90,810	534	57,215	5,813	2,126
2010/11	58,624	1,209,322	53,080	1,702	243,062	180,153	437	56,805	6,672	2,680
2011/12	41,605	1,195,612	106,107	4,113	270,518	252,112	640	56,471	7,469	2,023
2012/13	48,143	1,112,984	73,012	1,499	0	284,027	517	81,713	8,410	1,732
2013/14	27,544	1,438,055	61,396	1,238	363,181	374,237	631	69,501	13,033	2,188
2014/15	45,473	1,207,489	100,972	1,521	395,801	354,583	826	100,196	13,953	2,295
2015/16	73,048	1,638,483	114,961	1,339	485,172	410,886	449	117,198	17,749	1,794

Source: Ethiopian Revenues and Customs Authority, (2006/07-2015/16

Table 50: Value of Imports of Crops, Processed & Semi-processed Crop/Food Products in Ethiopia, 2006/07-2015/16 (In Birr)

Year	live trees &other plant ;bulbs ,roots, and like ;cut flowers & ornamental foliage	Coffee ,tea ,mate and spices	product of milling industry; malt; starches; insulin; wheat gluten	oil seeds & oleaginous fruits; miscellaneous grain, seed and fruit	Animal or vegetable fats and oils and their cleavage products prepared edible fat	sugars and sugar confectionery	cocoa and cocoa preparation	preparation of cereal ,flour, starch or milk ;bakers' wares	miscellaneous edible preparations	tobacco and manufactured tobacco substitute
2006/07	286,998	857,682	199,720	83,233	590,998	288,561	8,559	186,293	62,813	72,312
2007/08	281,364	1,350,590	234,428	60,890	949,477	379,918	9,511	127,075	81,075	105,927
2008/09	381,632	5,629,133	556,033	641,434	2,393,866	710,599	13,177	509,867	94,117	85,378
2009/10	594,963	4,359,359	635,379	244,927	2,818,674	481,767	26,196	492,663	107,014	144,649
2010/11	621,872	5,399,406	482,440	121,139	3,720,802	1,657,239	27,343	584,856	184,094	235,673
2011/12	598,624	7,987,249	1,376,045	236,397	6,596,741	3,087,315	56,008	1,158,764	292,159	218,140
2012/13	846,123	7,399,055	845,581	168,623	-	3,193,058	57,643	1,852,437	371,656	229,358
2013/14	526,939	11,125,999	814,406	215,515	7,361,338	4,158,862	53,298	1,504,396	698,328	271,815
2014/15	628,561	9,629,159	1,287,513	272,809	8,813,897	3,827,818	71,009	2,022,321	966,880	347,933
2015/16	1,217,196	12,559,009	1,321,335	258,693	9,990,593	3,946,780	52,137	2,364,419	1,280,136	304,411

Source: Ethiopian Revenues and Customs Authority

Table 51: Exports of Crops and Crop Products, in Ethiopia, 2006/07 – 2015/16

Year	live trees &other plant ;bulbs, roots, and like ;cut flowers & ornamental foliage	Coffee ,tea, mate and spices	product of milling industry malt; starches inulin; wheat gluten	oil seeds & oleaginous fruits; miscellaneous grain, seed and fruit	Animal or vegetable fats and oils and their cleavage products prepared edible fat	sugars and sugar confectionery	cocoa and cocoa preparation	preparation of cereal ,flour, starch or milk ;bakers' wares	miscellaneous edible preparations	tobacco and manufactured tobacco substitute
2006/07	158,099	197,981	931	206,870	357,425	22,236,885	15,568,800	723,256	11,811	
2007/08	241,386	176,111	991	218,974	1,448,136	54,519,539	-	1,056,350	183,414	8,824
2008/09	269,052	197,388	269	182,533	597,506	60,050,868	-	1,284,296	19,537	13,275
2009/10	291,544	146,369	206	328,597	383,679	41,953,196	-	1,052,096	23,897	24,325
2010/11	372,943	285,420	628	302,790	310,631	5,989	98	2,464,196	362,360	27,492
2011/12	408,182	256,502	883	282,008	361,602	1,555		4,256,204	87,839	51,445
2012/13	489,782	230,246	395	393,123	348,863	55	-	3,850,504	93,515	9,926
2013/14	560,038	202,741	525	321,298	342,076		530	4,190,699	1,108	23,937
2014/15	580,624	259,106	1,448	362,019	443,792	48	-	5,262,572	3,958	6,923
2015/16	556,886	228,987	2,550	357,228	415,867	3,470	-	6,073,280	250,984	7,451

Source: Ethiopian Revenues and Customs Authority

Table 52: Value of Exports of Crops and Crop Products in Ethiopia, 2006/07 – 2015/17 (in Birr)

Year	live trees &other plant ;bulbs, roots, and like ;cut flowers & ornamental foliage	coffee, tea, mate and spices	product of milling industry ;malt; starches; inulin; wheat gluten	oil seeds & oleaginous fruits; miscellaneous grain ,seed and fruit	Animal or vegetable fats and oils and their cleavage products prepared edible fat	sugars and sugar confectionery	cocoa and cocoa preparation	preparation of cereal ,flour, starch or milk ;bakers'wares	miscellaneous edible preparations	tobacco and manufactured tobacco substitute
2006/07	863,217.30	3,851,302.60	3,831.80	1,940,832.70	13,941.80	97,395.50	65,786.20	6,326.80	265.90	-
2007/08	1,764,437.40	3,855,340.00	4,005.10	2,455,803.20	17,558.80	172,801.30	-	8,270.00	1,535.80	795.10
2008/09	350,349.90	570,215.50	285.90	294,826.20	1,763.60	14,866.20	-	2,058.20	32.30	128.20
2009/10	437,857.10	374,671.30	320.70	385,944.20	1,711.10	15,131.40	-	2,289.20	35.20	237.50
2010/11	559,824.60	721,614.50	807.80	347,335.50	1,518.20	7.50	0.30	4,807.40	685.70	299.70
2011/12	604,502.40	897,098.20	1,825.80	377,095.90	1,889.60	19.50	-	7,234.20	208.80	526.80
2012/13	11,980,792.60	16,316,960.00	12,480.40	8,930,629.00	39,689.30	3.60	-	143,655.60	5,586.00	1,825.00
2013/14	13,773,196.60	12,025,169.90	17,231.60	9,893,051.20	47,750.10	-	25.50	179,827.10	46.20	4,637.90
2014/15	15,533,470.10	16,852,746.70	23,337.60	13,651,149.10	76,031.40	10.10	-	237,464.80	126.60	1,412.20
2015/16	14,946,132.40	16,827,589.80	39,890.50	9,600,370.80	79,244.30	216.30	-	303,728.10	8,688.90	1,602.60

Source: Ethiopian Revenues and Customs Authority

4.7. Livestock

The livestock sub-sector plays an important role in the Ethiopian economy. Livestock contribute about 40 percent of the country's agricultural GDP. The majority of smallholder farms depend on animals for drought power traction & transportation of goods. Livestock has been and still is the single most important capital asset of the rural people. Livestock are kept as form of insurance against crop failure and also kept as a form of savings for emergency use.

Livestock play an important role in food security. Livestock make significant contribution to food supply through the provision of high value protein-rich animal products; they

indirectly support crop production through transportation of goods and manure supply. They also supply meat and milk for direct human consumption. Estimates of the livestock herd size for cattle and other species in Ethiopia vary widely. In Ethiopia the estimated cattle population is approximately 58 million, with 29 million sheep, and nearly 30 million goats for the year 2015/16. Table 53 gives the estimated number of livestock numbers by type from 2006/07-2015/16. [3] Table 54 also describes the number of slaughters by type of livestock (for Cattle, Sheep, Goat, Camel & Poultry) during the reference period by year.

Table 53: Livestock Population Across the Country

Years	Cattle	Sheep	Goats	Horses	Donkeys	Mules	Camels	Poultry	Beehives
2006/07	43,007,315	23,617,496	18,423,395	1,655,284	4,486,171	325,659	615,197	33,957,837	4,870,679
2007/08	47,570,675	26,117,272	21,709,428	1,775,794	5,572,931	376,682	1,009,040	39,563,902	4,688,278
2008/09	49,297,898	25,017,218	21,884,222	1,787,211	5,421,895	373,519	759,696	38,127,504	5,149,244
2009/10	50,884,005	25,979,919	21,960,706	1,995,306	5,715,129	365,584	807,581	42,053,263	4,598,226
2010/11	53,382,194	25,509,004	22,786,946	2,028,233	6,209,665	385,374	1,102,119	49,286,932	5,130,322
2011/12	52,129,017	24,221,384	22,613,105	1,961,949	6,438,435	368,781	979,318	44,893,009	4,993,815
2012/13	53,990,061	25,489,204	24,060,792	1,907,047	350,026	6,748,357	915,518	50,377,142	5,207,300
2013/14	55,027,280	27,347,933	28,163,332	1,963,010	356,087	6,953,077	1,098,312	51,350,738	5,124,228
2014/15	56,706,389	29,332,382	29,112,963	2,033,115	400,329	7,428,037	1,164,106	56,866,719	5,885,263
2015/16	57,829,953	28,892,380	29,704,958	2,082,203	405,950	7,881,394	1,228,023	60,505,327	5,916,100

Source: AgSS main season reports of CSA 2006/07-2015/16

Table 54: Estimated Numbers of Slaughters by Type during the Reference Period

Livestock Type	Years									
	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Cattle	308,789	350,071	365,506	352,009	417,327	407,457	338,150	328,538	396,986	499,841
Sheep	2,374,273	3,018,617	3,105,380	3,314,765	3,273,016	3,313,454	3,077,367	2,958,191	3,318,420	3,539,278
Goats	1,242,315	1,741,473	1,782,747	1,775,170	1,916,553	1,773,854	1,771,527	1,980,029	2,448,134	2,421,576
Camels	6,760	7,667	6,734	5,160	7,910	5,735	5,596	2,082	4,596	4,625
Poultry	9,359,565	11,427,842	10,294,902	10,904,517	12,154,580	12,492,621	13,529,922	14,248,999	16,161,132	15,339,804

Source: AgSS main season reports of CSA 2006/07-2015/16

[3] The estimated figures in the tables cover only the highland and Semie pastoral areas. It does not cover the whole pastoral areas of the country.

Import and Export of Livestock

Table 55: Imports of Livestock, Ethiopia, 2006//07 – 2015/16

Volume in Tones

Year	Live Horse, Mule and Hinnies	Live pure breed bovine animals	Live sheep and Goats	Live duck ,Geese and Guinea fowls; chick for breeding and poultry	Other live animals
2006/07	0.65	0.00	0.00	20.76	0.00
2007/08	0.00	0.00	3.53	14.83	0.34
2008/09	0.62	0.00	0.00	19.91	1.43
2009/10	2.57	0.00	0.00	5.77	1.36
2010/11	0.09	0.00	0.24	17.08	3.12
2011/12	30.08	35.28	32.67	14.88	31.23
2012/13	13.00	7.95	0.00	18.11	56.43
2013/14	0.25	156.00	0.00	25.58	64.00
2014/15	17.50	0.00	1.05	18.35	59.82
2015/16	0.00	37.33	0.00	17.12	74.87

Source: Ethiopian Revenues and Customs Authority

Table 56: Value of Imports of Livestock, Ethiopia, 2006//07 – 2015/16

FOB Value in '000 (ETB)

Year	Live Horse, Mule & Hinnies	Live pure breed bovine animals	Live sheep & Goats	Live duck ,Geese & Guinea fowls; chick for breeding & Poultry	Other live Animals
2006/07	52.75	0.00	0.00	2687.40	0.00
2007/08	0.00	0.00	1634.56	3011.79	175.53
2008/09	7.08	0.00	0.00	5157.00	227.48
2009/10	5.00	0.00	0.00	2710.19	319.69
2010/11	3.83	0.00	91.73	8204.18	960.54
2011/12	947.60	7288.93	10283.46	6829.42	6575.02
2012/13	1282.75	2028.93	0.00	13368.24	66346.60
2013/14	228.73	18490.71	0.00	22097.81	101166.78
2014/15	135.09	0.00	330.09	14385.28	88891.11
2015/16	0.00	5488.26	0.00	20294.73	99068.70

Source: Ethiopian Revenues and Customs Authority

Table 57: Exports of Livestock, Ethiopia, 2006//07 – 2015/16

Volume in Tones

Year	Live Horse, Mule & Hinnies	Live pure breed bovine animals	Live sheep and Goats	Live duck ,Geese & Guinea fowls; chick for breeding & Poultry	Other live animals
2006/07	0.00	0.00	26,830.44	1,158.93	4,547.94
2007/08	0.00	0.00	23,959.30	5,866.37	5,580.42
2008/09	9,343.92	0.00	4,873.20	16,761.53	2,082.30
2009/10	13,770.93	0.00	0.00	27,921.12	1,567.50
2010/11	37,264.03	0.00	0.00	54,543.07	276.52
2011/12	32,186.73	0.00	0.00	106,662.09	80.20
2012/13	40,766.29	0.00	136.50	75,737.00	0.76
2013/14	23,303.96	0.00	0.00	81,187.38	8.60
2014/15	18,888.92	0.00	0.00	74,705.82	5.70
2015/16	18,807.35	3.34	0.00	64,873.49	0.00

Source: Ethiopian Revenues and Customs Authority

Table 58: Value of Exports of Livestock, Ethiopia, 2006//07 – 2015/16

Value in '000 (ETB)

Year	Live Horse, Mule and Hinnies	Live pure breed bovine animals	Live sheep and Goats	Live duck ,Geese and Guinea fowls; chick for breeding and poultry	Other live animals
2006/07	0.00	0.00	214,006.63	24,862.21	26,494.57
2007/08	0.00	0.00	217,578.95	99,927.73	37,837.07
2008/09	11,355.17	0.00	5,827.87	26,884.06	1,821.21
2009/10	16,892.73	0.00	0.00	42,488.95	1,416.96
2010/11	43,263.34	0.00	0.00	80,620.00	239.50
2011/12	35,845.80	0.00	0.00	151,840.53	26.28
2012/13	1,052,189.03	0.00	3,664.00	2,148,734.10	167.75
2013/14	730,369.14	0.00	0.00	2,667,010.72	284.47
2014/15	677,307.13	0.00	0.00	2,732,237.27	382.17
2015/16	702,352.83	686.92	0.00	2,630,317.71	0.00

Source: Ethiopian Revenues and Customs Authority

4.8. Conserved Land by Soil and Water Conservation Measures

Soil erosion is recognized as one of the most serious, common, widely spread, and well known environmental problem. Soil and water conservation measures have been carried out in different parts of the country that have been recommended for minimizing soil loss by erosion. Soil and water conservation measures that have been used include: the construction of terraces, reforestation, forestation of areas that have not been used for cultivation, inter cropping, the protection of regenerating natural vegetation are the widely used method that have been used.

The trend of soil and water conservation measures shows that conserved land holding by small holder farmers increased from 2006/07-2015/16. By the year 2015/16, at national level more than 18 million hectares of land was under the practice of soil and water conservation by small holder farmers. Counter ploughing and terracing are the widely used soil and conservation methods.

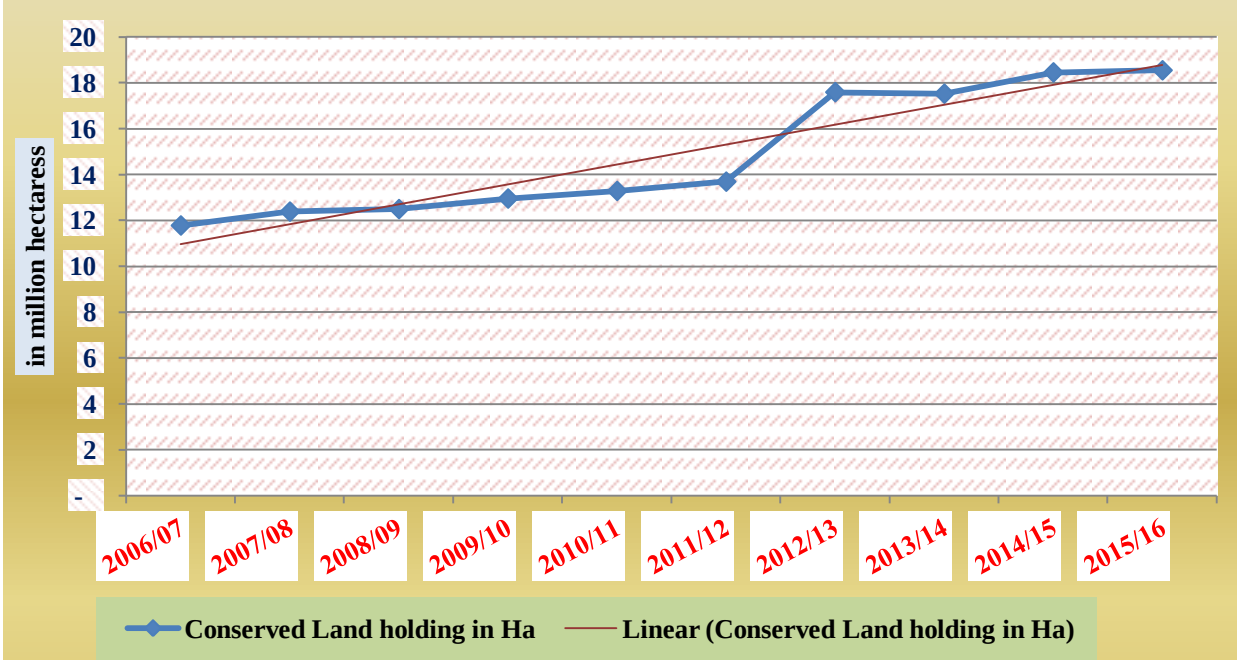


Figure 26: Conserved Land Holding in Ha by Year (2006-2015, Country Level)

Source: AgSS main season reports of CSA 2006/07-2015/16

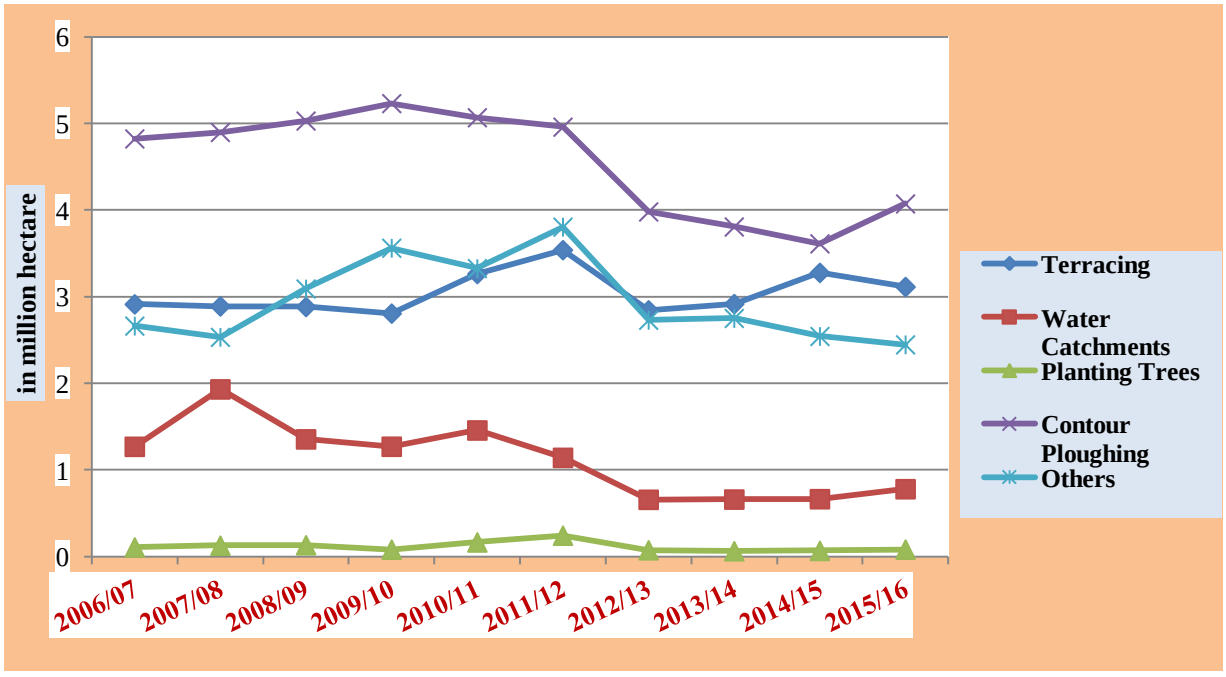


Figure 27: Conserved Land Holding by Method of Soil Conservation in ha at Country Level

Source: AgSS main season reports of CSA 2006/07-2015/16

At regional level the conserved land under the small holder holdings in the four major region reaches 8.7 million , 5.1 million, 3.2 million and 1.0 million hectares in Oromia, Amahara, SNNP and Tigray regions, respectively.

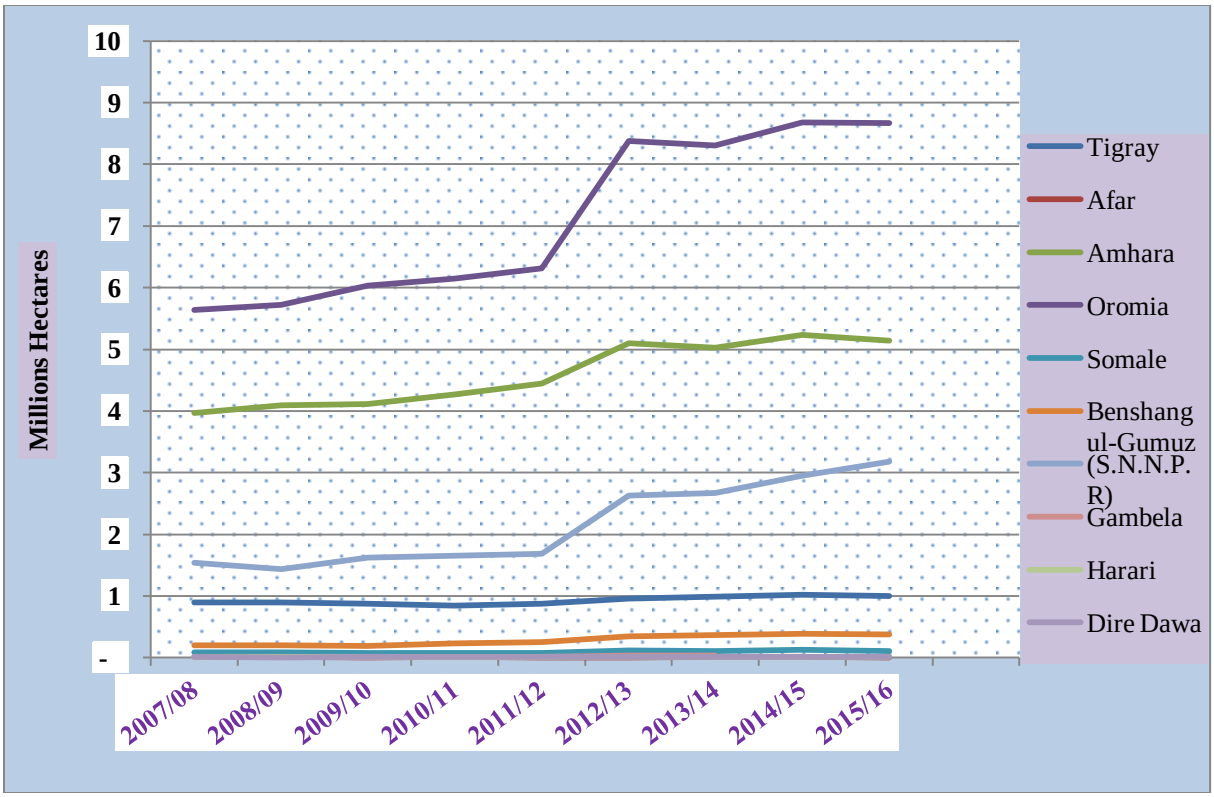


Figure 28: Conserved Land Holding in Hectare by Region (2006/07-2015/16)
Source: AgSS main season reports of CSA 2006/07-2015/16

Participation in Community Watershed Management Activity

Watershed management implies the wise use of natural resources like land, water and biomass in a watershed to obtain optimum production with minimum disturbance to the environment. In the last ten years there was a huge amount of work on water shed management have been done in most parts of the country through the huge mobilization and movements of the community. According to the result of the AgSS main season of CSA, in the last five years about 68% of the agricultural holder has been reported participating in community watershed management activities. Compared to the other regions the large number of agricultural holders participated in Tigray (75%) and Amahara regions (73%), followed by Oromia regional state (66%).

Constructions of terraces were the most common activity which was reported by about 70 percent of the agricultural holder. Planting trees, construction of check dams and road construction activities mentioned by 5.8%, 5.5% and 7.2% of the agricultural holder.

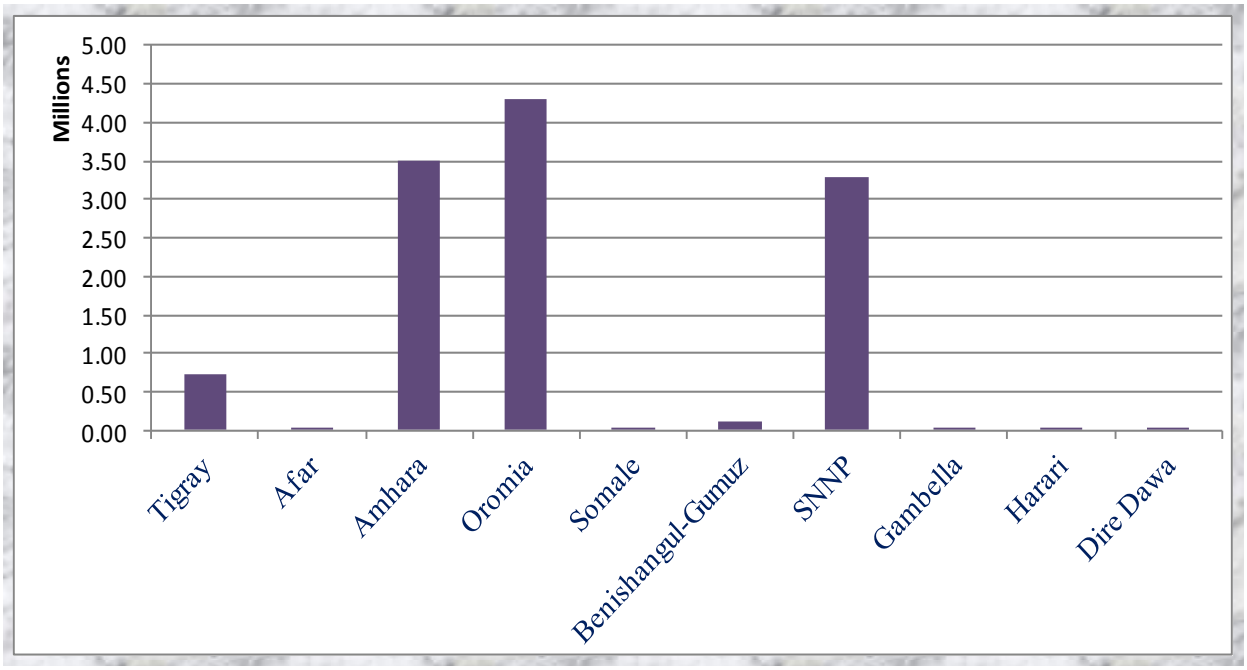


Figure 29: Number of Agricultural Holders Participated in CWSM Practices (2011/12-2015/16)

Source: AgSS main season reports of CSA 2006/07-2015/16

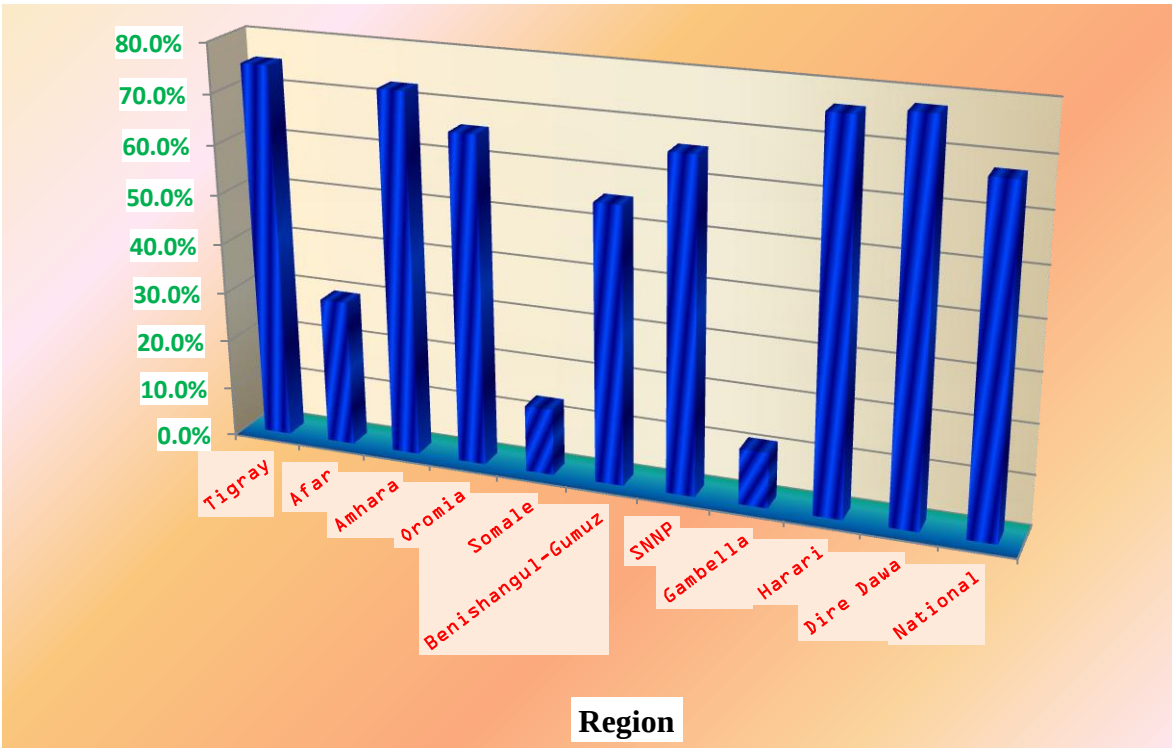


Figure30: Percentage Distribution of Agricultural Holders Participated in CWSM practices (2011/12-2015/16)

Source: AgSS main season reports of CSA 2006/07-2015/16

5 RESIDUALS

5. RESIDUALS

5.1 Emissions to Air

5.1.1 Emissions of Greenhouse Gases

Carbon dioxide (CO_2) is one of the main GHG emissions, constituting over 26 per cent of emissions in carbon equivalents. The highest level of CO_2 emissions occurred in the year 2001, mainly resulting from land use and land use changes and the energy sector. Emissions have since been on a generally declining trend. This trend is the result of various government initiatives to reduce emissions in response to climate change challenges and to conserve natural resources, especially forests. Most of the carbon dioxide results from land use and land use changes in cropland and grassland and respective conversions, which together contribute 92 per cent (cropland 59 per cent and grassland 33 per cent) of all the CO_2 emitted in the country. Transport and the energy industries follow as the other main sources, accounting for 3 per cent and 1 per cent respectively.

The second National Communication (SNC) report of Ethiopia submitted to the UNFCCC has done the recalculation of emissions estimates of the country for 1994 and 1995, which were reported in the Initial National communication (INC 2007) and of the estimates for 2010, which were used in the development of the Climate Resilient Green Economy (CRGE) Strategy for Ethiopia.

As it was mentioned in SNC, the INC total emissions were estimated to be 39,885 Gg and 44,886 Gg for 1994 and 1995 respectively, while the revised estimates for the SNC are 25,433.179 Gg for 1994 and 124,159.49 Gg for 1995. Although there was a great disparity in the two estimates for 1995, the estimates for 1994 were close and the estimated removals from the forests are very close.

In following the UNFCCC requirement to develop and submit data on national greenhouse gas emissions estimates, the emissions and sinks presented in the SNC,2015 report were calculated using internationally-accepted methods originating from the IPCC. In the report, the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories were used to estimate the country's greenhouse gas emissions for the years 1994-2013 by sources and removals by sinks.

Emissions/removals of seven gases, namely carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), nitrogen oxides (NOX), carbon monoxide (CO), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO2), were addressed.

In year 2013, the total emissions of the seven gases were estimated to be 146,160.43 Gg of carbon dioxide equivalent. The quantity by GHG was: carbon dioxide, 40,357.15 Gg; methane, 72,793.82 Gg and Nitrous Oxide, 30,418.03 Gg. In year 2013, there was a decrease of 24.11 per cent in total estimated emissions compared with 2010.

The results for CO_2-equivalent emissions and removals clearly indicate that the agriculture and energy sectors are the most important sources of emissions, while the land-use change and forestry sector (LUCF) is the most important with respect to removals. Methane and carbon dioxide are the primary greenhouse gases emitted through human activities in Ethiopia. In 2013, methane and carbon dioxide accounted respectively for about 52 and 26 per cent of all greenhouse gas emissions from human activities in the country. The pie charts in Figure 31 show emissions by sector and by gas in 2013. Figure 31 indicates that 79 per cent of all emissions were from the Agriculture, Forestry, and Land Use (AFOLU) sector while the energy and industrial processes and product use (IPPU) sectors contributed 15 per cent and 1 per cent respectively and the waste sector only 5 per cent.

The largest sources of CO_2 were cropland and grassland at 59 per cent and 33 per cent while the transport sector contributed only 3 per cent. CH_4 emissions were mainly from enteric fermentation associated with domestic livestock, at 26 per cent, other energy sector which is primarily from the use of fuel wood and wood waste in the residential and commercial institutions at 26 per cent, and solid waste disposal and decomposition at 25 per cent. The other sources of methane included wastewater treatment and discharge at 6 per cent, manure management and biomass burning at 5 per cent each, rice cultivation 3 per cent, transport 2 per cent, solid fuels (coal) and energy industries at 1 per cent each.

The largest contribution of nitrous oxide was from manure management at 44 per cent with direct and indirect N_2O emissions from manure management accounting for 38 and 6 per cent respectively. This was followed by direct and indirect N_2O emissions from managed soils, at 24 per cent and 16 per cent respectively. The fuel combustion activities, other energy sectors

(residential and commercial), and wastewater treatment and discharge contributed 5 per cent, 5 per cent and 4 per cent respectively. This indicates that manure management, agricultural soil management, energy generation and waste management were the major sources of N_2O emissions.

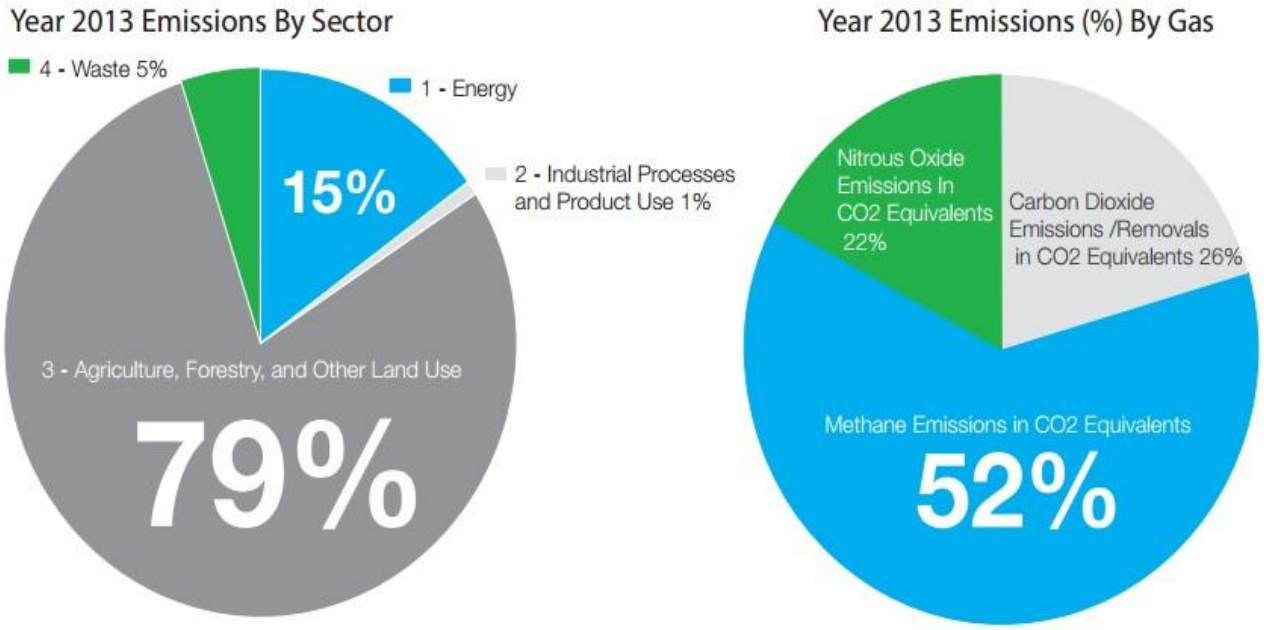


Figure 31: Emissions by Sector and by Gas, by 2013
Source SNC of Ethiopia, 2015, MEFCC

Aggregated Emissions and Trend

Aggregation of the 2013 CO2, CH4 and N2O emissions for all the national GHG inventory sectors using the Fourth Assessment Report (AR4) of IPCC Global Warming Potential (GWP) factors over a 100 years' time horizon yields a total of about 146,160.43 Gg CO2-equivalents, excluding emissions/removals from the categories classified as memo items.

Assuming a population of 91 million for the year 2013, the estimated per capita emission was 1.5776 tons of CO2-equivalents in that year. In figures 32, 33 and 34 below shows Percentage of Emissions Change between the years 2010, 2000 and 1994, and 2013. Table 59 and 60 next to the above mentioned figures below shows aggregated emissions for the years 1994-2013.

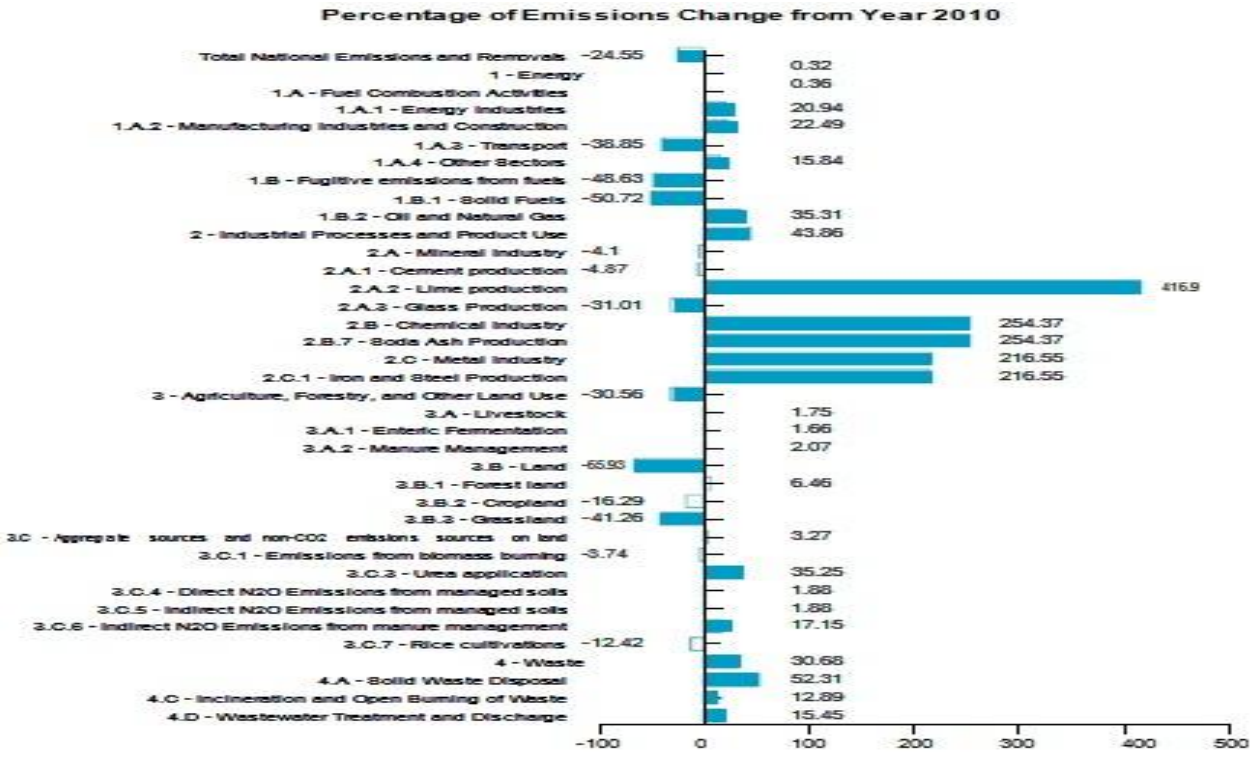


Figure 32: Change in Emissions Change between 2010 and 2013 (%)

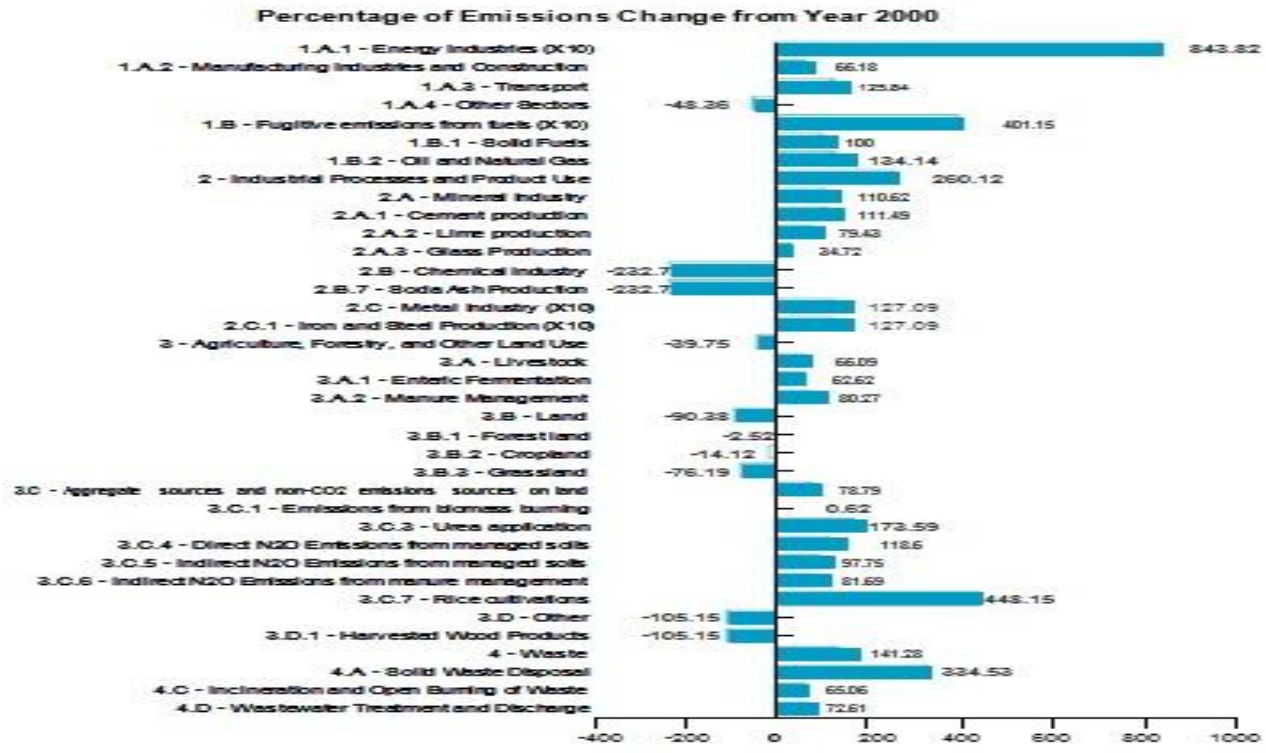


Figure 33: Change in Emissions between 2000 and 2013 (%)

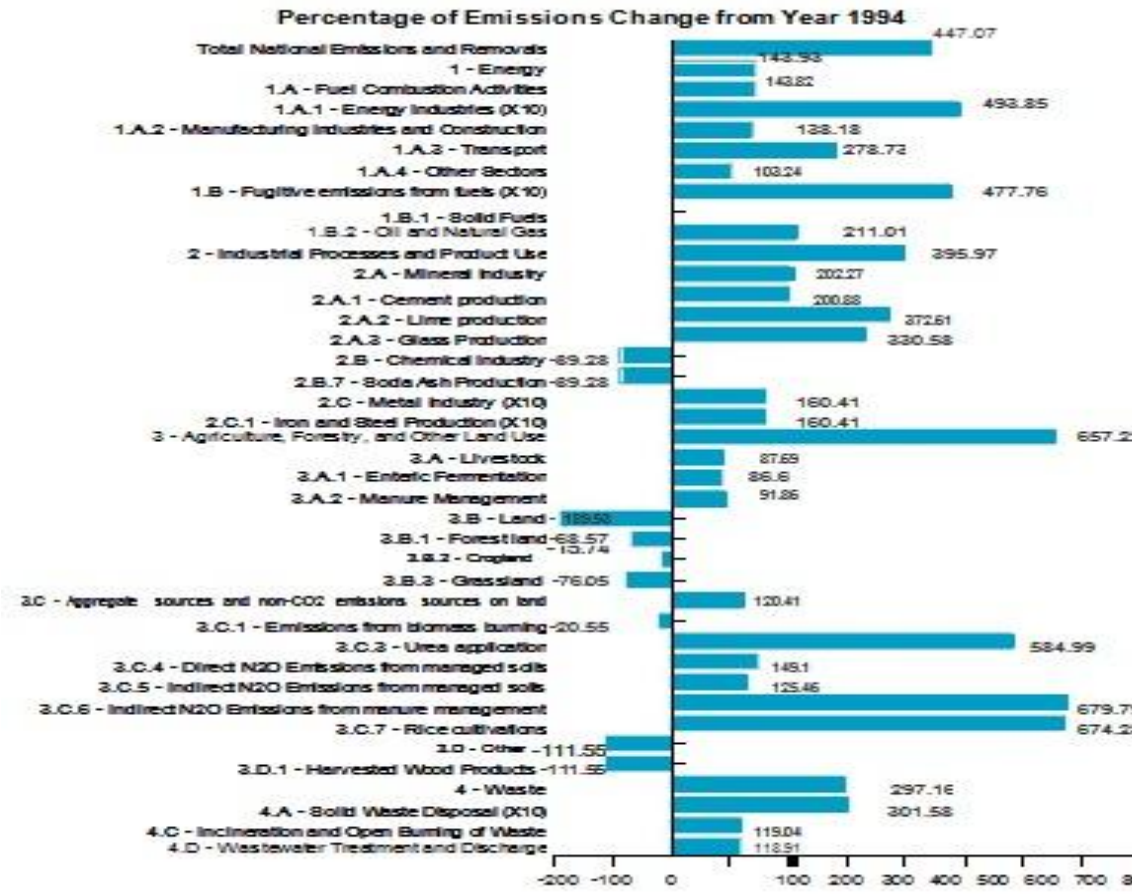


Figure 34: Change in Emissions between 1994 and 2013 (%)
Source: SNC of Ethiopia, 2015, MEFCC

Table 59 Aggregated Emissions, 1994-2013 (Gg)

Emissions	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total National CO_2 Equivalent Emissions and Removals	25,433.18	124,159.49	104,606.97	130,230.52	133,209.21	134,092.33	183,422.00	202,697.74	201,828.80	204,306.18
Carbon Dioxide Emissions/ Removals in CO_2 Equivalents	-26,050.54	72,340.09	50,511.81	51,561.39	53,760.92	54,478.54	105,663.20	122,681.30	113,253.80	116,779.50
Methane Emissions in CO_2 Equivalents	37,033.40	38,068.56	39,454.12	59,160.62	59,680.90	59,910.41	58,499.45	60,432.12	66,519.07	65,935.50
Nitrous Oxide Emissions in CO_2 Equivalents	14,303.66	13,492.57	4,658.64	19,299.66	19,558.63	19,721.68	18,911.62	19,260.92	22,077.24	21,614.56

Source: SNC of Ethiopia, 2015, MEFCC

Table 60: Aggregated Emissions, 1994-2013 (Gg)

Emissions	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total National CO_2 Equivalent Emissions and Removals	157,626.65	144,358.07	148,884.24	160,211.53	176,075.07	173,651.75	186,361.60	208,884.77	142,590.49	146,160.43
Carbon Dioxide Emissions/ Removals in CO_2 Equivalents	66,810.55	68,019.98	68,512.75	71,372.27	85,187.04	80,912.06	88,095.24	111,818.20	40,266.83	35,856.73
Methane Emissions in CO_2 Equivalents	67,051.69	53,905.57	55,932.86	62,142.80	63,410.74	65,551.89	68,699.37	71,341.65	71,825.46	72,793.82
Nitrous Oxide Emissions in CO_2 Equivalents	23,790.88	22,462.55	23,769.00	26,733.98	27,514.44	27,224.81	29,603.40	25,759.66	30,500.74	30,418.03

Source: SNC of Ethiopia, 2015, MEFCC

5.2. Generation and Management of Waste

5.2.1. Background Information

Solid waste management defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a manner that is in accordance with the best principles of public health, economics, engineering, conservations , and that is also responsive to public attitudes.

Solid waste Management pause a serious challenge particularly for most cities in the developing countries of the world where a dense concentration of people lives together. Thus, because of its quantity and diverse nature the problems associated with the management of solid wastes are complex. Indiscriminate dumping of solid waste and failure of the collection system in a populated community would soon cause many health problems. Ecological phenomena such as water and air pollution have also been attributed to improper management of solid wastes.

Therefore, rapid and sustainable economic growth and physical expansion of urban centers needs to be nurtured and supported as it is an expression and indicator of the rapid transformation of a country's economy. It is believed that in Ethiopia when the growth and transformation plan (GTP) succeeds, in transforming the economy from being agricultural led to industrial growth, the country's urban centers and the level of urbanization will be further enhanced. So, understanding the urban community and how they relate themselves to solid waste management problem is critical.

It is expected that, apart from the increase in urban population, the successful realization of the second growth and transformation plan (GTP II) will result in increases the income level and improvements in the lifestyles of urban residents. It is inevitable that the volume and mix of solid waste to be generated also increase. Unless appropriate system of solid waste management put in place, it is likely to lead to even more complicated situation problems than what the urban centers are currently experiencing.

The nature and operation of solid waste management varies significantly across the urban centers of Ethiopia. Regardless of these distinctions the way urban centers handles solid waste was not well organized, inefficient and unsustainable.

It is, therefore, critical to adopt a broad approach in developing a working framework for solid waste management that covers social, economic, technology, political and administrative dimensions. Moreover, Solid waste management is not an isolated phenomena that can be easily compartmentalized and solved with innovative technology or engineering. There is a whole culture of solid waste management that needs to be put in place - from the micro-level of household and neighborhood to the macro levels of urban centers.

The Ministry of Urban Development and Housing, hence has made an effort to undertake the above-mentioned problems. Urban Solid Waste Management Strategy was published and distributed to the regional states on July 2014. Since then training and awareness creation has been given at all level to improve public awareness and attitudes on solid waste management, the necessary structure and financial system for solid waste management has been in place for more than half of cities with population size 20,000 and above.

Although, the above mentioned activities carried out by the Ministry of Urban Development and Housing it is difficult to address the problem associated with solid waste management in most urban centers of the country within a short period of time. So, more ardent efforts and action is needed to be done in the future.

5.2.2 Amount of Waste Generated by Source

The statistics presented in this section is compiled by the CSA as pilot survey conducted only in the urban centers of 6 regions and in the 2 administrative cities of Addis Ababa and Dire Dawa. However, the required data was not fully available even in those urban centers of the country. Subsequently the amount of solid waste collected from different sources and waste treatment and disposal data presented in the following Tables (Table 61 -63).

Table 61: Town/City Source and Quantity of Solid Waste Collected per year

Town/ City	Source of Solid Waste	Amount of Solid Waste collected (in Ton)					
		2010	2011	2012	2013	2014	2015
Mekele	Not Stated	29,973	37,864	37,035	37,919	57,715	55,336
Bahir Dar	SW collected from HH	25,915	*	*	*	7	7
	SW collected from trade centers	8,333	*	*	*	1	1
	SW collected from hospital, school, Gov. building	6,205	*	*	*	1	1
	SW collected from construction centers	*	*	*	*	1	1
	SW collected from manufacturing centers	*	*	*	*	1	1
	Total SW collected	40,453	*	*	*	11	11
Adama	Not Stated	*	*	*	21,510	26,390	22,856
Gigjiga	SW collected from HH	2,120	2,250	2,620	2,870	3,360	3,840
	SW collected from trade centers	1,115	1,820	2,097	2,120	2,400	2,640
	SW collected from hospital, school, Gov. building	1,170	1,270	1,378	1,520	1,650	1,920
	Total SW collected	198	230	237	248	250	260
Assosa	SW collected from HH	350	430	620	680	770	960
	SW collected from trade centers	4,953	6,000	6,952	7,438	8,430	9,620
	SW collected from construction centers	*	6,826	7,644	554	16,772	9,137
	SW collected from economic activities	*	3,706	4,150	301	9,105	4,960
	SW collected from agriculture activities	*	829	928	67	2,037	1,109
	Total SW collected	*	11,361	12,722	922	27,914	15,206
Hawassa	SW collected from HH	*	23,860	27,751	27,883	40,320	36,480
	SW collected from trade centers	*	7,755	7,445	8,365	13,440	10,032
	SW collected from hospital, school, Gov. building	*	5,965	8,122	6,971	8,960	10,944
	SW collected from construction centers	*	6,562	6,769	4,880	11,648	16,416
	SW collected from manufacturing centers	*	2,983	3,384	4,183	6,272	6,384
	SW collected from economic activities	*	5,366	6,092	6,274	6,272	8,208
	SW collected from agriculture activities	*	7,158	4,738	7,668	2,688	2,736
	SW collected from minerals and quarry	*	*	3,384	3,485	*	*
	Total SW collected	*	59649	67685	69,709	89,600	91,200
Addis Ababa	SW collected from HH	82,882	105,851	116,161	142,300	175,310	146,784
	SW collected from trade centers	67	5,827	6,518	8,312	8,616	8,945
	SW collected from hospital, school, Gov. building	2,671	3,160	3,536	4,511	4,669	4,858
	SW collected from construction centers	2,670	3,159	3,534	4,509	4,666	4,856
	SW collected from economic activities	445	527	589	752	778	809
	Total SW collected	88,735	118,524	130,338	160,384	194,039	166,252
Dire Dawa	SW collected from HH	*	*	44,748	25,999	51,716	55,726
	SW collected from trade centers	*	*	*	*	*	30
	SW collected from hospital, school, Gov. building	*	*	*	*	*	97
	Total SW collected	*	*	44,748	25,999	51,716	55,853

Data was not available

Source: - CSA, Environmental Statistics pilot survey, 2015

Table 62: Source of Solid Waste Collected of Regional and Administrative Cities, and Collected Quantity per year

Source of Solid Waste of 8 Ethiopian Cities by quantity per year	Amount of solid waste collected (in Ton)						
	2010	2011	2012	2013	2014	2015	Total
SW collected from HH	110,917	138,787	198,924	199,606	287,485	251,974	1,187,693
SW collected from trade centers	9,515	19,108	20,210	19,098	33,562	26,608	128,101
SW collected from hospitals, schools, Gov. buildings	8,876	9,954	12,586	11,549	15,667	17,009	75,641
SW collected from construction centers	3,840	10,991	11,681	10,909	17,965	23,193	78,579
SW collected from manufacturing centers	*	2,983	3,384	4,183	6,273	6,385	23,208
SW collected from economic activities	643	6,123	6,918	7,274	7,300	9,277	37,535
SW collected from agriculture activities	350	7,588	5,358	8,348	3,458	3,696	28,798
SW collected from minerals and quarry	*	*	3,384	3,485	*	*	6,869
Not stated	29,973	37,864	37,035	59,429	84,105	78,192	326,598
Total SW collected	164,114	233,397	299,480	323,881	455,815	416,334	1,893,022

**Data was not available*

Source: - CSA, Environmental Statistics pilot survey, 2015

Table 63: Percent of Solid Waste Treatment and Disposal per year

Treatment Type	Solid Waste Treatment and Disposal of 8 Ethiopian Cities by Quantity per year (in percent)						
	2010	2011	2012	2013	2014	2015	Total
Change to production	0.77	0.86	0.75	1.77	1.69	2.38	1.52
Decomposed	*	2.04	10.79	4.55	8.19	9.39	6.77
Burn	0.11	1.61	1.42	1.15	0.66	0.49	0.89
Put it into the hole	18.41	42.92	40.95	41.56	45.72	46.26	41.66
Others	1.51	1.34	1.38	1.19	0.93	1.14	1.19
Not Known	79.20	51.23	44.71	49.77	42.81	40.35	47.95
Total	100	100	100	100	100	100	100

Data was not available

Source: - CSA, Environmental Statistics pillot survey, 2015

6 EXTREM EEVENTS AND DISASTERS

6 EXTREME EVENTS AND DISASTERS

6.1 Natural Extreme Events and Disasters

Ethiopia is exposed to a wide range of hazards associated with the country's diverse geo-climatic and socio- economic conditions. Drought and floods represent major challenges. A number of other hazards also affect communities and their livelihoods. These include: frost and hail, crop pests and diseases, livestock diseases, human diseases, conflict, landslides, earthquakes and urban and forest fires among the others. The chart below shows distribution of affected population by major disaster in the country (1990 -2013)

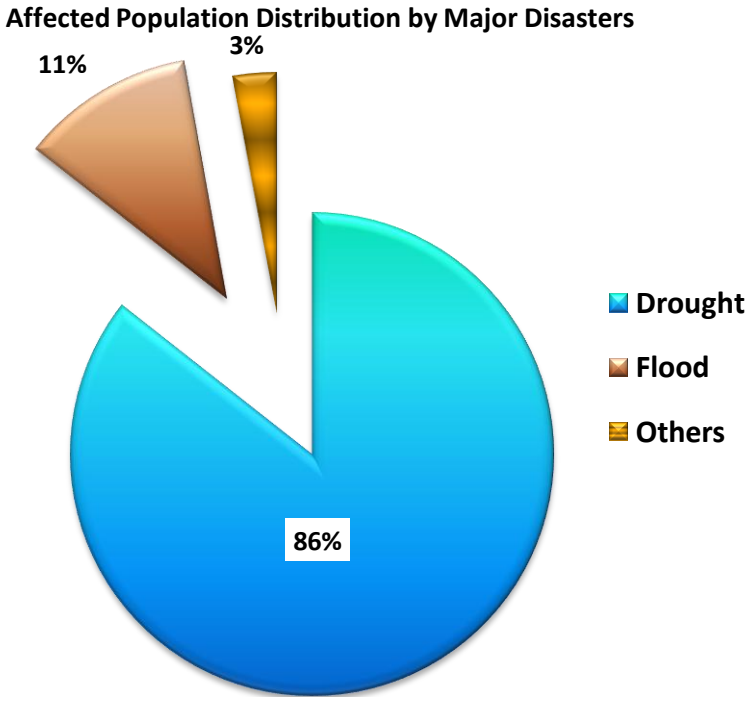


Figure 35: National Major Disaster distribution, 1990-2013
Source: UNISDR, Data base

6.1.1 Occurrence of Natural Extreme Events and Disasters

Drought and Flood are the most common natural disasters in Ethiopia during 2013-2014 periods. Prolonged drought is the most serious climatic hazards and a key development and environmental challenge of the country. Drought is not a new phenomenon in Ethiopia. Throughout its history, Ethiopia has encountered a number of drought crises. Hence, the most common drought prone areas of the country include:-

- Eastern part of Ethiopia which includes Afar and Somali regions,

- Central, Southern and Eastern parts of Tigray,
- Part of eastern Amhara ,
- South-western part of SNNPR and
- South and eastern parts of Oromiya regions are the most drought prone areas in Ethiopia.

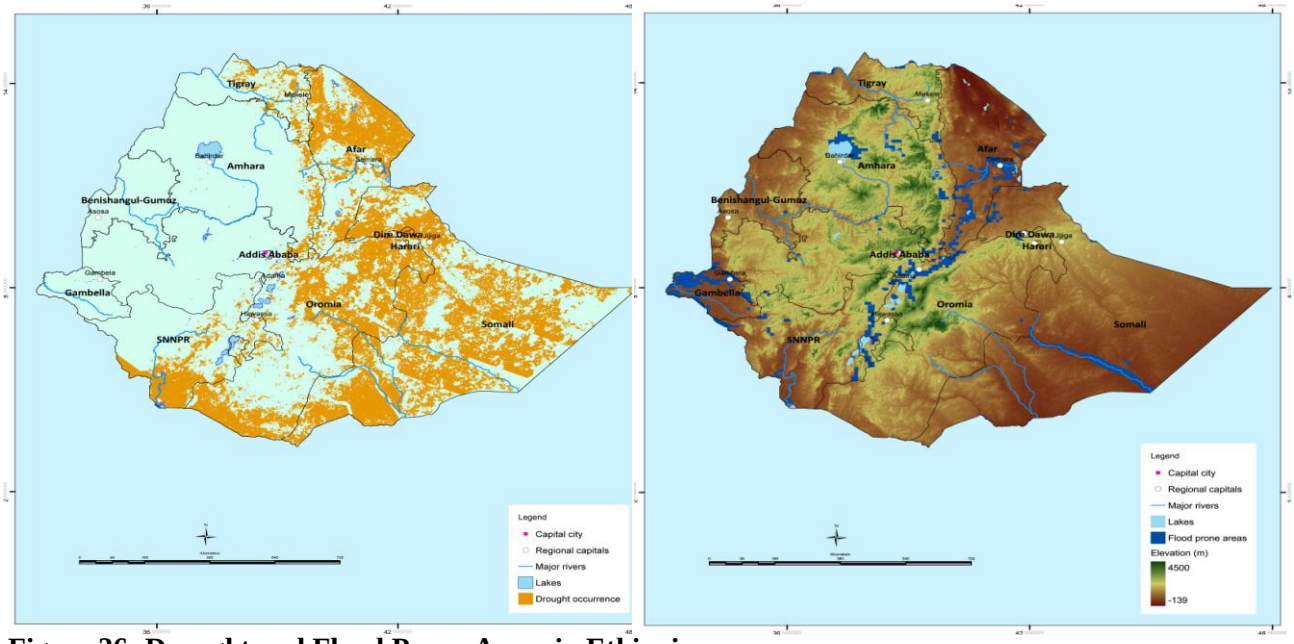


Figure 36: Drought and Flood Prone Areas in Ethiopia

Source: NDRMC/IGAD, 2013

Although its magnitude and impacts varied across the regional states of the country the worst drought events in Ethiopia were in 1974, 1984, 1994, 2000, 2003, and 2016. More over heavy rains resulted in flash floods and overflow of rivers also affects the livelihood of people. In Ethiopia the most flood prone areas include along the river banks of Awash in Afar region, Wabisheble and Genale river banks in Somali region, Omo river bank in the Southern Nation and Nationality People Region, the surrounding areas of Lake Tana in Amhara region and Baro river bank in Gambela region.

However, the effects of Flash floods occur in many pocket areas of the country which includes the unprecedented flood incidence of Diredawa town. Also, figure 36 above shows the spatial distribution of the most serious disasters Drought and Flood hazardous.

Affected Population

Generally, the effects of recurrent drought are often combined with other hazards such as flood depletes different economic assets of the majority of the Ethiopian population and creates weak resilience (high vulnerability) against disaster impacts year after year. Table 64 below shows that during the last 12 years the impacts of drought event critically affected millions of Ethiopian population.

Table 64: Total National Affected Population 2006-2016, Drought and Flood

Year of Disaster	Drought	Flood
2006	2579510	670000
2007	1360000	324000
2008	6421100	51900
2009	6242286	7692
2010	5229452	925900
2011	4567256	0
2012	3762351	1272
2013	2702312	0
2014	3235725	282225
2015	8248385	0
2016	10245227	269713

Source: NDRMC

Assistance Provided

Depletion of assets due to recurrent droughts has increased the vulnerability of households and decreased their ability to cope with climatic risks and other natural hazards. Because of such compounded effects many Ethiopians continue to rely on food, sanitation and related materials aids.

Hence, Figure 37 depicted below shows the frequency of assistance such as Relief food, targeted supplementary feeding programs, shelter materials and essential household items, potable water provision, health care and nutrition, agriculture and education intervention were provided by the government of Ethiopia and its partners to respond to the disasters caused by droughts and related hazardous events across the most drought-affected areas of the country.

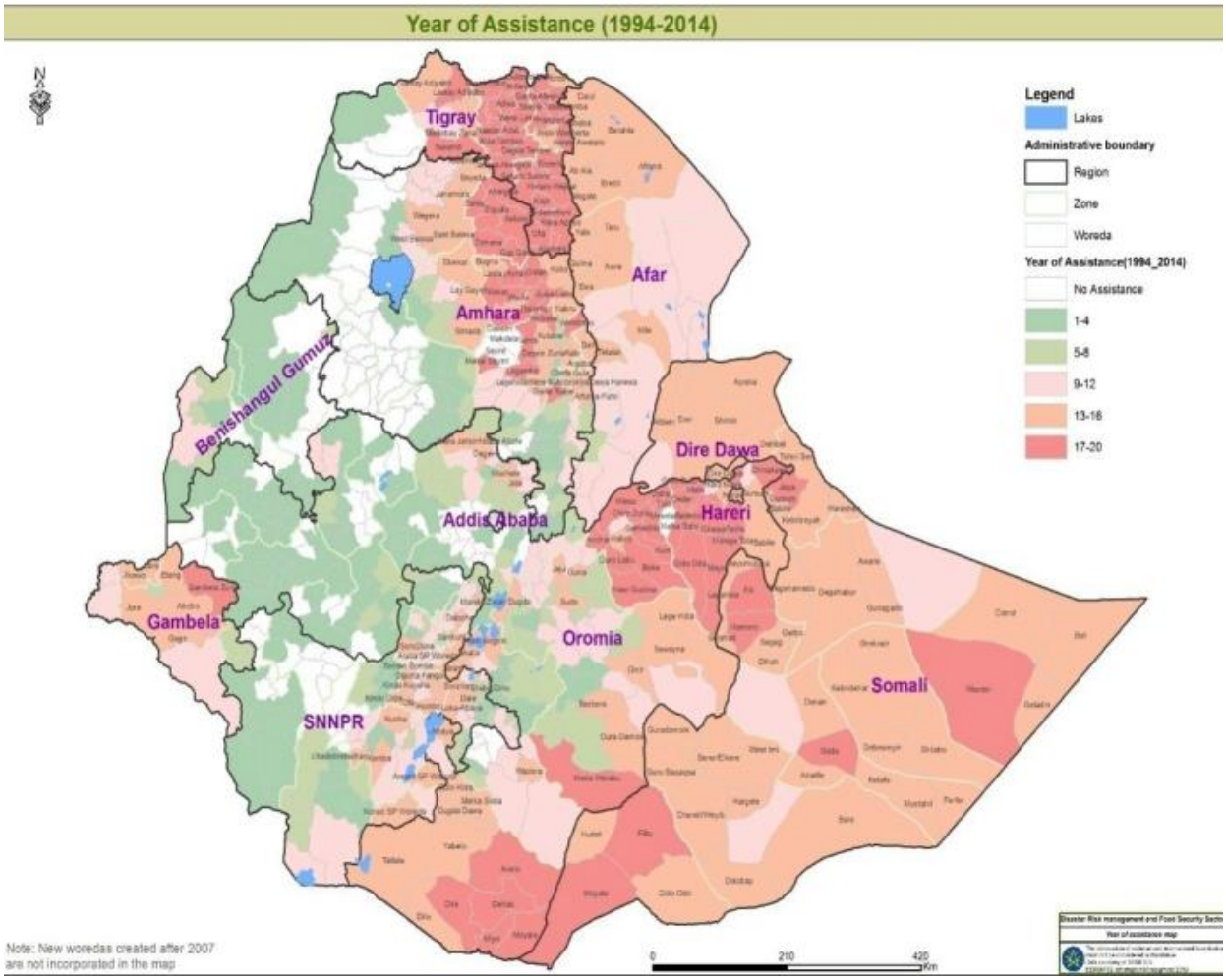


Figure 37: National Years of Assistance Provided (1994-2014)
Source: National Disaster Risk Management Commotion

6.2 Technological Disasters

6.2.1 Occurrence of Technological Disasters

As shown in table 65 male slight injuries is the highest in year of 2013 and 2015 as compared with female and the savior injury of male also the highest in 2014. Moreover, from the year 2012 to 2015 the death of male is high at the country level as compared to female. Generally figure 38 indicate that the number of people vulnerable to traffic accident increased from 2012 to 2016.

Regionally Oromiya is a highly vulnerable region for vehicles traffic accident followed by Amhara and **S.N.N.P.R** regions (Table 66). Table 67 also shows property damage (cargo loaded including vehicles) in birr is decreased since 2015 as compared with 2014.

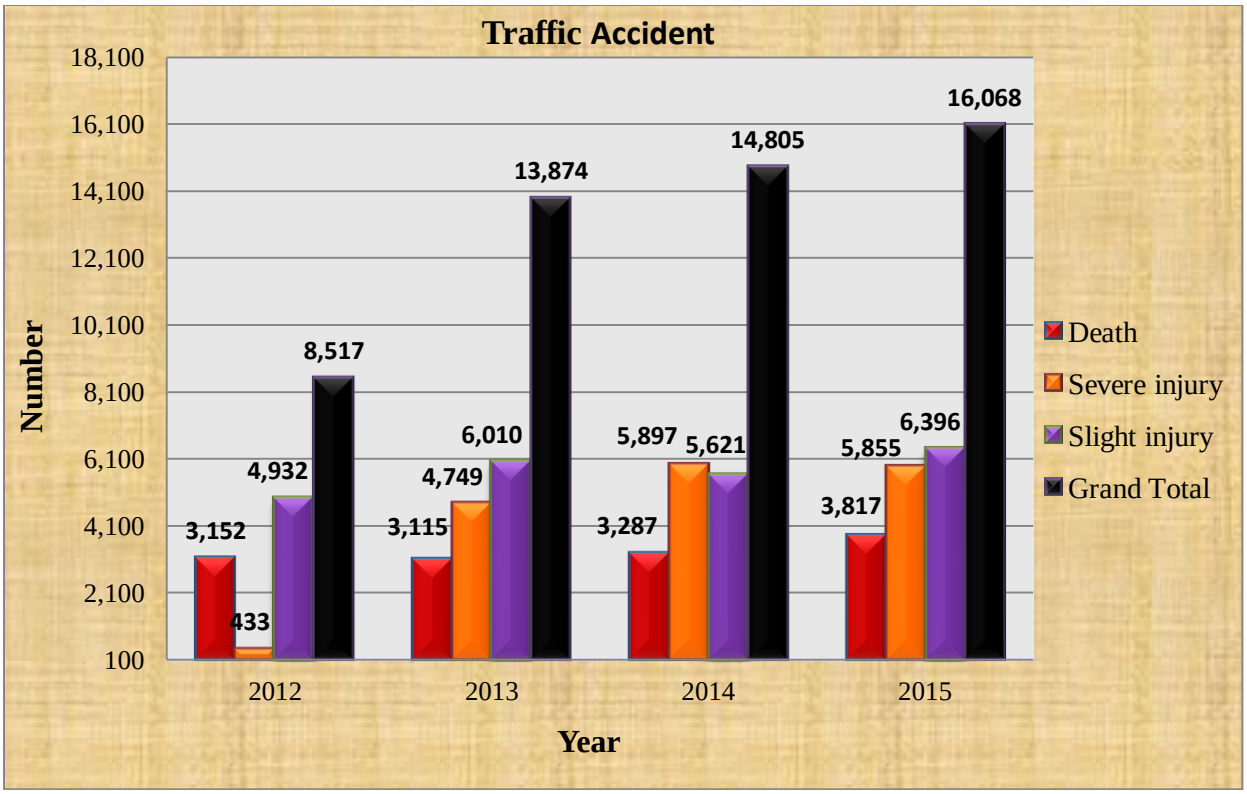


Figure 38: Number of Traffic Accident at Country Level

Source: - Ministry of transport

Table 65: Traffic Accident, Country Level

Accidents	Female				Male				Total			
	Year				Year				Year			
	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015
Death	827	667	869	1,240	2,305	2,448	2,418	2,577	3,152	3,115	3,287	3,817
Severe injury	1,230	1,124	1,607	1,631	3,103	3,625	4,290	4,224	433	4,749	5,897	5,855
Slight injury	1,146	1,461	1,644	1,816	3,785	4,549	3,977	4,580	4,932	6,010	5,621	6,396
Grand Total	3,203	3,252	4,120	4,687	9,193	10,622	10,685	11,387	8,517	13,874	14,805	16,068

Source: - Ministry of transport

Table 66 Traffic Accident by Sex and Region

Region	Accidents	Female				Male				Total			
		2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015
Tigray	Death	114	73	79	65	189	224	256	246	303	297	335	311
	Severe injury	144	117	136	151	272	304	340	396	416	421	476	547
	Slight injury	160	77	99	102	201	242	214	313	361	319	313	415
	Grand Total	418	267	314	318	662	770	810	955	1,080	1,037	1,124	1,273
Afar	Death	6	16	15	8	48	62	83	68	54	78	98	76
	Severe injury	25	10	26	18	76	74	91	63	101	84	117	81
	Slight injury	8	16	15	22	48	74	94	78	56	90	109	100
	Grand Total	39	42	56	48	172	210	268	209	211	252	324	257
Amhara	Death	96	228	215	203	340	524	586	600	436	752	801	803
	Severe injury	69	352	297	271	236	652	716	504	305	1,004	1,013	775
	Slight injury	100	494	494	457	470	1,184	1,097	1,216	570	1,678	1,591	1,673
	Grand Total	265	1,074	1006	931	1,046	2,360	2,399	2,320	1,311	3,434	3,405	3,251
Oromia	Death	419	225	317	740	995	1,099	787	864	1,414	1,324	1,104	1,604
	Severe injury	306	255	239	469	902	1,166	740	889	1,208	1,421	979	1,358
	Slight injury	104	234	343	495	1,298	1,539	624	1,289	1,402	1,773	967	1,784
	Grand Total	829	714	899	1,704	3,195	3,804	2,151	3,042	4,.024	4,518	3,050	4,746
Somalia	Death	14	30	19	12	58	66	73	50	72	96	92	62
	Severe injury	23	20	25	25	81	99	113	65	104	119	138	40
	Slight injury	14	38	18	13	50	113	100	71	64	151	118	84
	Grand Total	51	88	62	50	189	278	286	186	240	366	348	236
B.Gumuz	Death	13	5	*	*	11	22	*	*	24	27	*	*
	Severe injury	25	16	*	*	46	53	*	*	71	69	*	*
	Slight injury	23	53	*	*	79	233	*	*	102	286	*	*
	Grand Total	61	74	*	*	136	308	*	*	197	382	*	*
S.N.N.P.R	Death	53	*	74	85	218	-	221	351	271	-	295	436
	Severe injury	85	*	132	168	306	-	432	560	391	-	564	728
	Slight injury	113	*	159	182	462	-	344	465	575	-	503	647
	Grand Total	251	*	365	435	986	-	997	1,376	1,237	-	1,362	1,811
Gambela	Death	10	*	*	7	14	*	*	18	24	*	*	25
	Severe injury	25	*	*	19	27	*	*	25	52	*	*	44
	Slight injury	26	*	*	29	33	*	*	50	59	*	*	79
	Grand Total	61	*	*	55	74	*	*	93	135	*	*	148
Harari	Death	3	6	8	9	29	12	16	25	32	18	24	34
	Severe injury	12	4	28	32	30	46	39	90	42	50	67	122
	Slight injury	10	15	49	63	79	49	56	151	89	64	105	214
	Grand Total	25	25	85	104	138	107	111	266	163	332	196	370
D.Dawa	Death	4	4	8	7	17	20	19	18	21	24	27	25
	Severe injury	36	28	47	19	63	63	81	25	99	91	128	44
	Slight injury	74	72	77	29	124	130	136	50	198	202	213	79
	Grand Total	114	104	132	55	204	213	236	93	318	317	368	148

Source: - Ministry of transport

**** Data was not available***

Table 67: Property Damage, Country Level

Accidents	Accidents in Year					
	2013	2014	2015	Damage in Birr		
				2013	2014	2015
Total property Damage	**24,079**	**3,520**	**21,217**	**38,799,123**	**973,474,311**	**688,622,807**
Severe Car Damage	**3,614**	**1,996**	**5,262**			
Slight Car Damage	**20,465**	**1,527**	**23,147**			

Source: - Ministry of transport

7

HUMAN SETLEMENTS AND ENVIRONMENTAL HELTH

7. HUMAN SETLEMENTS ANDS ENVIRONMENTAL HELTH

7.1. Background Information

This section contains statistics on the environment in which humans live and work, particularly with regard to living conditions and environmental health. These statistics are important for the management and improvement of conditions related to human settlements, safe water, sanitation and health, particularly in the context of rapid urbanization, increasing pollution, environmental degradation, disasters, extreme events and climate change.

7.1.1. Human Settlements

Human settlements refer to the totality of the human community, whether people live in large cities, towns or villages. They encompass the human population that resides in a settlement, the physical elements (e.g., shelter and infrastructure), services (e.g., water, sanitation, waste removal, energy and transport), and the exposure of humans to potentially deleterious environmental conditions (FDES, 2013).

The FDES, 2013 further explained that human settlements can vary from tiny villages to large metropolitan agglomerations. Housing types also vary widely from slums to houses built up to local codes of construction. Besides human settlements and housing types, the increasing concentrations of humans in modern urban settlements pose special challenges to humans as well as to the physical environments in which these settlements are located.

Pollution of the air, water or soil due to activities in human settlements continuously causes environmental change that can have damaging effects on agriculture, water resources, the energy sector, as well as on human health. The capacity or the resilience of the environment to cope with the environmental impacts caused by human habitation can influence both the health of the human settlements and that of the natural environment.

The existence of human settlements and environmental health can be improve by a valid factors, there are the existence of appropriate infrastructure for the provision of water and sanitation, adequate waste disposal, wise land use planning, clean and safe transportation, safe building design and other measures of good housing, and ecosystem health.

7.2. Urban and Rural Population

Humans live primarily in rural or urban communities, building their shelters and institutions, while using environmental resources to satisfy human needs. Depending on the carrying capacity of ecosystems, human settlements and their use of environmental resources will affect environmental conditions, as well as human well-being and health. The main statistics presented under this sub section include rural, urban and total population of Ethiopia.

Therefore, the three successive population and hosing censuses and the 2012 inter-censual survey results demonstrates that Ethiopian population size has been increased in steady increments of significant proportions. As indicated in Figure 41 below, during the first Ethiopian population and housing census (1984) the total population size of the country was more than 42.6 million. In the 1994 census the national population total was increased by 10.9 million and continued to increase tremendously in 2007 census and inter-censual survey, exciding 73.7 and about 82.6 million, respectively. Similarly, the average annual population growth rates were 3.1 in 1984, 2.9 in 1994 and 2.6 percents in the 2007 censuses (Table 68).

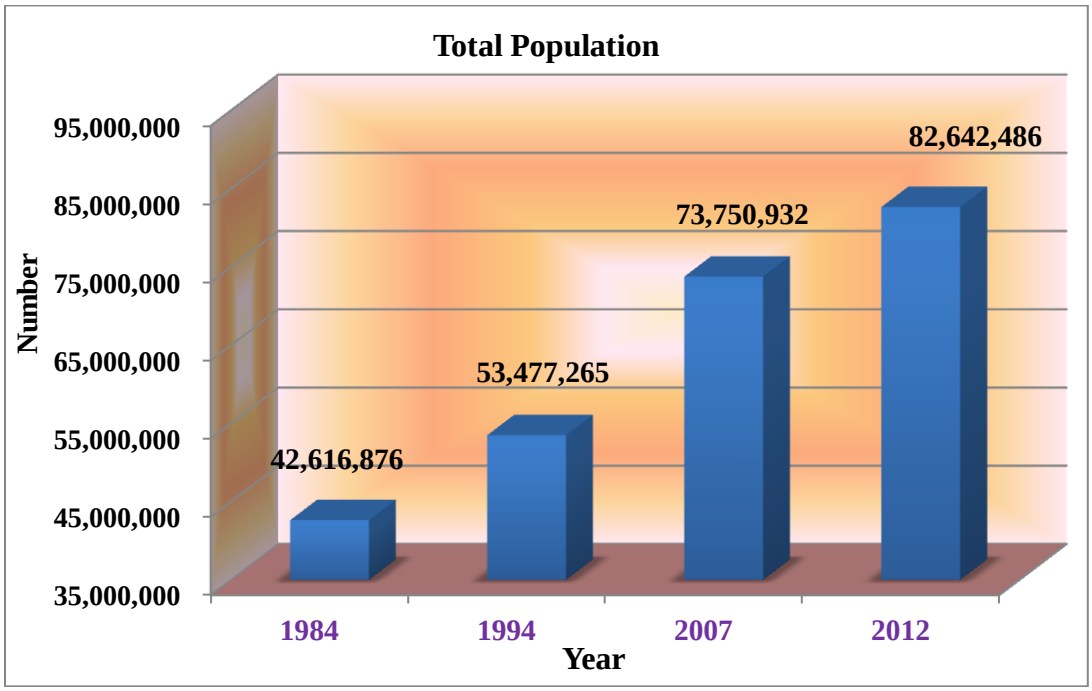


Figure 39 Total Populations of Ethiopia in the 1984, 1994 and 2007 Censuses and 2012 Inter-censual Survey.

** [1]Including Eritrea and Estimated Population in the 1984 Census*

Source: - CSA

Table 68 further indicate that the proportion of Ethiopian population living in rural areas much higher than in urban. In the 1984 census about 89.6 percent of the population was living in the rural area. However, it was decreased both in the 1994 and 2007 population and housing censuses.

Table 68: Basic Demographic Indicators of the Three Population and Housing Censuses held in 1984, 1994, and 2007

Indicator	1984 Census[1]	1994 Census[2]	2007 Census[3]
Population(millions)	42.6	53.5	73.8
Growth rate (%)	3.1	2.9	2.6
Density (population/km^2)	34.0	48.6	67.1
Urban population (%)	11.4	13.7	16.1
Life expectancy			
Male	51.1	50.9	60.2
Female	53.4	53.5	64.2

Na = Not applicable
[1] including Eritrea in the 1984 Census, CSA 1989
[2] CSA, 1998
[3] CSA, 2010

Source: - CSA, Censuses, 1984, 1994 and 2007

Table 69: Population by Sex and Age Group, 1984, 1994 and 2007 Census, Ethiopia.

Age Group	1984 Census			1994 Census			2007 Census			2012 Inter-censual Survey		
	Both Sex	Male	Female	Both Sexes	Male	Female	Both Sex	Male	Female	Both Sex	Male	Female
0 – 4	5,190,761	2,625,307	2,565,454	7,843,637	3,970,815	3,872,822	10,797,022	5,482,792	5,314,230	11,724,337	5,948,660	5,775,677
5 – 9	6,166,302	3,228,919	2,937,383	8,628,052	4,392,325	4,235,727	11,981,764	6,106,788	5,874,976	13,485,846	6,856,322	6,629,524
14-Oct	4,050,435	2,151,174	1,899,261	7,661,295	4,019,845	3,641,450	10,412,237	5,412,324	4,999,913	11,533,468	6,047,926	5,485,542
15-19	2,774,516	1,404,085	1,370,431	6,001,024	3,034,426	2,966,598	8,748,048	4,454,710	4,293,338	9,257,794	4,703,933	4,553,861
20-24	2,122,921	997,121	1,125,800	4,261,594	2,065,260	2,196,334	6,402,085	3,098,338	3,303,747	7,271,565	3,527,586	3,743,978
25-29	2,113,432	909,323	1,204,109	3,798,184	1,770,125	2,028,059	5,662,188	2,622,759	3,039,429	6,536,576	3,051,180	3,485,396
30-34	2,002,504	884,134	1,118,370	2,994,074	1,379,957	1,614,117	4,220,066	2,088,208	2,131,858	4,780,503	2,291,591	2,488,912
35-39	1,881,240	913,442	967,798	2,753,059	1,284,574	1,468,485	3,776,642	1,827,296	1,949,346	4,534,899	2,252,463	2,282,436
40-44	1,559,173	769,441	789,732	2,293,331	1,130,872	1,162,459	2,872,980	1,464,529	1,408,451	3,179,104	1,699,619	1,479,485
45-49	1,130,301	604,330	525,971	1,651,963	881,916	770,047	2,247,304	1,150,017	1,097,287	2,539,890	1,237,216	1,302,674
50-54	1,144,572	540,949	603,623	1,583,833	789,730	794,103	1,890,766	928,294	962,472	2,217,979	994,031	1,223,948
55-59	704,018	377,676	326,342	881,107	483,638	397,469	1,171,020	634,053	536,967	1,694,708	863,201	831,507
60-64	838,076	416,033	422,043	1,083,617	568,265	515,352	1,235,000	646,359	588,641	1,323,305	665,650	657,655
65-69	475,786	265,550	210,236	557,962	320,713	237,249	805,261	446,242	359,019	876,031	440,436	435,595
70-74	475,105	237,994	237,111	540,820	293,376	247,444	676,560	359,897	316,663	723,451	378,143	345,309
75+	652,809	355,990	296,819	598,705	348,009	250,696	851,989	494,524	357,465	963,032	515,411	447,621
country	34,500,972	17,298,536	17,202,436	53,132,257	26,733,846	26,398,411	73,750,932	37,217,130	36,533,802	82,642,486	41,473,368	41,169,118

Source:- CSA

****Age distribution for the 1984 data presented only areas covered by the census.***

Table 70 shows the total population projection which held by the Central Statistical Agency of Ethiopia from the year of 2014 to 2017. Based on this projection the total population of the country will rise to 94, 351 001 by 2017 from 87, 952991 in 2014. According to the estimation the size of Ethiopian population living in the urban areas will increase with a minimum of 19.1 million by 2017.

Table70: Population Projection Values from 2014 to 2017 by Urban and Rural Residence and Sex, CSA 2013.

Year	Country			Urban			Rural		
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
2014	44,204,988	43,748,003	87,952,991	8,301,000	8,374,000	16,675,000	35,904,000	35,374,000	71,278,000
2015	45,249,998	44,826,014	90,076,012	8,689,000	8,770,000	17,459,000	36,561,000	36,056,000	72,617,000
2016	46,302,002	45,904,003	92,206,005	9,083,000	9,173,000	18,256,000	37,219,000	36,731,000	73,950,000
2017	47,364,009	46,986,992	94,351,001	9,494,000	9,592,000	19,086,000	37,870,000	37,395,000	75,265,000
Total	183,120,997	181,465,012	364,586,009	35,567,000	35,909,000	71,476,000	147,554,000	145,556,000	293,110,000

Source: - CSA, Population Projection, 2013

7.3. Access to Selected Basic Services

Ensure access to safe water sources and sanitation for all is one of the Sustainable Development Goals that Ethiopia and other nations worldwide have adopted. Access to water, sanitation and hygiene is a human right, yet billions are still faced with daily challenges accessing even the most basic of services. Around 1.8 billion people globally use a source of drinking water that is focally contaminated. Some 2.4 billion people lack access to basic sanitation services, such as toilets or latrines (United Nations General Assembly, 2015). This sub section is, therefore, includes information about access to drinking water, sanitation and energy (Source of light and Cooking Fuel) in the urban and rural areas of the country.

Drinking Water

According to **2015/16** Ethiopian socio economic survey (**ESS)** about 28.6 percent of households have piped water public tap access facility which is followed by 16.9 and 11.9 percent of piped water into yard and protected spring respectively in rain seasons. Similarly 28.1 percent of

households have piped water public tap access facility which is followed by 16.1and 12.4 percent of piped water into yard and protected spring respectively in dry seasons (Figure 42).

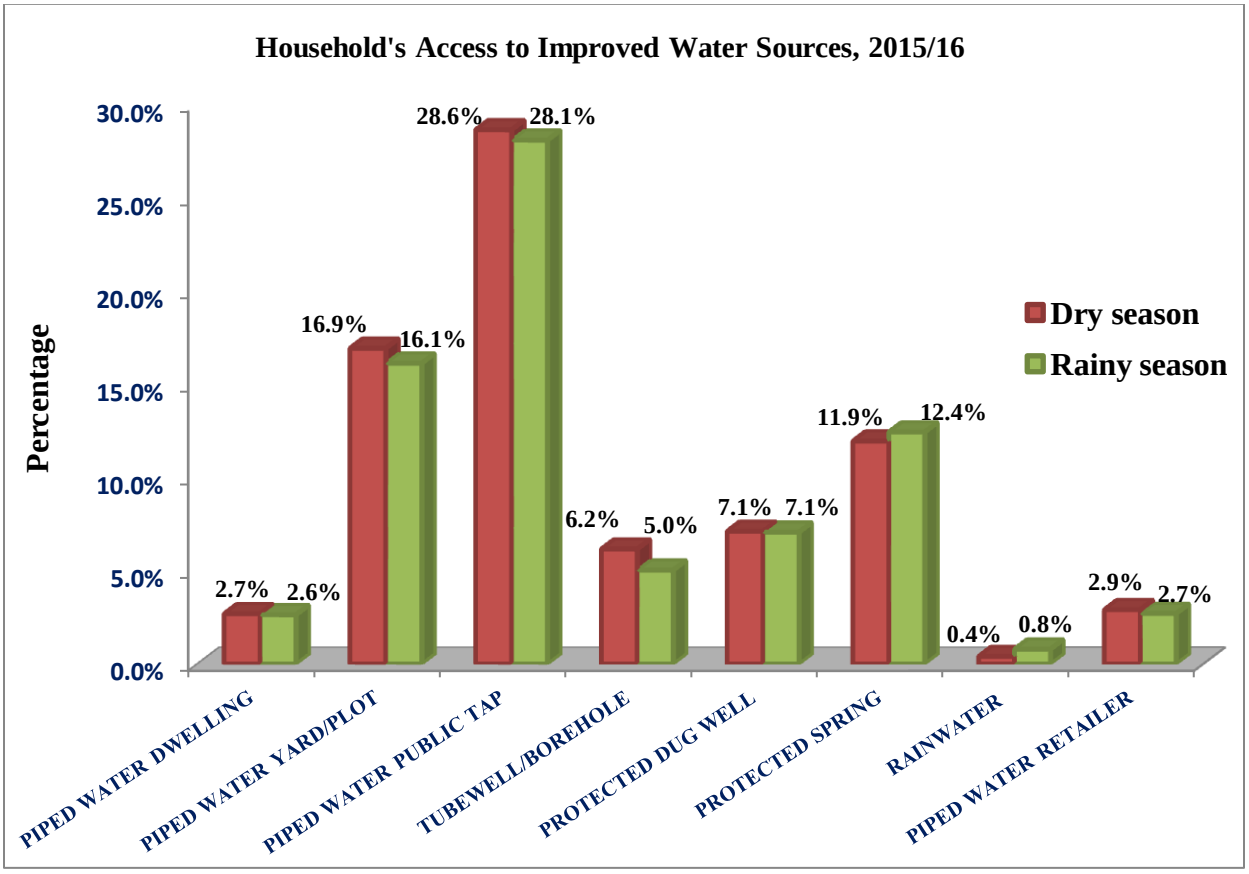


Figure 40: Percentage of Households Using Improved Water Source during 2015/16 ESS Period

Source: - CSA, Ethiopia Socio-Economic Survey, 2015/2016

Sanitation

At the household level, adequate sanitation facilities include an improved toilet and disposal that separates waste from human contact. A household is classified as having an improved toilet if it is used only by members of one household (that is, it is not shared) and if the facility used by the household separates the waste from human contact (WHO and UNICEF, 2010).

Table 71 shows the percentage of households with access the types of sanitation facilities. Nationally, about 53 percent of households have access to an improved sanitation facility. At the

regional levels 80.4 percent of households in Addis Ababa City Administration use improved toilet facilities followed by Benshagul-Gumu, and Harari, 75.4 percent and 65.8 percent, in that order.

Table 71 Percentage of Household with Access to Improved Sanitation by Region during 2015/16 ESS

Sanitation Facility	Region											Country
	Tigray	Afar	Amhara	Oromia	Somalie	Benshagul Gumuz	SNNP	Gambelia	Harari	Addis Ababa	Diredwa	
Flush toilet	12.80	1.60	2.60	1.70	2.60	0.00	1.80	0.50	0.10	29.20	11.50	4.00
Pit latrine, ventilated VIP	4.00	0.60	1.50	1.80	7.30	2.80	2.90	2.60	27.00	20.20	9.30	3.20
Pit latrine, with slab	23.10	36.80	41.50	50.80	17.60	72.60	49.80	44.70	38.70	31.00	44.50	44.70
Composting Toilet	1.40	0.00	0.20	0.80	0.00	0.00	1.80	0.50	0.00	0.00	0.00	0.80
Total improved	41.40	39.00	45.80	55.20	27.40	75.40	56.30	48.20	65.80	80.40	65.30	52.60
Pit latrine, without slab	9.30	1.90	15.90	18.60	7.40	16.30	37.90	25.30	11.20	12.90	16.80	20.20
Bucket	3.40	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.40	4.80	0.00	0.50
Field /forest	45.90	59.10	38.10	26.10	64.90	8.30	5.60	24.10	22.60	1.50	17.90	26.50
Others	0.00	0.00	0.20	0.00	0.20	0.00	0.20	2.40	0.00	0.40	0.00	0.10

Source: - CSA, Ethiopia Socio-Economic Survey, 2015/2016

Source of Light and Cooking Fuel

In Ethiopia, dry cell light with switch is one of the most important sources of lighting compared to other sources**.** Nationally, there were only about 14 percent and 16.8 percent of the households using Private and shared electricity for lighting.

Using environmentally friendly fuels can reduce air pollution, indoor air pollution and the impact on the health of the forest. The provision of wood energy is generally thought to be a major contributor to forest loss (FAO, 1998). In Ethiopia firewood remains the most important source of fuel for cooking. Overall, 61.5 percent of households use firewood as source of fuel for cooking (Figure 43).

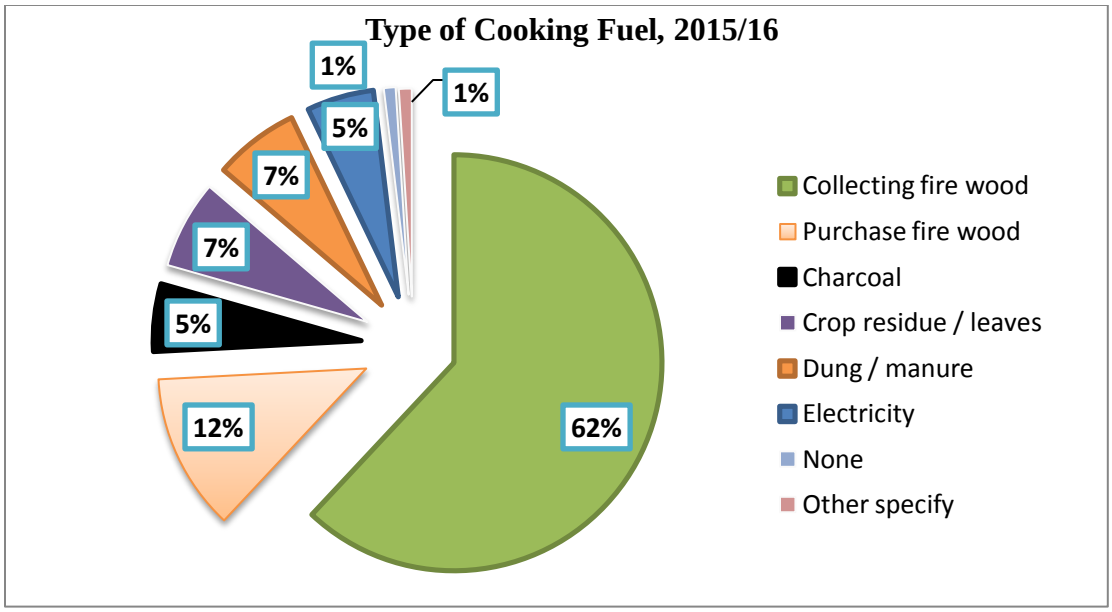


Figure 41 Percentage of Household Using Major Source of Cooking Fuel during 2015/16 ESS Period, Ethiopia

Source: - CSA, Ethiopia Socio-Economic Survey, 2015/2016

Gross Domestic Product (GDP)

Ethiopia is one of the fastest growing countries in the world. Over the last thirteen consecutive years (2003/04-2015/16), the country has registered rapid and sustainable growth. Accordingly, in this period the annual average growth rate of GDP was 10.6 percent. The agriculture, industry and service sectors' annual average growth was 8.3 percent, 14.7 percent and 11.7 percent respectively.

In the first and second growth and transformation plan implementation period (2010/11-2015/16), Ethiopia has registered robust economic growth. In this period, the annual average growth rate of the economy was 9.8 percent. Agriculture, industry and service sectors had 5.9 percent, 20.prcent, and 10.6 percent annual average growth rates respectively. The economic growth (GDP at constant basic price) for 2015/16 is estimated to be 8.0 percent. As per the estimates, annual growth rates of the major sectors such as agriculture, industry and service were 2.3 percent, 20.6 percent and 8.7 percent; respectively. In similar year, slight structural change of the economy has been observed. Thus, the shares of the major sectors, agriculture, industry and services out of the total GDP were about 36.7 percent, 16.7 percent and 47.3 percent, respectively (Table 72).

Table 72: Gross Domestic Product by Economic Activity at 2010/11 Constant Prices (000 birr)

Industry	Year					
	2010/11	2011/ 12	2012 /13	2013 /14	2014 /15	2015 /16
Agriculture, Hunting and Forestry	212,252,688	222,664,479	238,437,963	251,339,951	267,268,954	273,497,191
Crop	146,759,975	154,081,705	166,698,857	177,663,112	190,421,592	196,977,193
Animal Farming and Hunting	45,806,146	48,287,718	50,777,182	51,834,785	54,250,139	53,418,742
Forestry	19,686,567	20,295,055	20,961,923	21,842,054	22,597,223	23,101,257
Fishing	217,024	263,203	314,146	416,338	543,822	544,135
Mining and Quarrying	6,809,661	7,675,101	8,156,918	7,898,386	5,876,367	5,679,750
Manufacturing	18,968,032	21,207,108	24,798,229	28,923,921	34,194,623	40,483,083
Large and Medium Scale Manufacturing	12,323,846	14,283,814	17,740,910	21,566,212	26,558,610	32,652,616
Small Scale and Cottage Industries	6,644,186	6,923,294	7,057,320	7,357,708	7,636,013	7,830,467
Electricity and Water	4,902,440	5,566,123	6,124,207	6,538,159	6,831,926	7,857,756
Construction	19,100,365	25,107,973	34,831,637	43,146,685	56,772,610	70,968,538
Whole Sale and Retail Trade	70,907,534	79,785,451	87,831,413	103,350,213	116,095,327	125,658,385
Hotels and Restaurants	17,029,347	18,740,800	22,326,537	28,267,017	36,630,641	42,363,304
Transport and Communications	19,890,520	22,391,701	26,087,872	29,395,689	33,312,848	37,885,857
Financial Intermediation	11,927,707	14,744,398	12,944,182	14,793,331	15,896,088	17,425,770
Real Estate, Renting and Business Activities	44,064,394	45,749,910	47,529,014	49,383,899	51,432,465	53,318,350
Public Administration and Defense	25,735,826	26,529,002	28,554,424	31,701,100	33,613,164	36,094,338
Education	10,772,173	11,252,501	12,386,726	12,706,614	13,875,881	15,094,760
Health and Social Work	4,132,290	4,520,042	5,075,389	6,053,470	6,840,680	7,582,089
Other Community , Social & Personal Services	11,035,903	12,404,157	14,686,906	15,248,277	15,811,704	16,292,973
Private Households with Employed Persons	1,120,965	1,301,493	1,407,737	1,469,690	1,533,720	1,599,701
Total	478,866,870	519,903,443	571,493,300	630,632,739	696,530,820	752,345,981
Less : FISIM	3,219,328	2,876,907	3,060,967	3,655,355	4,309,091	5,036,755
GVA at Constant Basic Prices	475,647,542	517,026,536	568,432,333	626,977,384	692,221,729	747,309,226
Taxes on Products	39,431,000	42,595,029	50,409,895	55,381,125	61,008,007	62,878,024
GDP at Constant Market Prices	515,078,542	559,621,565	618,842,228	682,358,509	753,229,735	810,187,250

Source: National Planning Commission, 2015/16 report

7.4. Environmental Concerns Specific to Urban Settlements

A growing proportion of the world's population, currently more than half, lives in urban areas. This topic is intended to organize issues of specific relevance to this part of the population. Such issues may include, but are not limited to, the extent of urban sprawl, the availability of green spaces for urban residents and the prevailing types of transportation in and between urban areas and the existence and effectiveness of urban planning and zoning.

This sub section cover only transportation statistics that include the number of private, public and commercial vehicles by engine type, as well as the extent of roadway infrastructure. Moreover, it includes statistics on the number of passengers transported by public transportation systems and the number of passengers transported annually by hybrid modes of transportation. However, statistical data associated with those issues described above are not fully available in the country.

7.4.1. Transportation

Transportation is an essential part of human activity, and in many ways form the basis of all socio-economic interactions. Indeed, no two locations will interact effectively without a viable means of movement. Transport is important since it enables trade between peoples, which in turn establishes civilizations. Transport modes are the means by which people and freight achieve mobility. In today's world transport is one of the basic sectors which can play a leading role in economic and social integration of nations.

In Ethiopia, like most developing countries of the world, transport can be categorized as the biggest element of foreign debt. It also plays a key role in both the formation and degradation of national wealth. Increase in transport infrastructure and equipment can be assumed national wealth formation while on the other hand foreign exchange outlays in the form of interest and loan repayment constitutes the degradation of national wealth. It can also has negative economic, special, social, environmental impacts such as Air pollution, community displacement etc. The generation of externalities, positive and negative, by the provision of transport facilities and by their use is another argument put forward to support public supply of only selected infrastructure facilities.

Number of Private and Public Vehicles

Data and information on the number of private and public vehicles from 2014 to 2016 are presented in Table 73. Hence, during the year 2014 to 2016 over all dry cargo vehicles are the most common type vehicles in Ethiopia which is followed by Motor Cycle and passenger vehicles. In terms of the types of pleats, the highest number of vehicles was registered by the name of commercial, private and government pleats as compared to other types of pleats.

Table 73: Types of Pleat by Type of Vehicles, 2014-2016

Type of vehicles	Type of Pleat												
	Taxi	Private	Commercial	Government	Mass Org	Diplomatic	AID Org	OAU	UN	Well fair Org	Transferable	Polices	Total
Passenger vehicles	4481	8150	14169	2752	328	364	1012	63	332	781	101	101	32203
Dry Cargo Vehicles (Quintals)	5982	18090	28184	3599	379	407	1467	83	410	1514	276	218	60626
Liquid Cargo (liter)	2104	2796	5565	1262	91	1	9	0	51	192	6	7	12485
Dry trailer	2	6	5411	117	5	0	3	0	50	2	38	0	5635
Liquid Trailer	3423	6115	7112	1812	154	141	413	40	133	149	41	61	19594
Motor Cycle	7269	18146	19273	2536	253	225	926	57	253	1006	127	189	50260
Grand total	23261	53303	79714	12078	1210	1138	3830	243	1229	3644	589	576	180803

Source:- Ministry of Transport

Service Years of Vehicles

The other important aspect that needs to be considered in Transportation is service years of vehicles. Hence, data on service years of vehicles starting from ≤ 1 to ≥10 years of services by type of vehicles presented in Table 74. In Ethiopia, the largest number of Automobile gives the longest year of services i.e. ≥10 years as compared to the other types of vehicles followed by Dry Cargo (<=10 Quintals) and Bus (< 12 Seats) .

Table 74: Service Years of Vehicles by Type of Vehicles, 2014/ 2015

Type of Vehicles	Service Years of Vehicles								
	---1	1—2	2—3	3—4	4—5	5—7	7—9	>=10	Total
Automobile	538	934	990	051	1086	1135	1189	3827	10750
Bajaj	5	138	204	215	255	261	725	2	1805
Bus(< 12 Seats)	76	160	177	203	227	245	351	950	2389
Bus(> 12 Seats)	288	474	524	538	579	617	865	321	4206
Dry Cargo(<=10 Quintals)	101	179	284	327	380	418	624	994	3307
Dry Cargo(>10 Quintals)	464	797	932	939	970	1004	1098	536	6740
Dual Purpose Vehicle	594	1031	1114	1253	1278	1301	1439	398	8408
Field Vehicle	697	1065	1140	1183	1264	1290	1399	246	8284
Motor Bicycle	1128	1885	2173	2299	2322	2349	2423	86	14665
Other	115	177	219	227	238	245	282	157	1660
Trailer	197	245	328	332	341	348	372	121	2284
Tractor	28	44	45	48	48	50	55	7	325
Liquid Cargo	91	138	137	159	159	160	165	39	1048
Vehicle with Machinery	8	38	50	60	25	25	25	17	248
Total	4330	7305	8317	8834	9172	9448	11012	7701	66119

Source Ministry of Transport

Population Using Public Modes of Transportation

Public modes of transportation that presented in Table 75 are grouped into Road /vehicles transportation, Railway transportation and Air /plane transportation. At the national level using public mode of transportations has increased from year to year. Ethiopian population who used public mode of transport reached 879,757,123 by the year 2016 from 328,772,306 in 2014. Among the available mode of transport rail way has the highest role followed by road and air ways (Table 75).

Table 75: Population by Mode of Transportation, 2014-2016

Year	Mode of transport			
	Road /vehicles	Railway	Air /plane	Total
2016	412,300,000	432,000,000	35,457,123	879,757,123
2015	350,700,000	414,000,000	32,289,057	796,989,057
2014	298,600,000	-	30,172,305	328,772,306
Grand total	1,061,600,000	846,000,000	97,918,486	2,005,518,486

Source Ministry of Transport

Extent of Roadways

The country's total road networks are 110,414 Km in 2014/15. In year 2013/14 the total road network of the country was 99,522 Km. As compared to the year 2014/15, there is 10,892km additional road network constructed. URRAP road increases by great rate from year to year. But gravel and rural roads increases by small rate from year to year compared with other road listed in Figure 44. Because when gravel and rural roads are upgraded to asphalt, the annual growth rate them becomes small compared with other road networks.

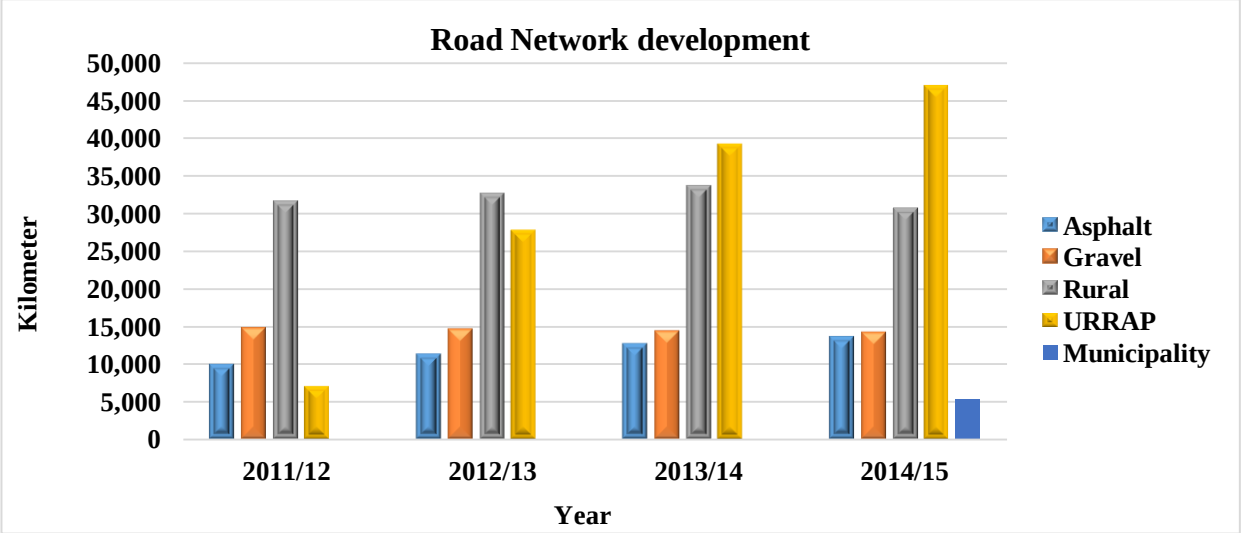


Figure 42: Road Network Developments in K/M, 2011/12 – 2014/15
Source Ministry of Transport

7.5. Environmental Health

The environment affects our health in a variety of ways. The interaction between human health and the environment has been widely studied and environmental risks have been verified to significantly impact on human health, either directly by exposing people to harmful agents or indirectly by disturbing life-sustaining ecosystems. In this publication, only Tuberculosis, Diarrhea and Malaria diseases presented.

When we see at the trend of patients of Tuberculosis disease (Figure:45), we can see that the number of patients has slightly decreases in the last six years. In addition to this the number of patients of Malaria was significantly decreased in the last three year periods. However, in the case of Diarrhea disease the number of patients was increased in the last six years except 2013/14 period.

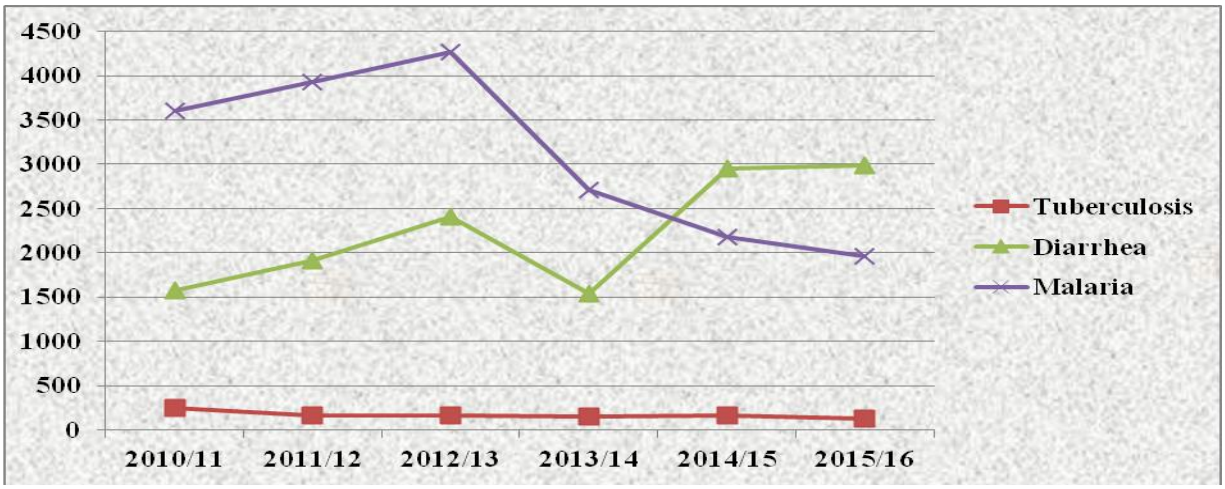


Figure 43: Number Patients with Tuberculosis, Diarrhea and Malaria 2010/11-2015/16
Source: Ministry of Health

Tuberculosis

Tuberculosis is among major public health problems throughout the world and its burden will remains enormous in Ethiopia. Cognizant of this, the Government of Ethiopia has given due attention to the control of TB and included the prevention and control of TB among the priority health programs in the country's HSTP. As result of widespread efforts, the total number of patients with Tuberculosis has decreased from 248,844 in 2010/11 to 131,223 by 2015/16. There was regional disparity in number of patients with Tuberculosis, the highest number was reported from Oromia Region (41504 patients), followed by Amhara Region (24962 patients) and SNNP Region (22535 patients) by the end of 2015/16 (Table 76).

Table 76: Number Patients with Tuberculosis by Regions 2010/11-2015/16

Regions	Year					
	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Tigray	16119	15890	44171	13485	11869	11253
Afar	1677	1502	1941	1845	1964	1743
Amahara	28975	58742	31475	21671	26260	24962
Oromiya	58880	45664	45393	72862	75718	41504
Somali	989	628	2704	2132	5696	5083
BenGumuz	1099	1231	623	783	840	1037
SNNPR	40405	28262	22581	21560	22989	22535
Gambella	83074	421	580	999	818	614
Harari	1155	1566	1738	1376	1124	1835
Addis Ababa	14354	8500	8294	6799	8556	18397
Dire Dawa	2117	2326	2445	1408	1715	2260
National	248844	164732	161945	144920	157549	131223

Source: Ministry of Health

Diarrhea

Generally the number of patients with Diarrhea at national level has increased to 1,916,886, 2,411,754, 2,945,540 and 2,989,783 in, 2011/12, 2012/13, 2014/15 and 2015/16 respectively, as compared to 1,574,716 patients recorded in 2010/11. However, the number of patients has decreased to 1534497 in 2013/14. Regarding to regional disparity, the highest number was reported from Oromia Region (788183 patients), followed by Amhara Region (788183 patients) and SNNP Region (420611 patients) by the end of 2015/16 (Table 77).

Table 77: Number Patients with Diarrhea by Regions 2010/11-2015/16

Regions	Year					
	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Tigray	87299	180881	518043	210082	218631	258184
Afar	19617	36539	49803	73205	93343	64017
Amahara	419330	558355	526804	503571	612437	788183
Oromiya	510473	440409	520306	112224	1230847	851923
Somali	9113	35061	79604	30466	17490	124733
BenGumuz	31683	50864	51646	59612	69848	79901
SNNPR	368472	457549	476503	337473	423505	420611
Gambella	11062	13477	15737	23777	12127	16369
Harari	7597	9870	11817	10827	14926	18034
Addis Ababa	92126	109162	123489	131299	210526	317946
Dire Dawa	17944	24719	38002	41961	41860	49882
National	1,574,716	1916886	2411754	1534497	2945540	2,989,783

Source: Ministry of Health

Malaria

Malaria transmission in Ethiopia mainly occurs up to the 2000 meter (m) elevation but can also occasionally affect areas up to 2300m elevation. The levels of malaria risk and transmission intensity within these geographical ranges, however, show marked seasonal, inter-annual and spatial variability because of large differences in climate (temperature, rainfall and relative humidity), topography (altitude, surface hydrology, land vegetation cover and land use, etc.) and

human settlement and population movement patterns. In most parts of the country, the peak periods of malaria incidence occurs from September to December, following the main rainy seasons (June-September), and from March to May, during and after the small rainy seasons (February-March).

Hence in the previous years, Ethiopia has planned and implemented different activities for malaria prevention and control focused on expanding vector control and strengthening malaria case detection and treatment. As result of widespread efforts, the total number of Malaria Patients has decreased from 3,601,044 in 2010/11 to 1,963,506 by 2015/16. In general, there was a decrease on the Number of Malaria Patients at national level. Regarding to regional distribution, the highest number of malaria Patients was reported from Amhara Region (610571), followed by SNNPR Region (356903 Patients), and Tigray Region (256580 Patients) by the end of 2015/16 (Table 78).

Table 78: Number of Malaria Patients by region, 2010/11-2015/16

Regions	Years					
	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Tigray	165828	402098	1014332	309414	300952	256580
Afar	42988	61165	84967	102937	119065	82138
Amhara	1030761	1115590	1131576	639117	610571	587329
Oromiya	999546	553454	502902	712726	431183	213344
Somali	3764	37337	43520	28016	67079	113660
BenGumuz	150591	195293	241923	237080	209674	250165
SNNPR	1166181	1519202	1166839	589789	375912	356903
Gambella	35454	41288	59219	69612	48800	78815
Harari	1478	2556	9296	11416	4267	10190
Addis Ababa	3352	3425	5709	5469	6270	12232
Dire Dawa	1101	1148	1855	1036	1596	2150
National	3601044	3932556	4262138	2706612	2175369	1963506

Source: Ministry of Health

8 ENVIRONMENT PROTECTION, MANAGEMENT AND ENGAGEMENT

8. ENVIRONMENT PROTECTION, MANAGEMENT AND ENGAGEMENT

8.1. Environmental Regulation and Instruments

Direct regulation

The following direct regulations are made effective in Ethiopia:

- The Environment Policy of Ethiopia, April 1997,
- Ethiopia's Growth and Transformation Plan (GTP),
- National Adaptation Programme of Action (NAPA) , 2007,
- Energy Policy
- Water Policy

The other environment and related policies and strategies that are put in place by the Ethiopian government include:-

- The Conservation Strategy of Ethiopia (April 1997) including 9 Regional States' Conservation Strategies,
- National Policy on Ethiopian Women (1993),
- The Health Policy (1993),
- The National Drug Policy (September 1994),
- The National Policy on Disaster Prevention and Management (1997),
- The National Policy on Biodiversity Conservation and Research (1998),
- The Ethiopian Water Resources Management Policy (1999),
- National Biodiversity Strategy and Action Plan (2005),
- Radiation Protection: Proclamation No 571/2008,
- Development, Conservation and Utilization of Wildlife: Proclamation No 541/2007,
- Ethiopian Wildlife Development and Conservation Authority Establishment Proclamation No 575/2008,
- Forest Development, Conservation and Utilization Policy (2007),
- Forest Development, Conservation and Utilization Proclamation No 542/2007,
- Environmental Impact Assessment Proclamation 299/2002,
- Pollution Control Proclamation 300/2002,
- Prevention of Industrial Pollution: Council of Ministers Regulation No 159/2008,
- Environmental Organs Establishment Proclamation,
- Guidelines on Technology Selection and Transfer,
- Guidelines on Enforcement and Compliance in Industrial Pollution,
- Guidelines on the Procurement of Environment Friendly Goods,
- Guidelines on Integrated Pollution Prevention and Control,

- Guidelines on Pollution Release and Transfer Registry,
- Guidelines on Industrial Waste Handling and land filling and Management,
- Guidelines for undertaking sector specific Environmental Impact Assessment on development projects in 21 sectors,
- National Adaptation Plan Of Ethiopia (E-NAPs) , 2017.

8.2. Participation in MEAs and Environmental Conventions

Ethiopia`s Contribution to International Climate Change Processes Climate change represents a significant threat to Ethiopia with drought-induced food, water and energy insecurity already being felt as recurrent problems. Some steps were taken or envisaged to implement the convention.

In terms of policy, unlike in the case of developed countries which are obliged to mitigate their greenhouse gas emissions, the practical responses expected from Ethiopia are to adapt and mitigate the impacts of climate change through the development of nationally appropriate policies and practical adaptation and mitigation measures, while lobbying for international solidarity, equity and climate justice. Accordingly, Ethiopia has ratified the UNFCCC (1994) and its related instrument, the Kyoto Protocol (2005), and submitted its initial national communication (in 2001) and National Adaptation Programme of Action (NAPA) (in 2007) to the UNFCCC. The country also submitted its Nationally Appropriate Mitigation Action (NAMA) plan to the UNFCCC in January 2010. The country has completed the preparation of a new work programme, Ethiopia's Program of Adaptation to Climate Change (EPACC) and had by 2011 launched an overarching framework and national strategy Called Climate Resilient Green Economy (CRGE) in addition to more detailed sectoral adaptation strategies produced as a result of the implementation of the CRGE.

Status of the Implementation of Ethiopia's obligations under the UNFCCC NMSA established Climate Change and Air Pollution Studies Team in 1994 under the Meteorological Research Studies Department to implement the UNFCCC in Ethiopia are mentioned below. In this regard the following major activities have been undertaken

- CRGE Strategy Implementation,
- Coordination of the CRGE Strategy Implementation

Institutions involved in the CRGE Strategy development and implementation include:-

- The Prime Minister's Office;
- Ministry of Environment, Forest and Climate Change (MEFCC);
- Ethiopian Development Research Institute;
- Ministry of Finance and Economic Cooperation (MOFEC);
- Ministry of Agriculture; Ministry of Water;
- Ministry of Water, Irrigation & Electricity;
- Ministry of Trade
- Ministry of Industry;
- Ministry of Transport;
- Ministry of Science & Technology;
- Ministry of Urban Development
- Ministry of Construction;
- National Regional States and City Administrations.

The Ministry of Environment, Forest and Climate Change (MEFCC) and the Ministry of Finance and Economic Cooperation (MoFEC) are the main entities coordinating the CRGE implementation. MEFCC's role includes putting in place the overall technical approach and system for coordination for CRGE implementation and the monitoring of progress. MEFCC is also responsible for managing the technical aspects of the CRGE Facility;

A national Financing Mechanism for CRGE Implementation

MOFEC's responsibility is to establish the CRGE Facility in collaboration with MEFCC. The Facility is functional fully equipped with an operational manual developed in consultation with the national stakeholders and, multilateral and bilateral partners.

The CRGE implementing entities include priority sectors; agriculture, energy, transport, industry and urban development and all regions. The sectors which immensely contributed to the development of the CRGE have also established CRGE units with the focus of ensuring effective mainstreaming the strategy at sector level. The sectors are also preparing their sector specific climate resilience strategies and are developing specific subsector CRGE investment and action plans.

8.3. Participation in MEAs and Other Global Environmental Conventions

Ethiopia has signed and/or ratified and made effective international conventions, protocols and some of the important MEAs are briefly discussed below:

- The United Nations Framework Convention on Climate Change (UNFCCC) (1994): The UNFCCC was signed by Ethiopia during the 1992 Rio Conference in Brazil and was ratified on 31 May 1994 and Proclamation 97/1994 was put in place to provide a legal basis for its implementation.
- .The Convention on Biological Diversity (1994): Ethiopia ratified the Convention on 31 May1994 through Proclamation 98/1994.
- The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa (known as the Desertification Convention – adopted in 1994): The Government of Ethiopia signed the Convention to Combat Desertification (CCD) in October 1994 and ratified it in June 1997.
- The Cartagena Protocol on Bio-safety to the Convention on Biological Diversity (known as the Bio-safety Protocol – adopted in 2000),
- The Stockholm Convention on Persistent Organic Pollutants (known as the Stockholm Convention– adopted in 2001

Table 79: Multilateral Environmental Agreements to which Ethiopia is party, (1977 - 2000)

Environmental Indicator: Governance												
Ethiopia's Participation in Selected International Multilateral Environmental Agreements												
Basel Conv.	**CITES**	**Conv. on Biological Diversity**	**Conv. on Migratory Species**	**Kyoto Protocol**	**Montreal Protocol**	**Ramsar Conv.**	**Rotterdam Conv.**	**Stockholm Conv.**	**UN Conv. on the Law of the Sea**	**UN Conv. to Combat Desertification**	**UN Framework Conv. on Climate Change**	**World Heritage Conv.**
Year												
2000	**1989**	**1994**	**2010**	**2005**	**1994**	**..**	**2003**	**2003**	**...**	**1997**	**1994**	**1977**

Source: Ministry of Environment, Forest & Climate Change

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