REMA
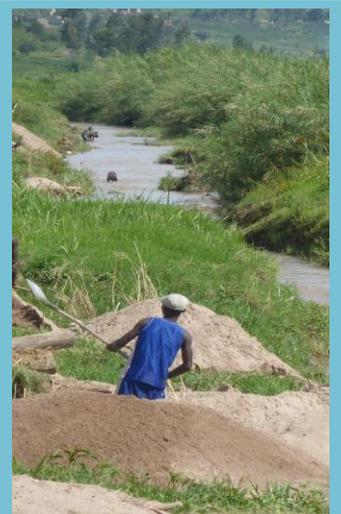OUR ENVIRONMENT OUR FUTURE

Rwanda Compendium of Environment Statistics, 2018

February 2019

Rwanda Environment Statistics Compendium

Final Report

February 2019

Acknowledgements

The development of Rwanda Environmental Statistics Compendium could not have been a successfully developed without contribution of several individuals and institutions. The Rwanda Environment Management Authority (REMA) wish to thank all individuals and institutions who, in one way or the other, played a role in helping complete this important task. Thanks are due to Government line ministries, Non-Governmental Organisations and Civil Society Organisations, to name few.

Executive Summary

This is the first edition of Rwanda Environmental Statistics Compendium 'publication produced by the Rwanda Environment Management Authority (REMA).

The report was compiled from data existing within Government Ministries, Authorities, Agencies, Non-Governmental Organizations and data produced by the National Institute of Statistics of Rwanda (NISR). The data presented in this publication was adapted from 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 and guideline for strengthening environment statistics in countries. 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, Environmental Protection, Management and Engagements.

This first compendium informs the environmental authorities on the existing statistics and gaps as per the FDES 2013 guidelines. Consequently, statistics documenting state and change of environmental conditions over time are necessary for policy makers to make informed decisions. It also helps to avoid shortage or restriction of use, to ensure availability for new and emerging applications, to determine immediate and short run actions needed and other risks, as well as to generally enable continued use over time. Data concerning the availability of environmental resources and their use are important to sustainably manage current and their future use by the human sub-system.

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Acronyms and Abbreviations

AEWA	: African-Eurasian Water Birds Agreement	
AMCEN	: African Ministerial Conference on the Environment	
ANP	: Akagera National Park	
APEFA	: Action pour la Protection de l'Environnement et la promotion des Filières Agricoles	
ARECO	: Association Rwandaise des Ecologistes	
BAIR	: Bureau d'Appui aux Initiatives Rurales	
BOD	: Biological Oxygen Demand	
BTC	: Belgian Technical Cooperation / Belgian Development Agency	
CBD	: Convention on Biodiversity	
CBOs	: Community Based Organizations	
CGIS-NUR	: Center for Geographic Information Systems and Remote Sensing-National University of Rwanda	
CMS	: Conservation of Migratory Species of Wild Animals	
CO₂	: Carbon Dioxide	
COD	: Chemical Oxygen Demand	
CoK	: City of Kigali	
COMIFAC	: Central African Forest Commission	
ECC	: Environment & Climate Change	
EDPRS	: Economic Development and Poverty Reduction Strategy	
EMP	: Environmental Management Plan	
FDES	: Framework for the Development of Environment Statistics	
FFS	: Farmer Field School	
FHA	: Forest of Hope Association	
FOB	: Free On Broad	
FONERWA	: Fonds National de l'Environnement au Rwanda	
FY	: Fiscal Year	
GEF	: Global Environment Facility	
GoR	: Government of Rwanda	

HHs	: Household	
IPM	: Integrated Pest Management	
ITCZ	: Inter- Tropical Convergence Zone	
KPI	: Key Performance Indicators	
LAFREC	: Landscape Approach to Forest Restoration and Conservation	
LDCF	: Least Developed Country Fund Project	
LEAP	: Long-range Energy Alternatives Planning	
MEA	: Multilateral environmental Agreements	
MIDIMAR	: Ministry of Disaster Management & Refugee Affairs	
MMI	: Modified Mercalli Intensity	
MINAGRI	: Ministry of Agriculture	
MININFRA	: Ministry of Infrastructure	
MINILAF	: Ministry of land and Forestry	
MINICOM	: Ministry of Trade	
MINALOC	: Ministry of Local Governance	
MINITERE	: Ministère des Terres, de l'Environnement, des Forêts, de l'Eau et des Mines	
MoE	: The Ministry of Environment	
MoH	: Ministry of Health	
NAEB	: National Agricultural Export Board	
NBI	: Nile Basin Initiative	
NGOs	: Non-Government Organization	
NISR	: National Institution of Statistics of Rwanda	
NNP	: Nyungwe National Park	
NOx	: Nitrogen Oxide	
NRI	: National Rainfall Index	
NST	: National Strategic Transformation	
NSS	: National Statistical System	
NTU	: Nephelometric Turbidity Units	
O$_3$	: Ozone	

ODS	: Ozone Depleting Substances
POPs	: Persistent Organic Pollutants
PRGP	: Poverty Reduction and Gender Promotion Organization
RAB	: Rwanda Agricultural Board
RCMRD	: Regional Centre for Mapping for Resources Development
REDO	: Rural Environment and Development Organization
REG	: Rwanda Energy Group
REMA	: Rwanda Environment Management Authority
RENGOF	: Rwanda Environmental NGOs Forum
RHA	: Rwanda Housing Authority
RNRA	: Rwanda Natural Resources Authority
RSB	: Rwanda Standards Board
RTDA	: Rwanda Transport Development Agency
RURA	: Rwanda Utilities Regulatory Authority
RWFA	: Rwanda Water & Forestry Authority
TSS	: Total Suspended Solid
SAICM	: Strategic Approach to International Chemicals Management
SDEI	: Sustainable Development Initiative
SICM	: Strengthening Institutional Capacity
SDGs	: Sustainable Development Goals
SO$_2$	: Sulphur dioxide
UNCDD	: United Nation Convention to combat Desertification
UNFCCC	: United Nations Framework Convention on Climate Change
UNSD	: United Nations Statistics Division
USD	: United State Dollars
VNP	: Volcanoes National Park
WASAC	: Water and Sanitation Company

List of Annexes

Chapter One: General introduction

1.1 Background

Data and information constitute a backbone for evidence-based decision making and for all national, regional and international policies. Though environment statistics is relatively a new statistical area, the demand for such statistics is increasing considerably in conjunction with continuing environmental degradation and the challenges associated with improved environmental management and sustainable development in the World. In Rwanda, the Rwanda Environment Management Authority (REMA) recognizes that lack of necessary environmental statistics, including those related to the national, regional and global development plans as well as multilateral environmental agreements restricts the ability of policy makers to make informed decisions. This recognition results in an increase of the demand for environment statistics which is fueled by the necessity to monitor national, regional and global development agendas like the Rwanda Vision 2050 which is split into medium run National Strategy for Transformation (NST), to support implementation of the African Union Agenda 2063, the East African Community Vision 2050 of which Rwanda is signatory and the 2030 Sustainable Development Goals (SDGs).

It is in this context that REMA developed the first Rwanda Environment Statistics Compendium with objective to provide statistical information about the environment of Rwanda, its most important changes over time across the country and their main influencing factors.

1.2 Objectives and Scope of the Environment Statistics Compendium

A. Objectives

The Environment Statistics Compendium seeks to provide high-quality statistical information to improve knowledge of the current environment profile so as to support evidence-based policy- and decision-making. It also provides clear and understandable environment statistics for the general public in the area of environment management.

In this regard, the environment statistics compendium covers in details statistical information about the state and changes of environmental conditions over time, the quality and availability of environmental resources in Rwanda, the impact of human activities and natural events on the environment and the impact of changing environmental conditions.

It also provides information about the social actions and economic measures that Rwanda opted to through environmental plan and strategies to mitigate negative impacts and to restore and/or maintain the capacity of the environment to provide the services that are essential for life and human well-being. Beside, this compendium assesses gaps in availability of environment statistics in Rwanda and provides corresponding recommendations for future consideration in the process of developing the National Statistical System (NSS).

B. Scope

Regarding the scope, this compendium of environment statistics covers biophysical aspects of the environment and socio-economic issues that have impacts on the environment. Targeted users of this compendium are expected to include but not limited to policy and decision makers at all levels, the general public, media and civil society, analysts, researchers and academia as well as international agencies.

The Compendium follows the structure of the Framework for the Development of Environment Statistics (FDES 2013) developed by the United Nations Statistics Division (UNSD) as a guidance tool for formulating environmental statistics programs, and structure to guide collection and compilation of data from various subject areas and sources, covering aspects of the environment that are relevant for analysis, policy and decision making. In this compendium, compiled environmental statistics are organized around six components and sub-components of the FDES 2013 framework.

Chapter Two: Methodology

Environment statistics synthesize data originating from a wide range of source types. This means that data used for the production of environment statistics are compiled by many different collection techniques.

i. Statistics surveys (e.g., censuses or sample surveys of population, housing, agriculture, enterprises, households, employment, and different aspects of environment management)

ii. Administrative records of government and non-government agencies.

The FDES describes the scope and components of environment statistics and harmonizes data with common standards.

FDES 2013 is, particularly, useful for guiding the formulation of environment statistics in this study mainly because 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.

2.1 Methods of Data and Information Collection

Most of information to be used in this initial edition of Rwanda Environment Statistics Compendium will be captured from review of secondary data, i.e. results of the surveys/thematic reports or censuses conducted by the National Institute of Statistics of Rwanda (NISR), and annual reports officially published by various institutions whose mandate relates to environment.

The first step to collect environmental data and information for this compendium strongly relies on listing the relevant institutions that can provide the required data.

2.2 Sources of Data and Information

It is commonly known that environment statistics' sources are scattered over a number of institutions, and similarly numerous methods are applied in their compilation.

Normally, environment statistics cover a wide range of information, namely:

- 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.

Data presented in this first Rwanda environment statistics compendium are mainly taken from official publications such as annual reports of institutions which relate to environment. Some of these partner institutions are not only considered as custodians of required information, but also substantive stakeholders in routine activities within the Environment & Climate Change (ECC) sub-sector. These are namely: The Ministry of Environment (MoE), Rwanda Water & Forestry Authority (RWFA), Meteo Rwanda, Ministry of Agriculture (MINAGRI), Ministry of Infrastructure (MININFRA), Ministry of Emergency Management, Ministry of Health (MoH), Ministry of land and Forestry (MINILAF), Ministry of Trade and Industry (MINICOM), Ministry of Local Governance (MINALOC) with the City of Kigali (CoK), Rwanda Housing Authority (RHA), Rwanda Energy Group (REG), Water and Sanitation Company (WASAC), Rwanda Utilities Regulatory Authority (RURA), Rwanda Agricultural Board (RAB) National Institute of Statistics of Rwanda (NISR) and Rwanda Standards Board (RSB) among others.

Though, the National Institute of Statistics of Rwanda (NISR) is the very agency with the mandate to produce the national statistics by coordinating the National Statistical System as a whole, Rwanda Environment Management Authority (REMA) is always committed to advocate for collection, processing, analyzing and disseminating of environmental information through

surveys, censuses and administrative recording systems, to ensure full awareness that no one and no generation should be left behind in the benefits of green growth & clean ecosystem services. It is also important to highlight that due to the cross-cutting nature of Environmental protection programs, Statistical data collection on environment required coordination among government agencies. Hence, REMA often has to liaise with NISR working as the agency responsible for coordinating the National Statistical Systems (NSS) in Rwanda, to ensure 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 aggregated 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 Environment & Climate Change (ECC) data in an integrated manner, and for analyzing the data needs of users in the field of environment. The ongoing efforts under REMA planning & research department, will lead to Key Performance Indicators (KPI) standardization and improved public awareness, to capitalize coordination among various private, government agencies & various development partners, in the development of national environmental statistics system.

However, due to data unavailability or data uncertainty, some sub-components of FDES 2013 do not contain any statistics, and are therefore not included in this compendium. Hence, to help a better capture of unavailable or uncertain data in future compendium, related recommendations will be formulated accordingly.

2.3 Key Concepts and Definitions

The concepts and definitions used in this compendium are taken from several sources, including National Institute of Statistics of Rwanda (NISR), The Ministry of Environment (MoE), Rwanda Water & Forestry Authority (RWFA), Meteo Rwanda, Rwanda Housing Authority (RHA), Rwanda Energy Group (REG), Water and Sanitation Company (WASAC), Rwanda Utilities Regulatory Authority (RURA), Rwanda Agricultural Board (RAB) and Rwanda Standards Board (RSB) among others. 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 mainly by either the FDES 2013 or official gazettes and laws establishing relevant institutions.

A. **Environment Statistics**: Environment statistics are environmental data that have been structured, synthesized and aggregated according to statistical methods, standards and procedures. The scope of environment statistics covers biophysical aspects of the environment and those aspects of the socioeconomic system that directly influence and interact with the environment.

B. **Natural Resources**: consists of naturally occurring assets such as biological resources, mineral and energy resources, soil resources and water resources that provide use and non-use benefits to humanity now or in the future (UN, 2014).

C. **Extreme event:** are events that are rare within their statistical reference distribution at a particular location. According to the Inter-governmental Panel for Climate Change (IPCC) glossary, an **extreme** weather **event** would normally be as rare as or rarer than the **10**th or **90**th **percentile** of a probability density function estimated from observations.

D. **Disasters**: are unforeseen and often sudden events that cause great damage, destruction and human suffering. They often exceed local response capacities and require external assistance at the national or international level. A disaster is often described as a result of exposure to an extreme event.

E. **Human settlement**: 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, and the exposure of humans to potentially deleterious environmental conditions.

F. **Residuals**: are flows of solid, liquid and gaseous materials, and energy, that are discarded, discharged or emitted by establishments and households through processes of production, consumption or accumulation.

2.4 Data Analysis

Through analytical processes with appropriate tools and Illustrator features for advanced data visualization, this compendium is presented in a way that even the non-statisticians can understand and contribute to the awareness of environment protection. Besides, statistical tables depicting environment data, suitable graphs and charts were used to make the publication more user friendly and comprehensive. Appropriate and current pictures related to Rwanda environment were taken and used in the compendium to informatively illustrate environment aspects as per FDES components structure.

2.5 Organization of the Rwanda Compendium of Environment Statistics

For this 2018 Edition, the content of Rwanda Compendium of Environment Statistics is essentially organized into eight chapters. After the general introduction to environment and methodology used for the compilation of the compendium chapters, the remaining six chapters comprise the six components of the environment statistics as described in the FDES 2013 (see the figure 1 below), and each of these individual component is further broken down into its respective sub-components.

Figure 1: Components of Environment Statistics in FDES 2013

Source: Adapted from United Nations Statistics Division (2018). "Environment Protection and Resource Management Expenditure". Manuel on the Basic Set of Environment Statistics of the FDES 2013. p. ii

Chapter Three: Environmental conditions and quality

3.1 Introduction

Environmental Conditions and Quality which is the FDES Component 1 largely determines the agricultural potential of a country. These environmental conditions (such as climate and weather, hydrological conditions, terrain, soil types and fertility levels) actually provide the basic ecological foundation for agriculture. However, Agricultural production uses environmental resources which is the FDES Component 2 such as land, soil resources, biological resources, water resources and energy resources. The figure 2 below shows the relationship between agriculture and environment.

Figure 2: The relationship between agriculture and environment
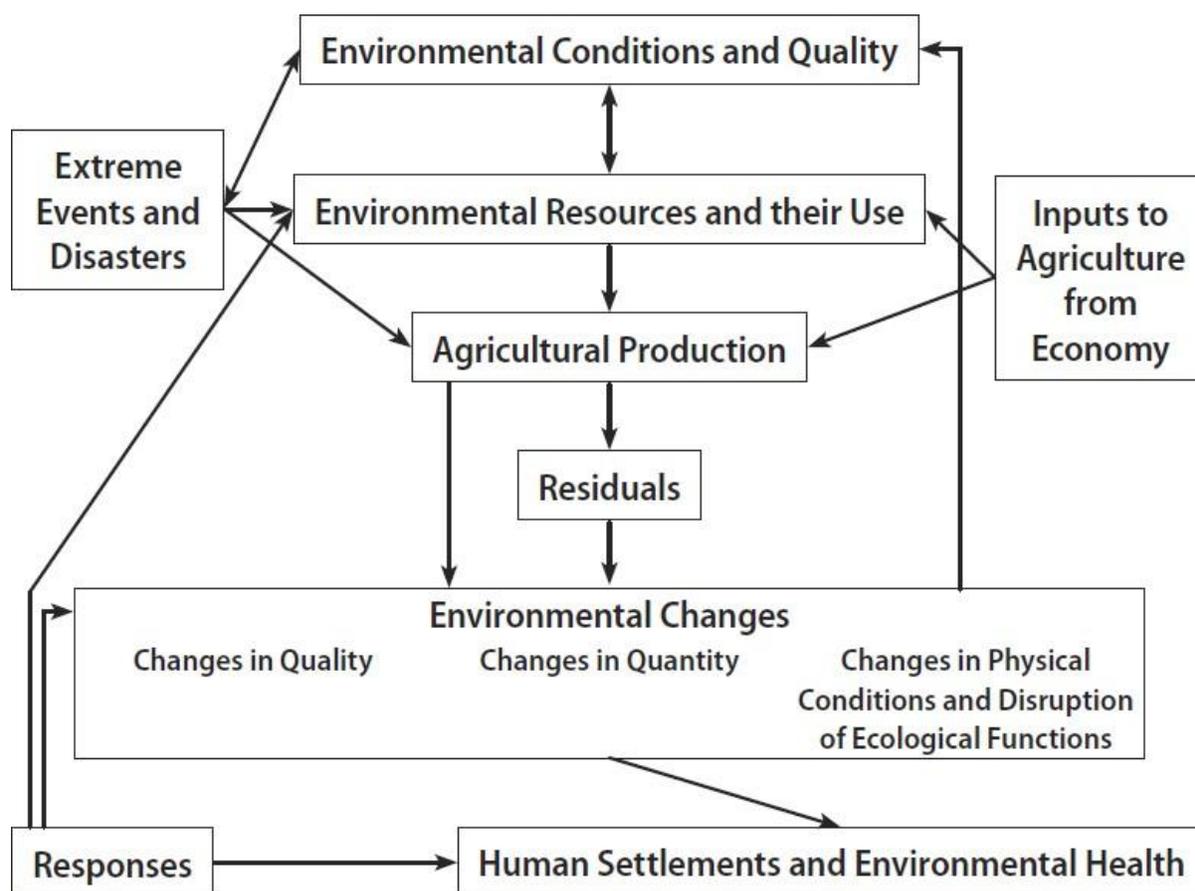
Source: United Nations, 2018

3.2 Physical Conditions

Climate change and variability have rapidly emerged as one of the most serious threats to sustainable development especially for developing African countries such as Rwanda (Republic of Rwanda, 2018). Extremes in temperature, precipitation and wind and other natural hazards impact every country and every sector of society. Rarely does a day go by without news of a weather-related disaster somewhere in the world or new information on the expected impacts of human-induced climate change.

Recently, Rwanda has experienced heavy floods caused by severe torrential rain that have damaged villages located in the mountainous northern part of the country killing people and destroying hundreds of homes. Rain- fall patterns, and beginning and end of rainfall season have been erratic with the consequence that cultivators were confused as to when to plant and harvest. There are some indications that Rwanda has been subject to climate change.

According to Safari (2012), observations from Meteo Rwanda have indicated that during the last 30 years minimum temperature has risen up to two degrees. The year 2005 was the hottest year for many years in Rwanda. Minimum temperature climbed to 20.4°C in August and maximum temperature climbed to 35°C in Kigali.

It is important to note that informed use of meteorological, hydrological, oceanographic and related information can deliver enormous benefits to society.

3.2.1 Weather variables

Weather variables are indicators that help understand the weather. The main variables describing the weather are temperature, precipitation, wind speed, radiation, humidity, clouds, pressure and predictability. For the case of Rwanda like many other countries located in the inter-tropical region, temperature and precipitation are the main descriptors of climate and weather.

Rwanda enjoys a tropical climate moderated by hilly topography stretching from east to west. The country is divided into four main climatic regions, namely, eastern plains, central plateau, highlands, and regions around Lake Kivu. The mean annual temperature oscillating between 20 °C and 22 °C. The central plateau region enjoys rainfall of between 1,100 mm and 1,300 mm,

received in 90 to 150 days, with an annual mean temperature of between 18 °C and 20 °C. The highlands, including the Congo-Nile Ridge and volcanic chains of Birunga, benefit from an annual rainfall of between 1,300 mm and 1,600 mm, received in 140 to 210 days, with annual mean temperature ranging between 10 °C and 18 °C. Regions around Lake Kivu and Bugarama plains get annual rainfall of between 1,200 mm and 1,500 mm, received in 150 to 210 days, and annual mean temperature oscillating between 18 °C and 22 °C (Ilunga et al., 2004; MINIRENA, 2010; Muhire and Ahmed, 2015 and 2016 cited by Republic of Rwanda, 2018).

A. Temperature

We commonly express temperatures in degrees Celsius (°C). Under normal circumstances, pure water freezes at 0°C and boils at 100°C at 0 meter above sea level. Maximum and minimum temperatures indicate the highest and lowest temperature respectively that occurred in a specific recording time period.

Temperature data can be shown as: Hourly temperatures, Daily minima and maxima, Daily averages, Weekly temperatures, Monthly temperatures, Yearly temperatures: all these can be indicated as maxima or minima, sometimes as averages.

Unless tough mitigation measures are taken in Rwanda as well as in many extensive areas of Africa are likely to see a mean annual temperature rise exceeding 2°C by the last two decades of this century, relative to the mean annual temperature rise during the late 20th century. It is also likely that land temperatures over the continent will rise faster than the global land average, particularly in more arid regions.

Table 1: Annual trend in average maximum and minimum temperature (^{o}C)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Minimum	15	14	14	14	14	14	14	14	14	14	15.3	15.4
Maximum	25	25	25	25	26	26	25	25	25	25	25	26

Source: Adapted from Meteo Rwanda, 2018

Figure 3: Annual mean temperature at Kigali (°C) from 1970 to 2015
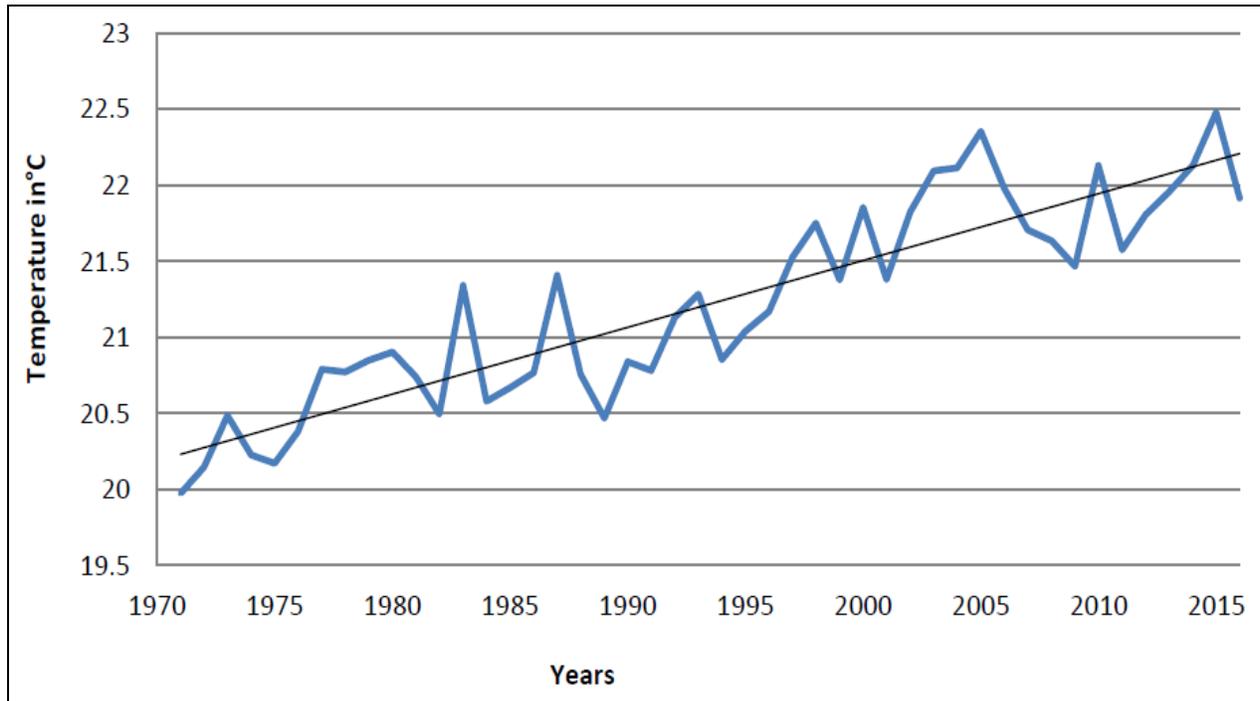
Source: REMA, 2018, p.10

There has been an increased general warming over Africa's land regions in the last 50 to 100 years, as is consistent with human-induced climate change (IPCC, 2014b). In Rwanda, if we consider Kigali site, the average temperature increased by 1.4°C since 1970, higher than the global average, and unless measures are taken for mitigation efforts; by the 2050s, it is likely to rise by up to 2.5°C from the 1970 average. This implies that the increase expected is from 0.75 to 3.25°C during the shorter dry season (December to February) and from 1 to 3.25°C during the longer dry season (June- August). There is also high probability that the number of days with extreme temperature will continue to increase by 2050 while the days with extreme rainfall will be relatively stable (REMA, 2018).

B. Precipitation

Precipitation is the deposition of water to the Earth's surface, in the form of rain, snow, ice or hail. All precipitation quantities are expressed in millimeters (mm). By simulation, one

millimeter of rain corresponds to 1 liter per square meter of water on the surface, or approximately 10 millimeters of snow.

Precipitation is measured in quantity for a certain time interval. In Rwanda, precipitation is measured using 3 methods:

- Local weather stations: with pluviometer ("rain gauges").
- Tele-detection: using reflection of radar, the distribution of precipitation in the atmosphere is calculated.
- Local indirect observation: using bowls, surface cavities, surface runoff or flood gauges.

Figure 4: Annual rainfall and Mean per Kigali site (From 1960 to 2016)
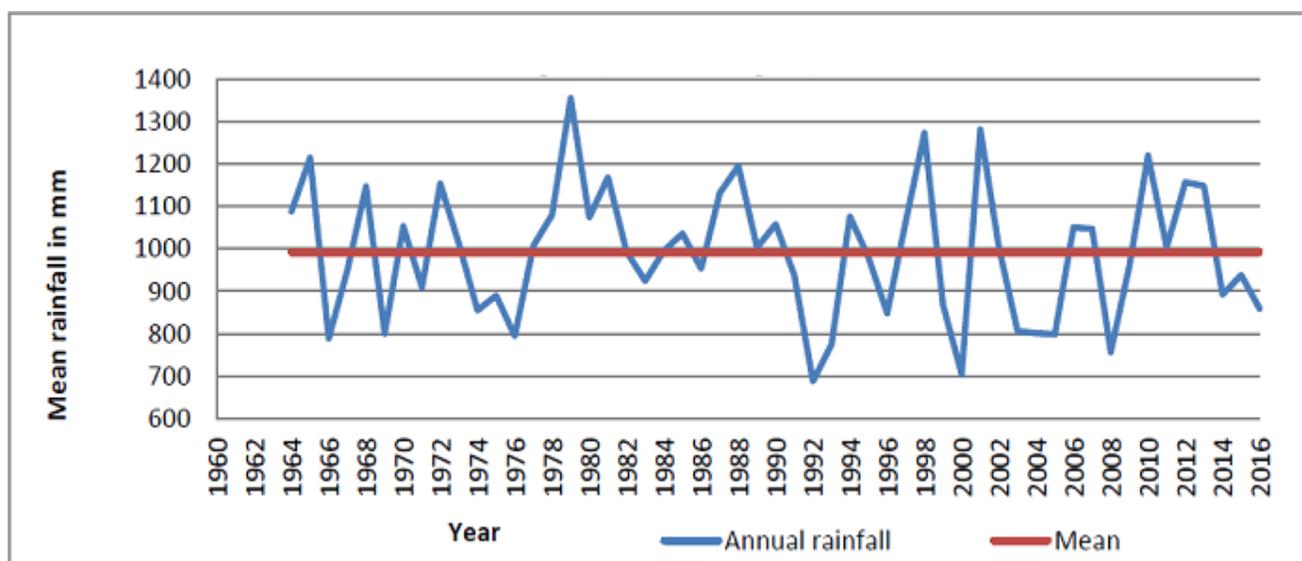
Source: REMA, 2018, p. 10

According to the third national communication report, the annual rainfalls in Rwanda exhibited very high fluctuations since 1961 to 2016. The mean rainfall dominantly decreased in January, February, May and June with a dominant increasing trend in the remaining months of the year across the country. Arise in rainfall was observed in northern region from 1960, reaching the apex in 1982 while the period of 2000-2009 was the driest with more fluctuations in mean rainfall for 2009-2016 (REMA, 2018).

According to the same report, a dry period was observed from 1998 to 2005 while 2008-2014 was the wettest period in the western region along with volcanic region. Contrary to eastern region which

experienced the dry and wet years for 1992- 2008 and 1978-1990 respectively. This shows that the eastern region has faced frequently the dry episodes. Furthermore the period of 1978-1992 was the wettest while 1998-2010 was the driest in the central plateau region. The period of 1961-1991 was wetter than 1991-2016 across the country.

Examples of the triple bottom line benefits of met/hydro services (Lazo et al. (2009))

1. Social

- Avoidance of loss of life and/or injuries/illnesses from natural disasters
- Safety and security of the travelling public
- Improved information and data to the scientific community
- Contribution to the day-to-day safety, comfort, enjoyment and general convenience of citizens, including (recreation, travel, home improvement, decisions, event management)
- Avoided climate-related illnesses (for example, heat-related illnesses, vector-borne diseases that are worsened by climate such as malaria).

2. Environmental

- Long-term monitoring of basic indicators of the state of the environment
- Minimization of release of toxic substances and other pollutants
- Management of local environmental quality
- Support for addressing major global environmental issues
- Water savings
- Reduced runoff from fertilizer application, resulting in improved water quality

3. Economic

- Avoidance of crop losses from frost, hail or drought
- Increased farm production and sales
- More efficient scheduling of the use of agricultural machinery
- Reduced transportation fuel consumption through route planning
- Improved scheduling of flight arrivals and departures
- Minimization of airline costs from aircraft diversions
- Minimization of search and rescue costs
- Minimization of drought-relief costs

- Efficient scheduling of ship loading facilities

- Avoidance of unnecessary shutdown of offshore oil and gas operations

- Avoidance of weather damage to personal property

- More efficient planning of energy production and delivery

3.2.2 Land Cover, Ecosystems and Biodiversity

According to the Fifth National Report to the Convention on Biological Diversity (REMA, 2014), Rwanda is rich in biodiversity which is mainly conserved in protected areas (national parks, natural forests, wetlands). The Natural Capital Account Report (2017) suggests that over 74% of national territory is used for agriculture (including cultivated lands, cultivated marshlands, pasture and fallow, agro-forestry, woodlots and others) (REMA, 2017).

Climate change threatens agro-biodiversity, as many plants, animals and microorganisms are unable to adapt to changing temperatures and moistures gradients caused by global warming (REMA, 2014).

The country's location at the heart of the Albertine Rift eco-region in the western arm of the Africa's Rift Valley, makes it home to 40 per cent of the continent's mammal species (402 species). There is a huge diversity of birds (1,061 species), reptiles and amphibians (293) species, and higher plants (5,793 species). Rwanda is also recognized as a biodiversity hotspot, hosting more endemic mammals, birds, butterflies, fish and amphibians than anywhere else in Africa.

According to Rwanda state of environment and outlook report (2009), there are 151 different types of mammalian species, 11 of which are currently threatened and none of which is endemic. Among these are the primates (14 to 16), with a half of the remaining world population of mountain gorillas (Gorilla Berengei) – an attraction for tourists – found in the Volcanoes National Park. Others include the owl faced monkey (Cercopithecus hamlyni), the mountain monkey (Cercopithecus l'hoestii) in Nyungwe, the Chimpanzee (Pan troglodytes) in Nyungwe and Gishwati, and the Golden monkey (Cercopithecus mitis kandti) found in Volcanoes National Park.

Rwanda also shelters 15 species of antelopes, and has a wide diversity of wild species such as

buffaloes, zebras, warthogs, baboons, elephants, hippopotamuses, crocodiles, tortoises and rare species such as the giant pangolin (Chemonics International Inc. 2003 cited by REMA, 2015).

Biodiversity outside protected areas continues to be vulnerable to erosion. Although actions by REMA and partners succeed in reducing water pollution by industrialists and developers of wetlands, the recovery of aquatic biodiversity is negligible. And as the country becomes more open to biotechnology and opens up to regional and international cooperation on developing biotechnology, there is initial vulnerability to the erosion of genetic resources due to the clandestine actions of gene hunters who pose as tourists in Rwanda.

However, in the interest of reaping the financial benefits associated with the Convention on Biological Diversity, Rwanda builds national capacity to develop and implement national and regional projects supported by the Global Environment Facility (GEF).

A. Forests and protected areas

According to the third national communication report, over the last half a century, Rwanda lost more than half of its natural forest estate to deforestation, as population growth increased and the area under agriculture expanded. Due to this reason, the Government of Rwanda has embarked on a number of programmes to restore the forest estate through national interventions and private sector initiatives in carbon marketing. As target, Rwanda forestry policy is expected to facilitate achievement of targets set respectively in EDPRS and the Vision 2020 in terms of increased forest cover. In this context, national forest cover will be brought to 30% of total area equivalent to 790,140 ha of forests in year 2020 (REMA, 2018)

According to the 2012 forest cover mapping, forest covered an area of 673,516.80 ha equivalent to 28.28% of the total land area. Differentiation of forests into categories shows that the total forest area comprised 18% natural forests (123,538 ha), 39% shrub-lands (260,569 ha) and 43% (286,811 ha) forest plantations. Of this total plantation forests, the majority (256,065 ha) is Eucalyptus forests while a variety of other species exists either in monocultures or in mixed forests (MINILAF, 2017, p. 6-7).

Rwanda forests and woodlands fall into four categories: the natural forests of the Congo Nile Ridge comprised with Nyungwe National Park (NNP), Gishwati-Mukura national park; the natural forests of the Volcanoes National Park (VNP); the natural forests in savannah and

gallery-forest of the Akagera National Park (ANP) and remnants of gallery forests and savannahs of Bugesera, Gisaka and Umutara; and forest plantations dominated by exotic species including Eucalyptus spp., Pinus spp. and Grevillea Robusta and trees scattered on farmlands (agroforestry) and along anti-erosion ditches (REMA, 2016).

B. Forest area within Rwanda protected areas (km²)

Normally forest protected areas play important landscape roles by providing habitat, shelter, food and genetic materials, acting as buffers against disasters, and delivering stable supplies of many goods and environmental services. In Rwanda, they keep helping species adapt to climate change.

Despite some factors of deforestation which were mostly related to demographic and human settlement pressure, Rwanda has managed to keep long term stability in terms of green canopy within national protected areas.

The main threat to forests is the rapid increase in population, which is leading to forest encroachment and deforestation for settlement, agriculture and grazing land. The other threats include illegal logging, charcoal production, and bushfires. According to the state of environment report (2009, p.6), mainly deforestation in Rwanda was a result of the major threats including illegal tree cutting (78.3 per cent), charcoal making (4.9 per cent), livestock grazing (2.5 per cent), farming activities (1.9 per cent), bushfires (1.9 per cent), stem debarking (0.6 per cent), mining (0.5 per cent) and beekeeping (0.4 per cent) (MINITERE- ISAR, 2007).

Table 2: Forest area by forest type

Forest management status	Forest name/ Province	Forest area (ha)	Vegetation Characteristics
National parks	Nyungwe NP	111,561	Montane tropical rainforest
	Volcanoes NP	16,000	Montane tropical rainforest
	Akagera NP	113,160	Shrub land/Savannah
	Gishwati-Mukura NP	4,520	Montane tropical rainforest
Forest reserves (107)	e.g. Busaga, Buhanga, Sanza, Iwawa, Rubirizi, Makera, etc.	37,886	Montane tropical rainforest/ shrubland /savannah woodlands
Unprotected shrub land/savannah & woodlands	Public and Private lands	116,210	Mostly arid species, e.g. Acacia, combretum spp.
Public and Private Plantation forests	West Province	74,905	Mainly Eucalyptus spp., Pinus
	South Province	109,765	sp., Grevillea robusta, Acacia
	East Province	35,986	melanoxylon and Callitris
	North Province	54,813	
	Kigali city	11,340	
	Country (National)	**286,809**	

Source: *DFS et al., 2016 (National Forest Inventory, 2015); Department of Forestry and Nature Conservation (2016), Nyirambangutse et al. (2017) (Nyungwe studies)* cited by REMA, 2018.

Forests provide ecosystem services and products such as protection of water catchments, regulation of water flow, influencing climate, protection against soil erosion, water purification, food, wood for fuel and construction, tourism, non-timber forest products including medicine plants, honey and handcrafts. The role of forests in preserving ecological balance is particularly important in Rwanda.

3.3 *Water resources*

In Rwanda, the water resource consists of fresh water systems of the country's lakes, rivers, marshlands and ground water, all supplied by rainfall. The lakes in Rwanda cover more area than the rivers. The hydrological system is divided into two river basins, the Congo and Nile river basins; the latter contributing approximately 90 per cent of the total national surface water stock.

According to Rwanda water resources management sub-sector strategic plan (2011-2015), surface water bodies in Rwanda occupy a total of 135,000 ha or 8% of the country's surface area (RADA, 2005).

These include 101 lakes (1,495 km2), 861 rivers totaling 6,462 km (REMA, 2010) and a network of disconnected wetlands. At least 3 of the largest lakes are shared - Lake Kivu (shared with DRC), Lake Cyohoha south and Lake Rweru (shared with Burundi). The in-land lakes are sustained by inflows from the dense network of rivers, streams and wetlands (MINERENA, 2011). The major perennial and voluminous rivers include Nyabarongo, Mukungwa, Muvumba, Akanyaru, Akagera, Ruvubu, and Base, all of which are in the Nile Basin. Some of these offer potential sites for hydro-electric power development. The Rusumo falls on the Akagera River is site for the upcoming largest hydro-electric power station. Although Rwanda possesses abundant water resources, the distribution of drinkable water is still inadequate and the rate of access in the country is estimated at 54 per cent, but does not exceed 44 per cent in rural areas (NISR, 2013).

According to the third national communication on climate change (2018), Wetlands of Rwanda are composed of marshlands, lakes, rivers and streams and represent about 14,9% of the national territory of which 6,3% are marshlands and 8,6% are lakes, streams that are permanent or seasonal.

Wetland classification indicates that the total wetlands cover 276,477 ha where 74% of total wetlands are conditional exploitation, 6% are unconditional exploitation and 20% of the total wetlands are fully protected. They are dominated by papyruses especially in Kamiranzovu, Gishoma, Rugezi marshlands and around lakes such as Muhazi, Burera and Ruhondo. Surface water bodies in Rwanda is provided by 101 lakes (1,495 km^2), 861 rivers totaling 6,462 km and a network of disconnected wetlands (REMA, 2010).

Table 3: Major river systems and corresponding basin extent

	River system	Surface Area (km^2)	Average Rainfall (mm)	Location
1	Nyabarongo Upstream	2,700	1,500	Northern highlands
2	Nyabarongo plateau	4,450	1,200	Downstream Central and south-Eastern plains
3	Rusizi	650	1,300	South- Western parts draining into L. Kivu
4	Sebeya	300	1,400	North-western parts draining into L. Kivu
5	Mukungwa	1,500	1,300	Northern parts
6	Akanyaru Upstream	2,650	1,200	
7	AKagera Upstream	5,000	900	
8	Akagera Downstream	4,550	800	
9	Muvumba	1,450	1,000	North Eastern part; drains into Akagera river and the

				Akagera Protected Area lakes
10	Mulindi	200	1,100	Northern Province

Source: UNEP (2009) cited by MINIRENA, 2011

At least 3 of the largest lakes are shared - Lake Kivu (shared with DRC), Lake Cyohoha south and Lake Rweru (shared with Burundi). The in-land lakes are sustained by inflows from the dense network of rivers, streams and wetlands (MINIRENA, 2011).

Table 3: National Potentials and status of water resources

No	Items	Status	Potentials
**2012**			
1	Surface Water	101 lakes covering an area of 149.48 ha,	7-6 Billion m^3
		861 rivers of a total length of 6,462 km.	
2	Ground Water	-	5-4.5 Billion m^3/year
3	Rainfall Water	-	28-25 Billions m^3/year
4	Water yield/person	-	1,135 - 193 m3/person/year
5	Water storage/person	-	7-5 m3/person
**2013**			
1	Surface Water	101 lakes covering an area of 149.48 ha	6.826 billions of m^3
		861 rivers of a total length of 6,462 km	
2	Ground Water	-	4.554 billion m^3
3	Rainfall Water	-	27.505 billions m^3
4	Water yield/person	-	670 m^3/year/person
5	Water storage/person	-	447m^3/year/person
**2014**			
1	Surface Water	101 lakes covering an area of 149.48 ha	6.826 billions of m^3
		861 rivers of a total length of 6,462 km	
2	Ground Water	-	4.554 billions m^3
3	Rainfall Water	-	27.505 billions m^3
4	Water yield/person	-	670 m^3/ year/ person
5	Water storage/person	-	447m^3/year/person
**2015**			
No	**Items**	**Status**	**Potentials**

1	Rainfall	27.5 Billions on cubic meter (BCM)/annum	
2	Ground water recharge	4.5 BCM/annum	
3	Total renewable water	6.8 BCM/annum	
4	Renewable water availability per capita	670 m3/annum	
5	Artificial water storage	2.5 m3	

Source: NISR, 2018, p.69

Figure 5: Status of water resources
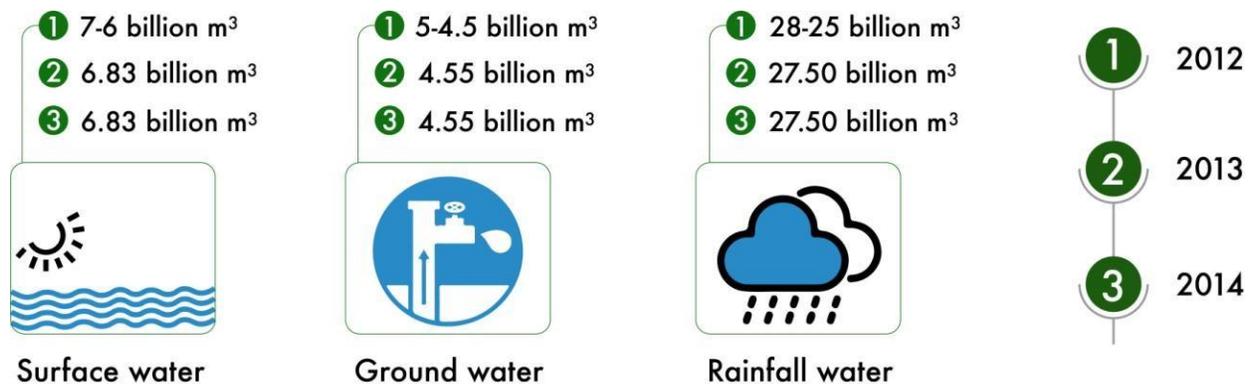
3.4 Water quality monitoring in Rwanda

According to MINERENA (2015), population growth has increased pressure on land and forests for agriculture and settlements, resulting in land degradation, siltation of water bodies and reduced water quality.

According to RWFA (2017), since late 2016, freshwater quality is being monitored alongside Muhazi lake and at Ntaruka river, Kanyonyomba, Bwanya, Nyabugogo bridge, Yanze bridge and Nemba. For instance water quality from River Nyabugogo downstream of Muhazi Lake revealed to be characterized as follows:

- High loads of e. coli and coliform bacteria (and others not measured) from untreated sewage;
- High organic loads and high biological oxygen demands (BOD) and chemical oxygen demands and resulting low concentrations of oxygen (mg/L);
- High sediment loads and turbidity from agriculture and mining activities.

An extensive monthly water quality monitoring study was conducted from October 2008 to May 2009 and covered nutrients, organic and heavy metal pollutants (Nhapi et al. 2012). Its summary

results were presented as per figure 6 below.

Concentrations of Cadmium, Iron and Lead have been sampled at a series of sampling points along Lake Muhazi and found to exceed the recommended levels for aquatic life (Nhapi et al., 2012). These high levels of heavy metals are attributed to riparian land use practices such as agriculture, urban runoff, and mining activities around the lake.

Figure 6: Water quality measurements in Nyabugogo catchment
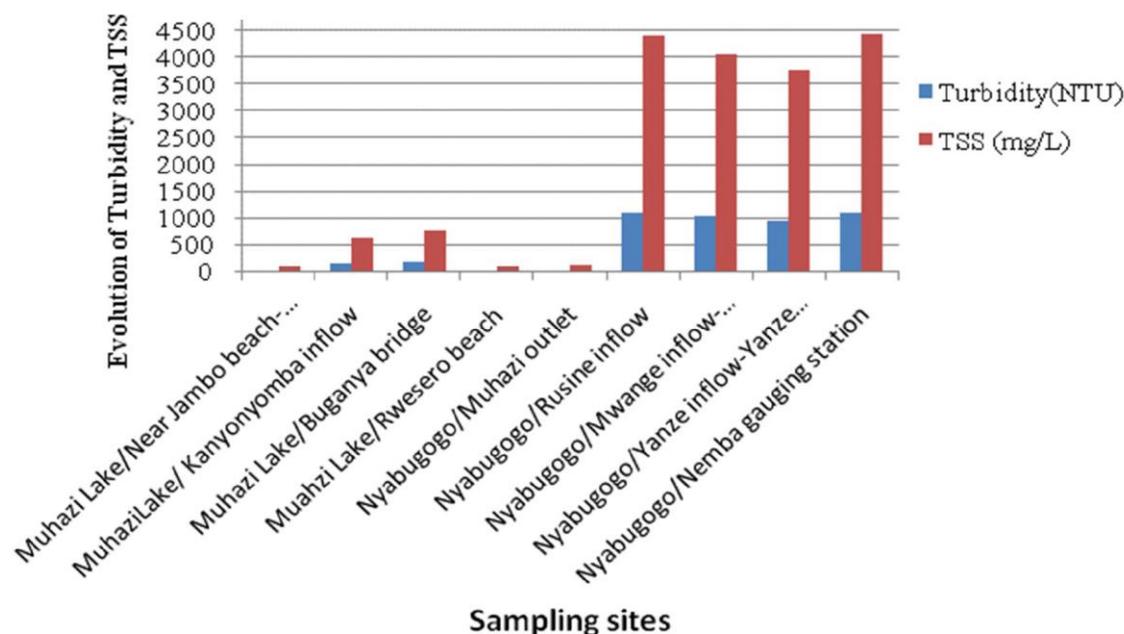
Source: RWFA, (2017), p.22

According to Nhapi et al. (2012), the major sources of the pollution for the Nyabugogo River are:

1. Rusine River (mining activities); highest in Turbidity, PO_4-P, and COD;

2. Ruganwa River; highest EC and TDS values. The Ruganwa River collects a lot of water from the City of Kigali, especially the Kicukiro, Remera, Kiyovu, Kimihurura, Muhima areas, and also receives waste from the former industrial area of Kigali. We are expecting that the reduction of the effect of that area after the shift of all industries out of Kigali.

3. Nyabugogo T3; lowesr DO and highest NH_4-N values. The Nyacyonga Flower farm could be having an influence through this warrants further investigation;

4. Nyabarongo 2; highest in Fe, Mn and Zn values, A water treatment plant is discharging sludge from iron/manganese removal process.

As far as the main use of water is either the human consumption or irrigation, annexes 13 & 14, show the

chemical requirements for water intended for human consumption and maximum concentration of trace elements in irrigation water. As highlighted in these annexes of standards, hydrated lime should be of a purity of not less than 80% available calcium hydroxide. Hydrated lime is typically 80%-95% Ca $(OH)_2$, and hydrated lime for matter treatment should not contain inorganic contaminants in excess of limits. The water insoluble matter should not exceed 2%.

3.5 Soil characteristics

Rwandan soils are naturally fragile. They are generated by physico-chemical alteration of basic schistose, quartzite, gneissic, granite and volcanic rocks that make up the superficial geology of the country.

The Rwandan pedology is characterized by six types of soils namely:
* ❖ Soils derived from schistose, sandstones and quartzite formations;
* ❖ Soils derived from granite and gneissic formations;
* ❖ Soils derived from basic intrusive rocks;
* ❖ Soils derived from recent volcanic materials;
* ❖ Soils derived from old volcanic materials;
* ❖ Alluvial and colluvial soils.

Figure 7: Rwanda Soil Structure
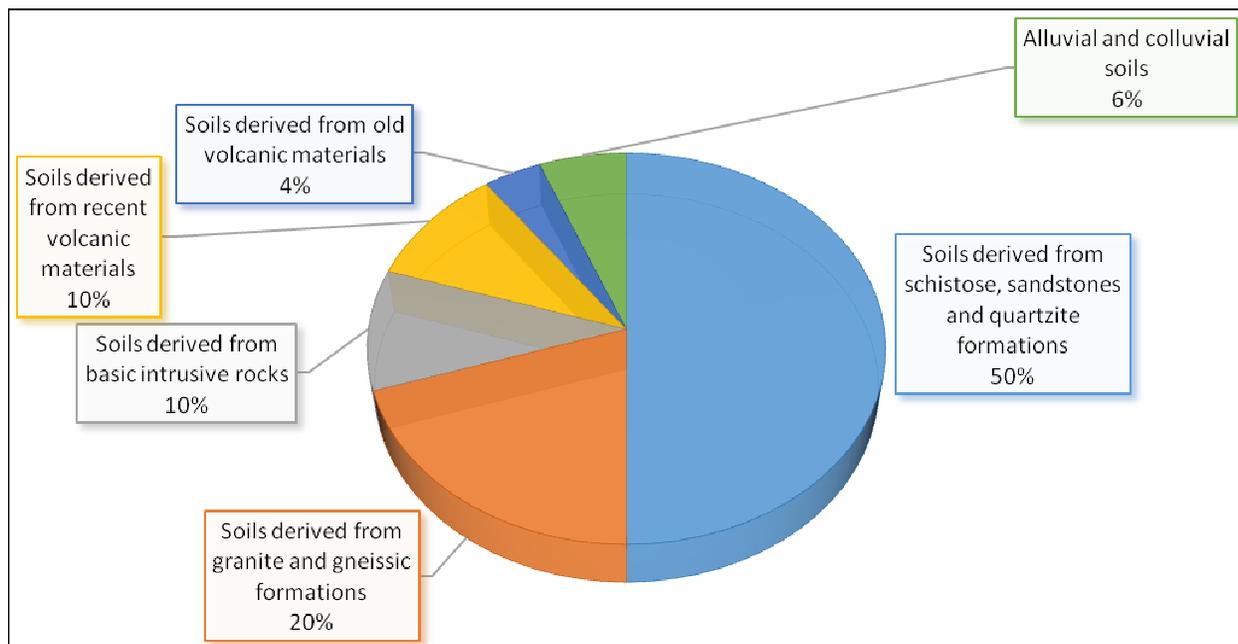
Source: MINAGRI, 2016

3.5.1 National soil characteristics by geographical regions

A. Highland soils

The highland soils are particularly prone to erosion and landslides especially regions of the Congo-Nile ridge, valleys and lowlands (peat lands) as well as highland meadows. Soils of foothills of the Congo-Nile Ridge and of other transition regions between the central plateau and highlands are fertile but, always exposed to deforestation and inappropriate agricultural practices.

B. Soils of the central plateau

The central plateau covers the regions of South and Southeast (covering the Southern Province, Kigali City peripherals and Southeastern part of the Country). Here the soil types are hill ferro soils and valley histosoils. The slopes of hills are exposed to erosion notably in the case of clay-sandy or gravely soils.

C. Soils of the lowlands

They cover the Eastern and South-eastern regions and are ferro soils with savannah vegetation. Like the region of Bugesera, the river-lake complex along Nyabarongo and Akanyaru rivers underwent serious leaching. In addition, the geological structure of soils in those regions allows rain waters to infiltrate deeply into soils, and that can partly explain the lack of runoff waters and shallow brooks.

D. Soils of valleys

These are soils of histosoil and peat soil types that constitute potential agricultural and energy wealth (case of intermountain basins of Kamiranzovu and Rugezi). In the wide water surfaces, eastern savanna regions like Umutara and Bugesera, as well as the Rusizi region (Bugarama), the valleys are of vertisoil and alluvial types which are quite fertile but sometimes threatened by high temperatures and erosion due to the weak permeability of soils.

3.5.2 Soil pollution and degradation

Soil pollution occurs when the presence of toxic chemicals, pollutants or contaminants in the soil is in high enough concentrations to be of risk to plants, wildlife, humans and of course, the soil itself tends to be degraded. In 2011, it was estimated that soil erosion affects the ability to feed 40,000 Rwandans per year.

The accelerated soil degradation which is reflected in various forms of erosion is currently a factual evidence in Rwanda. A study on commercial crops' agricultural zones has described this erosion phenomenon to be caused not only by topography but also by human activities.

This soil degradation involves both the physical loss and reduction in the amount of topsoil associated with nutrient decline. Soil samples were collected from eleven tropical zones in Rwanda and from variable depth within each collecting site. Of these, samples from three locations in each zone were analyzed in the laboratory, with the result that:

> ➢ The pH of all soil samples is shown to be less than 5 (pH < 5) with a general average of 4.4.

> The elements such as iron (Fe), copper (Cu), manganese (Mn), and zinc (Zn) are present in high concentration levels. In contrast calcium (Ca) and sodium (Na) are present at low-level concentrations and carbon (C) was found in minimal concentrations.

> Elements derived from fertilizers, such as nitrogen (N), phosphorous (P), and potassium (K) which is also from minerals such as feldspar, are also present in low-level concentrations.

The results indicate that the soil in various agricultural zones, is acidic and that their level of pH may help explain, in addition to natural factors, the deficiency of some elements such as Ca, Mg, P and N. The use of chemical fertilizers, land use system and the location of fields relative to household plots are also considered to help explain why such soils are typically degraded.

3.6 Air quality of Rwanda

According to the recent inventory on sources of air pollution in Rwanda (2018), highest NO_2, SO_2 and CO concentrations were measured at the Nyabugogo roadside location. The report continues stating that due to the sites 'close proximity to major roads and a bus station, it would be expected to have the highest pollutant concentrations. Highest mean PM10 and PM2.5 concentrations were measured at the Kawangire rural location. Period mean concentrations of PM10 are below the annual mean standards for rural and residential areas, which is 50µg/m3, at Nyabugogo, Gitega and Gasaka but they are above the standard at Kawangire. Monitored concentrations are below the PM2.5 annual mean standard of 35µg/m3 at all four sites (REMA, 2018).

However monitored concentrations of NO_2 at the rural sites are low. Although the concentrations at Nyabugogo are the highest monitored but they remain below the Rwanda annual mean ambient standards of 0.05ppm (96µg/m3). Reasons behind such levels of pollutants' concentration are mainly associated with motor vehicle emissions (because the site is located to major roads and bus station) and biomass energy commonly used for domestic cooking.

Table 4: Average pollutant concentrations at four monitoring sites

	Monitoring sites and monitored mean concentration (µg/m3)				
	Current Rwanda annual mean ambient air quality standards	Nyabugogo (roadside)	Gitega – Meteo (urban Background)	Kawangire (rural)	Gasaka (rural)
NO$_2$	96µg/m^3 (0.05ppm)	35.0	20.7	9.6	**8.7**
O$_3$	-	58.9	42.4	33.0	**149.0**
SO$_2$	60µg/m^3	11.9	6.9	2.0	**2.0**
PM10	50µg/m^3	36.7	19.5	101.9	**17.5**
PM2.5	35µg/m^3	10.0	8.5	31.1	**6.4**
CO	**-**	**973.7**	**714.4**	**144.3**	**178.9**

Source: REMA, (2018)

3.7 Noise pollution

Researchers from World Health Organization (WHO) report that at least 15% of adults have permanent hearing damage due to noise exposure.

Based on national standards regulating noise pollution released by Rwanda Standards Board (2014), the National Police has intensified their operations against noise pollution by ensuring that sound level is controlled in a way that it doesn't affect the beliefs and wellbeing of others in the neighborhood. This implies the enforcement of law on environment 48/2018 (Official Gazette of 21/09/2018) determining the modalities for protecting, conserving and promoting the environment in Rwanda.

Normally, medical experts say that an increase in 10 decibel of sound produces noise pollution by 100 times. The distance from a source of noise and duration of exposure determine the harmful effects of noise on an individual. About 45 decibels (dB) may cause disturbed sleep, whereas 80 to 85 (dB) sound can impair hearing.

So far, there is no statistics on noise pollution in Rwanda, but preventive measures have been taken to control the choice of location, functioning and furnishing of public places and leisure infrastructures (see tables 5 and 6 below).

Table 5: The categorization and tolerance limits for noise

Category of area	Limits in dB, max	
	Day time	Night time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence zone	50	40

Source: RSB (2014). RS 236 2014 Acoustics — Noise pollution — Tolerence limit

Table 6: Maximum acceptable noise levels inside the buildings

No	Types of buildings	Maximum acceptable noise level, dB
1	Offices	50-60
2	Dwellings (houses and flats)	45-55
3	Schools (classrooms and lecture rooms	45-50
4	Hospitals	40-50

Source: RSB (2014). RS 236 2014 Acoustics — Noise pollution — Tolerence limit

Chapter Four: Environmental resources and use
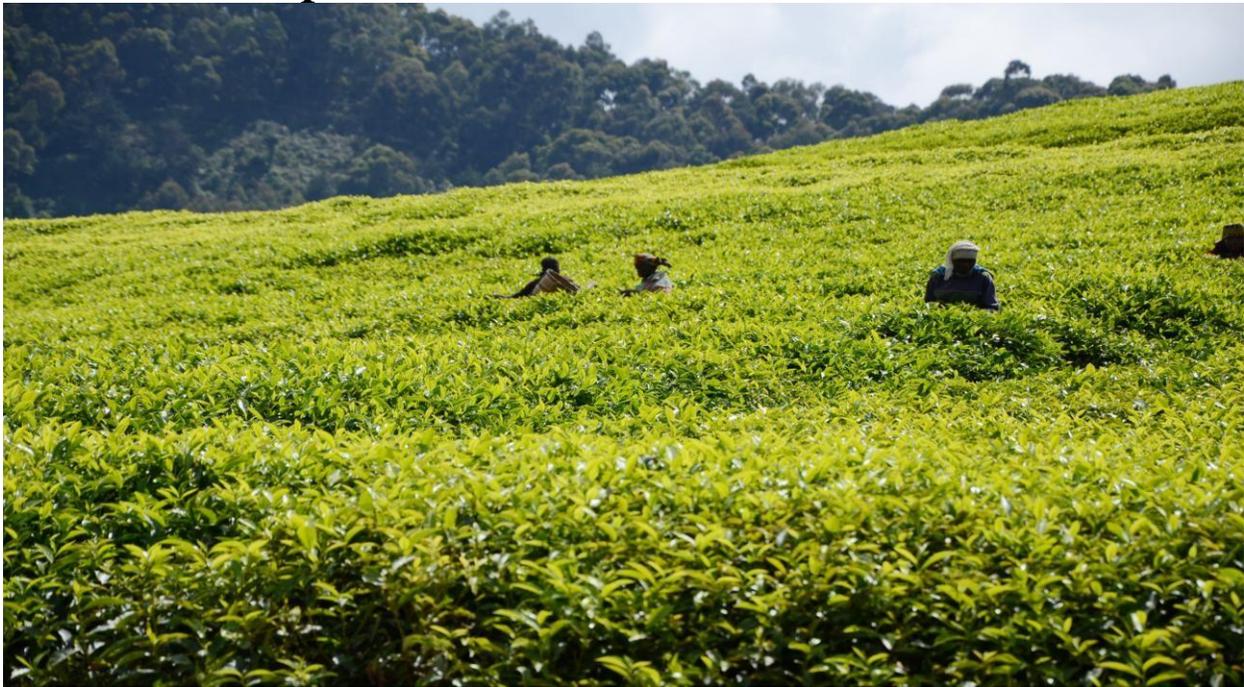
4.1 Introduction

Environmental resources and their use, groups statistics related to the availability and use of environmental resources. Environmental resources include natural resources, such as subsoil resources (mineral and energy), soil resources, biological resources and water resources, and land. Statistics describing the goods and services provided by ecosystems are included in Environmental Resources and their Use.

4.2 Environmental Resources and Use

Environmental resources and their use focus on measuring stocks and changes in stocks of these resources and their use for production and consumption. Statistics regarding the human activities related to the use of environmental resources help identify the possibilities for policy intervention. Consequently, statistics documenting their availability and quality over time are necessary for policy makers to make informed decisions, to avoid shortage or restriction of use, to ensure availability for new and emerging applications, to determine import dependence and other risks, as well as to generally enable continued use over time. Data regarding the availability of environmental resources and their use are important in order to sustainably manage current and future use by the human sub-system.

4.2.1 Mineral Resources

Minerals are elements or compounds composed of a concentration of naturally occurring solid, liquid or gaseous materials in or on the earth's crust. Minerals include metal ores (including precious metals and rare earths); non-metallic minerals and various other minerals.

A. Stock and changes of mineral resources

Stocks of mineral resources are defined as the amount of known deposits of non-metallic and metallic mineral resources. According to RMA, there is no exhaustive study on stock of mineral resources in Rwanda. Mineral resources are not renewable so their depletion reduces their availability in the environment over time. The scale of their extraction can determine the amount of stress placed on the environment. Statistics presented in this section focus on the production and importation of minerals, to assist in the sustainable management of these resources.

B. Production& trade of Mineral

Social economic development of Rwandan people is dependent on the environment and natural resources such as water, land, air, minerals and biodiversity.

Table 7: Volume of Mineral Exports in kg

Year	Products				
	Cassiterite	**Coltan**	**Wolfram**	**Other minerals**	**Total**
2011	6,952,070	890,076	1,006,237	442,523	9,290,906
2012	4,636,642	1,144,684	1,750,568	56,388	7,588,282
2013	4,895,268	2,466,025	2,217,930	59,347	9,638,570
2014	5,929,940	2,302,520	2,166,168	5,958,850	16,357,478
2015	3,845,658	1,651,712	1,784,403	6,708,261	13,990,034
2016	3,549,916	1,269,940	1,715,960	6,572,417	13,108,233
2017	1,240,907	1,725,182	1,523,677	742,941	5,232,707

Source: NISR, 2018

Figure 8: Value of mineral exports (in ,000 USD)
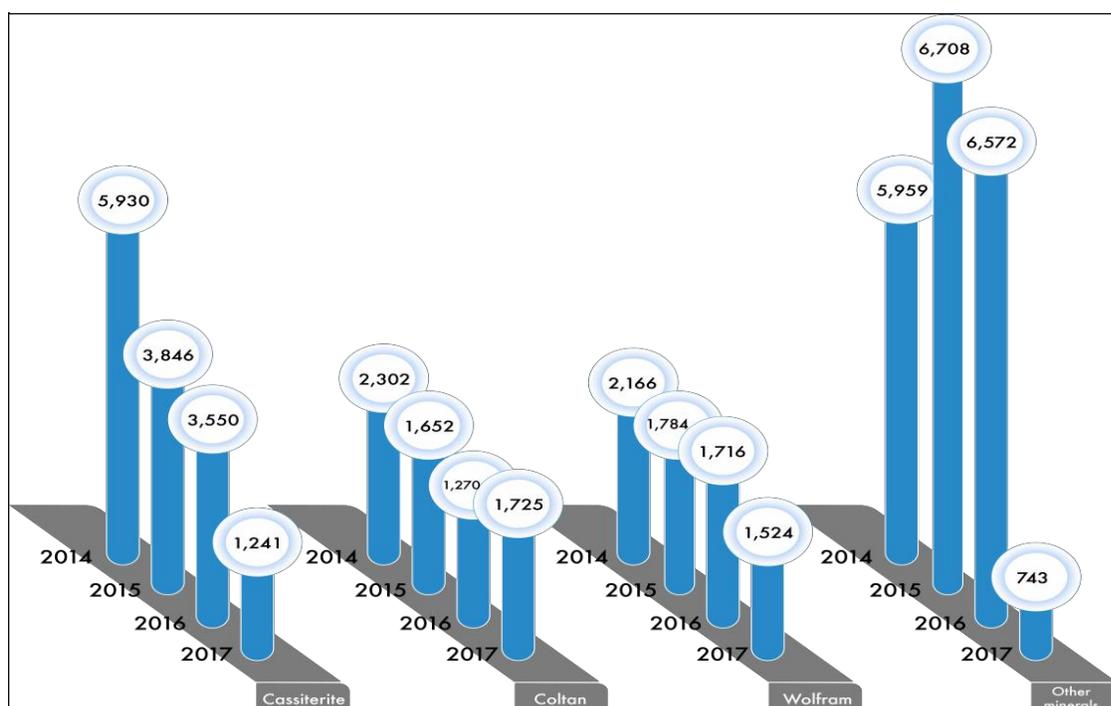
Source: RRA, cited by NISR (2018a)

Table 8: Value of minerals export in USD

MINERALS	2012	2013	2014	2015	2016	2017
Cassiterite	52,896,906	61,074,480	71,945,617	34,263,244	34,807,904	50,154,998
Coltan	56,911,604	134,571,614	104,780,331	66,200,323	39,742,507	62,209,186
Wolfram	26,262,461	30,053,783	26,592,318	17,343,125	11,873,683	12,604,563
Other minerals	274,239	489,438	8,043,448	31,275,751	80,057,528	248,492,668
Re-exports	-	-	-	-	-	-
TOTAL	136,345,210	226,189,315	211,361,714	149,082,443	166,481,621	373,461,416

Source: NISR, 2018a

For illustrating the role of minerals in social economic development of Rwanda, for the fiscal year 2014/2015 the total exports (formal & informal) value grew by 0.3% with amount of USD 709.32 Million from 707.32 million registered in 2013/2014. The total value of export products is dominated by the minerals which recorded USD 174.10 Million (REMA, 2018).

4. 2.2. Energy Resources

In Rwanda, energy is a critical productive sector that can boost economic growth and contribute significantly to country's socio-economic transformation. Through the Ministry of Infrastructure, Rwanda has established and stared implementing Energy Policy which was developed to guide and influence decisions on the extraction, development and use of Rwanda's energy resources in a transparent and sustainable manner. This policy is linked to the vision 2020 in that the former is founded upon three essential government principles namely transparent and effective sector governance, easing doing business and reducing barriers to private investment. It also targets to enhance institutional, organizational, human capacities as well as the legal and regulatory framework.

Also, Energy Policy and Energy Sector Strategic Plan (ESSP) are mutually reinforcing. The policy outlines a long-term vision by providing high-level goals, and recommending clear and coordinated approaches for achieving the vision, whereas ESSP outlines targets and implementation framework of the policy. The critical energy sector challenges are but not limited to:

- Inadequate co-ordination and information sharing among the various projects, government bodies, the private sector and civil society organizations;
- Lack of investment;
- Inadequate energy planning information system (energy supply and demand analysis);
- Lower rate of access to modern energy;
- Inadequate financial resources for planning and monitoring the energy sector and carry out appropriate research and development (R&D);
- Lack for appropriate curricula in energy studies at many higher learning institutions ;
- Inadequate human resource and institutional capacity.

Energy production refers to the capturing, extracting or manufacturing fuels or other energy products for public consumption. Human being produces energy in different ways, depending on its sources. The process of production, transformation, distribution and consumption of energy may cause serious environmental impacts like land use change, air pollution, GHG emissions, waste etc.). Therefore statistics regarding these activities are key to inform environmental

sustainability policy. Total energy production results from non-renewable or renewable resources which constitute key environment statistics that can assist in analyzing the sustainability of energy at the national level.

This section present data on energy production which includes the production of primary and secondary energy. The section also presents highlights in imports and exports of energy refer as amount of fuels, electricity, etc obtained from or supplied to Rwanda. The main sources of statistics on the production, trade and consumption of energy are mainly the Integrated Household and Living Conditions Surveys and Administrative data from national energy authority. Main sources of statistics about stocks of non-renewable energy resources are geological surveys and administrative inventories. For more details, annex 5 highlight the electricity produced by source location. The following table indicates the location and the storage capacity of the existing oil storage depots.

Table 9: Petroleum Storage per site (M^3)

Product	Petroleum Storage Capacity M^3						
	Gatsata	**Kabuye**	**Bigogwe**	**Rwabuye**	**Kanombe**	**Jabana**	**Rusororo**
Gasoline (PMS)	7200	3000	3000	1900	-	7000	8000
Gas Oil (AGO)	5100	2100	2000	1900	-	13000	22000
Kerosene	1500	-	-	-	-	-	-
Fuel Oil	1900	600	-	-	-	-	-
Jet A-1	-	-	-	-	2025	-	2000
Total	15700	5700	5000	3800	2025	20000	32000

Source: EAC, WTO Trade policy review,2018, p. 27

The dominant activities in which liquid fuels are used include transportation and electricity generation. Obviously, these two subcategories contribute heavily to the national GHG emissions. While the table 11 illustrates the number of registered vehicles and is split by period of registration, figure 9 highlights the contribution of the various energy sources generated in Rwanda between 2006 and 2015.

Table 10: Number and year of registration of vehicles in Rwanda

Vehicle type	Up to 1999	2000-2005	2006-2011	2012-2017	Total
Bus	232	155	398	623	1,408
Car	26,590	6,165	1,130	493	34,378
Artic HGV	516	107	343	204	1,170
Jeep	7,365	7,780	5,439	3,089	23,673
Microbus	297	512	36	22	867
Minibus	4,572	906	562	285	6,325
Motorcycle	2,284	13,357	37,905	45,261	98,807
Pick-up	9,858	2,411	3,152	2,282	17,703
Tricycle	-	-	60	13	73
Rigid HGV	2,853	872	1,404	1,482	6,611
Total	54,567	32,265	50,429	53,754	191,015
Percentage	0.29	0.17	0.26	0.28	

Source: Rwanda Revenue Authority, Cited by REMA(2018). Notes: HGV = Heavy Goods Vehicle, Artic HGV = articulated Heavy Goods Vehicle and is equivalent to a 'half-trailer' and 'trailer'. Rigid HGV is equivalent to a 'truck'.

The data in table 11 shows that the Rwanda policy related to the import of motorcycles has reduced the entry of ageing fleet which might have a high GHG emissions and hence provides direct evidence that policy interventions such as this have a positive effect on air quality.

4.2.3 Production, trade and consumptions of Energy Resources

Figure 9: Contribution of various energy sources to electricity generated in Rwanda between 2006 and 2015.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Solar	0	0	0.31	0.36	0.32	0.3	0.31	0.14	5.03	13.55
Methane Gas	0	0	0	3.31	8.97	6.11	8.83	9.94	15.62	23.35
Hydro	65.73	32.09	266.58	347.22	388.09	494.82	574.44	561.26	680.57	808.13
Oil	50.12	133.24	122.06	145.75	159.86	189.76	202.4	254.95	250.64	202.42
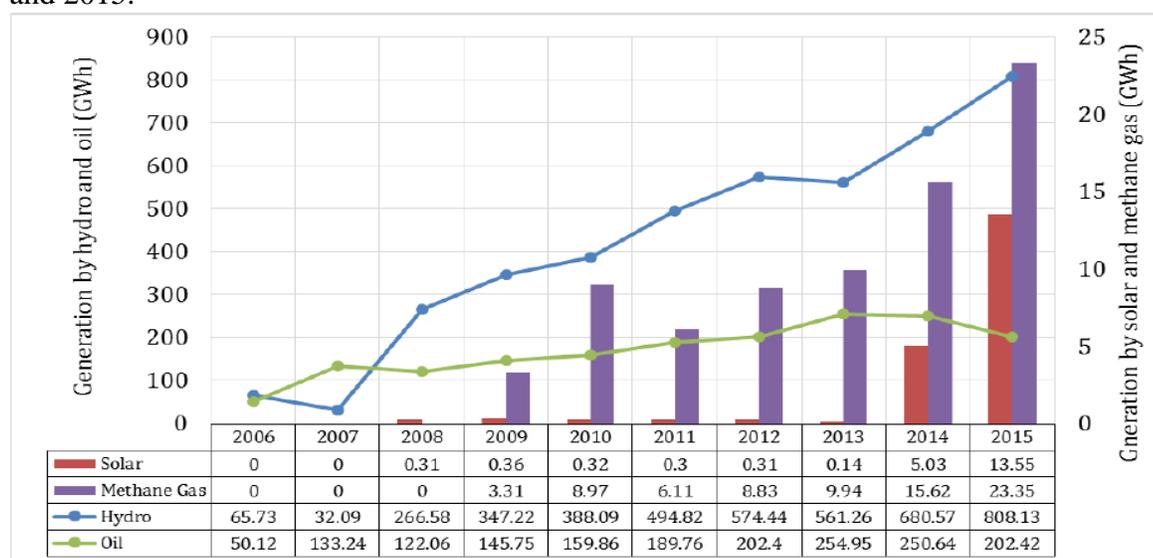
Source: REMA (2018)

According to the third national communication to UNFCCC (2018), the electricity power in Rwanda is mainly generated from hydro and fuel oil, which have generating facilities in Rwanda, together with the power imported from neighboring countries. It is clear that the hydroelectricity had a dominant contribution to total electrical power generated during the whole period between 2006 and 2015 followed by the thermoelectricity generation (electricity generated from fuel oil and methane gas) and solar electricity had a modest contribution. The decline in the observed in the electrical power generated by fuel oil in 2015 (see figure 9) could be explained by the implementation the Rwanda's policy of reducing the electricity generated by the latter.

Figure 10: Electricity consumption (Kwh)

2011	345 Millions
2012	393 Millions
2013	413 Millions
2014	476 Millions
2015	524 Millions
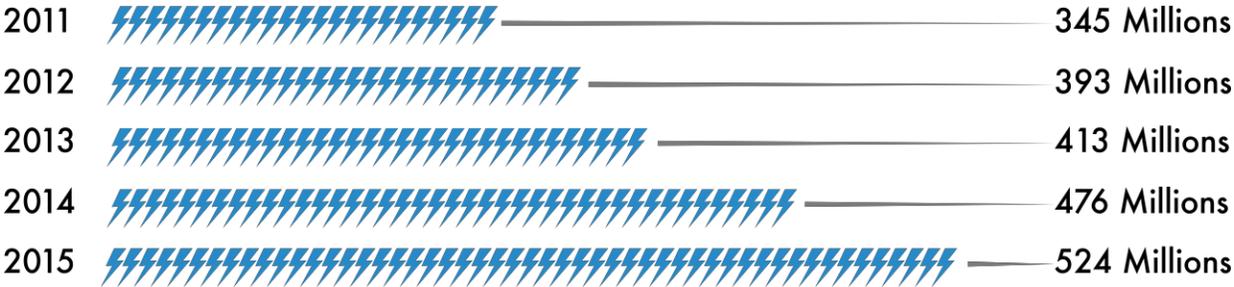
Source: Adapted from NISR, 2018b

Table 11: Electricity Exportation and importation (Kwh)

	2011	2012	2013	2014	2015
Total exportation	**4,859,934**	**2,938,936**	**265,390**	**3,789,413**	**2,726,282**
Cyanika - Gisoro	2,461,934	2,912,936	205,390	3,706,818	2,236,282
Mururu II	2,398,000	26,000	60,000	76,000	490,000
Goma	0	0	0	6,595	0
Total importation	**77,649,668**	**90,845,533**	**94,408,691**	**89,453,986**	**41,552,478**
Rusizi i (SNEL)	19,984,800	20,154,060	22,750,050	25,153,380	10,299,780
Rusizi II (SNELAC)	52,362,000	68,298,000	70,610,000	61,964,000	29,694,000
Kabale (UEB)	5,302,868	2,393,473	1,048,641	2,336,606	1,558,698

Source: REG, cited by NISR, 2018

Figure 11: Trend of energy import & Export over period 2011 – 2017
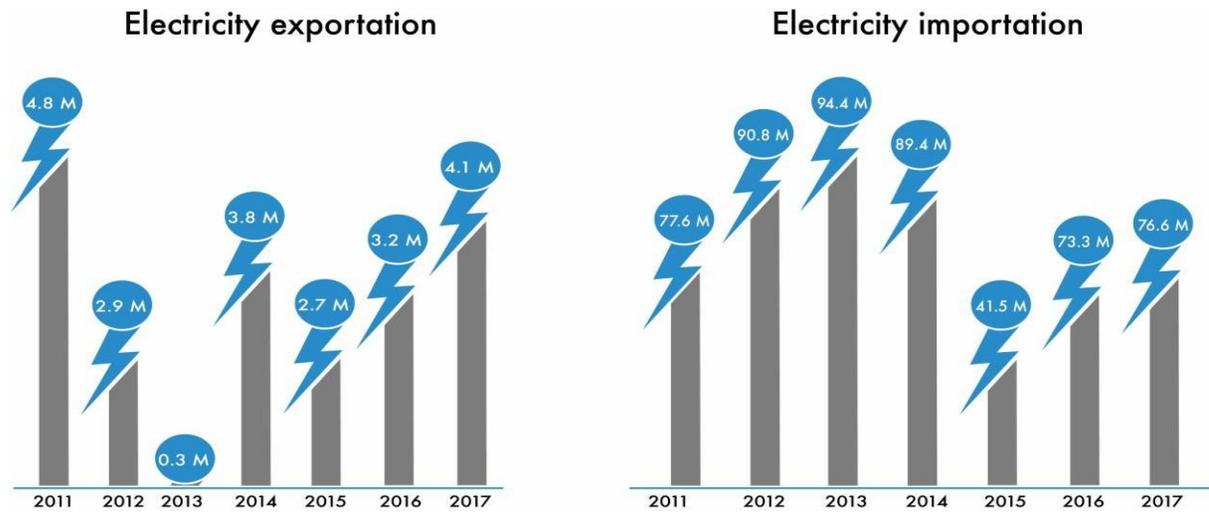
Source: NISR, 2018b

Table 12: Imported Petroleum Products as of 2010-2017 (Home Consumption)

Period	PMS (Premium)	AGO (Automative Gas Oil) for Diesel Engines	Illuminating Kerosene (I.K)	Jet A-1	PMS Growth rate in %	AGO Growth rate in %	I.K Growth rate in %	Jet A-1 Growth rate in %
2010	74,716,880	111,033,437	15,592,077	562,259				
2011	82,263,817	122,594,979	15,365,807	1,688,768	10.1	10.4	-1.5	200.4
2012	90,453,941	136,549,538	16,967,201	1,862,646	10.0	11.4	10.5	10.3
2013	103,278,037	158,073,669	-	787,985	15.3	15.8	-	-57.7
2014	104,372,134	165,777,744	11,666,659	714,033	0.1	4.9	-100.0	-9.4
2015	119,665,769	173,976,918	9,185,528	1,310,348	14.7	4.9	-21.3	83.5
2016	127,413,437	168,698,295	7,193,458	1658,032	6.5	-3.0	-21.7	26.5
2017	129,360,744	169,032,935	4,356,068	2,430,399	1.5	0.2	-39.4	46.6

Source: EAC (2018), WTO Trade policy review, p. 25

Rwanda does not produce but imports all domestically consumed petroleum products, mostly diesel and petrol, which represented approximately 15% of total imports' value during 2011-16. About 75% of all imported petroleum products are consumed in the transport sector. Diesel is also used by generators accounting for approximately 10.7% of all electricity produced in Rwanda (EAC, 2018).

Table 13: Liquefied Petroleum Gas (LPG) importation since 2010 to 2017

Period / Years	LP imported in (Kg)	Increment change in %
2010	724,595	
2011	959,864	32%
2012	1,430,851	49%
2013	1,579,705	10%
2014	2,142,968	36%
2015	2,808,426	31%
2016	5,020,595	79%
2017	10,278,617	105%

Source: EAC (2018). WTO Trade policy, p.25

Table 14: Primary fuel used for cooking by province, urban/ rural quintile and Sex of head of household

EICV5	Firewood	Charcoal	Gas	Biogas	Electricity	Oil or Kerosene	Crop waste	Others	Total	Total no. HHs (000)
					Primary fuel used for cooking					
All Rwanda	**79.9**	**17.4**	**1.1**	**0.0**	**0.0**	**0.0**	**0.6**	**0.9**	**100**	**2,708**
					Urban/rural					
Urban	26.3	65.1	5.0	0.0	0.2	0.1	0.1	3.1	100	524
Rural	92.7	6.0	0.2	0.0	0.0	0.0	0.8	0.3	100	2,184
Province										
Kigali City	22.4	68.1	6.1	0.1	0.2	0.1	0.0	3.1	100	410
Southern	92.6	6.5	0.2	0.1	0.0	0.0	0.2	0.4	100	626
Western	87.2	12.2	0.1	0.0	0.0	0.0	0.0	0.3	100	574
Northern	91.7	7.3	0.2	0.0	0.0	0.0	0.4	0.3	100	422
Eastern	89.3	7.6	0.3	0.0	0.0	0.0	2.1	0.8	100	677
					Sex of head of household					
Male	78.3	18.9	1.2	0.0	0.1	0.0	0.6	1.0	100	2,031
Female	84.7	13.0	0.9	0.0	0.0	0.0	0.8	0.5	100	677

Source: NISR, 2018c

According to the 7 years government programme (NST1), Rwanda is targeting to reduce the percentage of households using firewood for cooking from the EICV5 situation considered as baseline (79.9%) to 66,6% by 2020/21 and then 42% by 2023/24.

Figure 12: Primary fuel used for cooking by province, urban/ rural quintile and Sex of head of household

PRIMARY FUEL USED FOR COOKING

- % of HHs that use firewood
- % of HHs that use charcoal
- % of HHs that use gas
- Others

West: 87.2 / 12.2 / 0.1 / 0.3
North: 91.7 / 7.3 / 0.2 / 0.3
Kigali city: 22.4 / 68.1 / 6.1 / 3.1
East: 89.3 / 7.6 / 0.3 / 0.8
South: 92.6 / 6.5 / 0.2 / 0.4
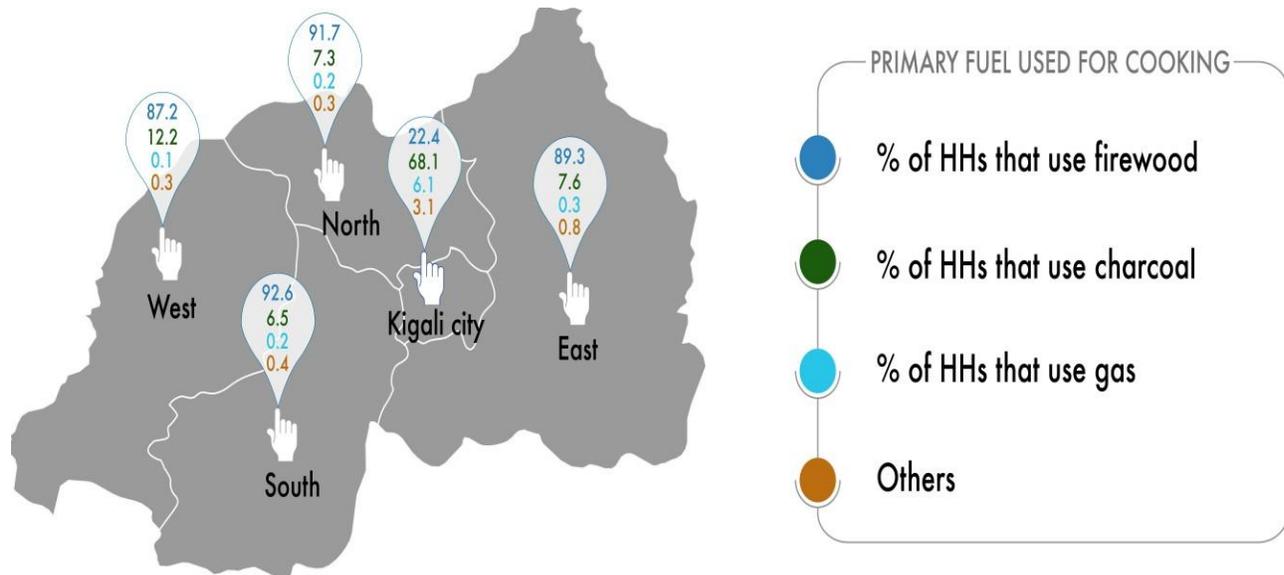
Source: Adapted from NISR, 2018c

The GHG emissions reduced in efficient cooking can vary according to fuel type, cookstove efficiency, non-renewable biomass content and cooking practice. Regarding the fuel type, in 2016/17, around 97% of households are still using firewood or charcoal (see figure 13).

Figure 13: Distribution of households by primary fuel used for cooking at national level

Others: 0.8% / 0.9%
Gas: 0.1% / 1.1%
Charcoal: 15.2% / 17.4%
Firewood: 83.3% / 79.9%

2013/14   2016/17
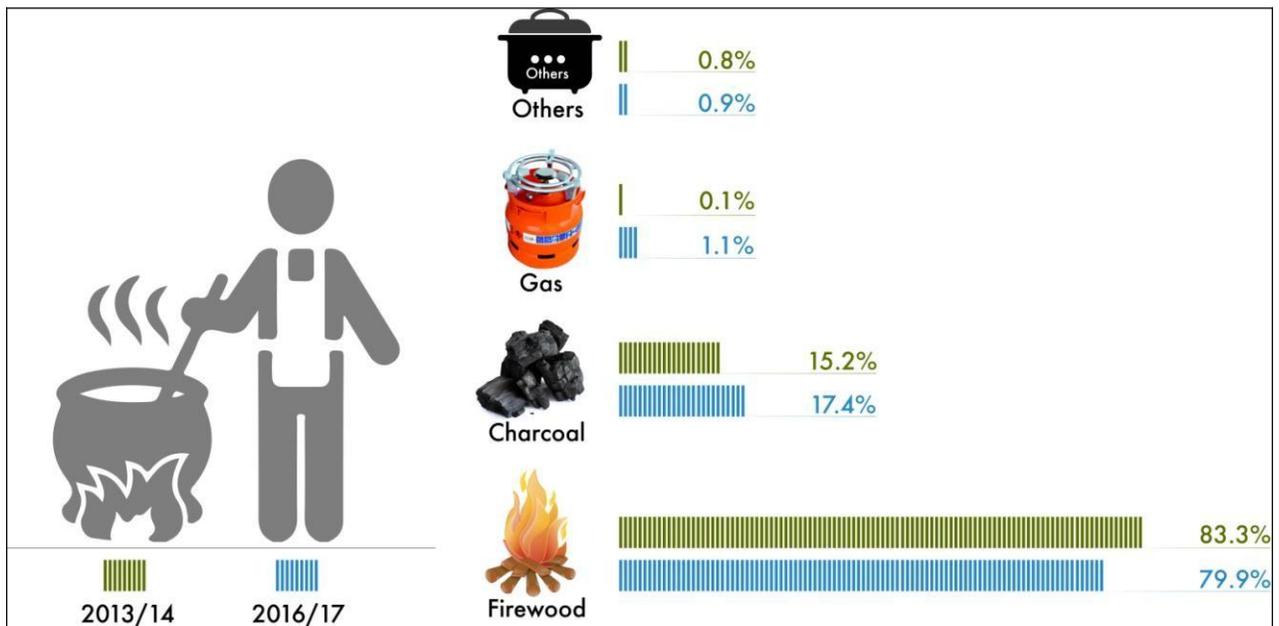
Source: Adapted from NISR, 2018c

4. 2.4 Land

Land is a unique environmental resource that serve as the space in which economic activities and environmental processes take place. Since 2017, Rwanda through the Ministry of Natural Resources (MINERENA) has put in place Rwanda National Land Use Planning Guidelines as a consolidation of existing land use guidelines and standards from various sectors into one document for ease of implementation towards an efficient and optimal use of our scarce land resource. These guidelines serves as a planning tool to guide efficient land use and management and to standardize land use plans preparation and development in Rwanda. The guidelines targets coordinated efforts of different stakeholders to address key challenges that Rwanda is facing which are, but not limited to:

- Population pressure in Rwanda that causes the overexploitation of land
- The increase in degradation processes leading to excessive deposition in the valley bottoms conditions which over time precipitate flood damages and destruction of low land crops in different areas of the country
- Soil erosion resulting from lack of reliable soil conservation methods as well as persisting cultivation of land, settlement on marginal land that is unsuitable for agriculture
- Unpredictability of rainfall in Rwanda as a Climatic change issue
- Effects resulting from exploitation of wetlands that have been cultivated by local communities for subsistence farming
- Deforestation and Loss of biodiversity due to the fact that Rwandan forests are for long subjected to strong human pressure. Through forest clearing, between 1958 and 1978 Nyungwe mountain forests surface area was reduced from 114,125 ha to 97,138 ha, i.e. a loss of approximately 17,000 ha in a space of 20 years, to say a reduction of 15% of the forest surface area (MINITERE, 2004). This also results from stripping off of fuel substances for commercial purposes, as well as the poaching of big mammals such as the buffaloes and the elephants.
- Poor management and use of land resources are also challenging issue. For instance, the cadastral system, which is the core land administration technique necessitates trained and

motivated staff as well as enormous financial resources beyond the capacity of the country.

It is important to note that land current land policies are well aligned with the Vision 2020 through its pillars of infrastructure development, land use management, urban development and natural resource and environmental protection. The present sub-component of the compendium will help to monitor coordinated efforts made in the area of land use management for national development.

The two primary aspects of land are land cover and land use and the two aspects are strictly interconnected in a way that land cover describes the biophysical aspects of land, whereas land use refers to the functional aspects of land. The relation relies in that changes in land cover can be the result of natural processes and of land use changes.

A. Use of forest land

Currently, forests in Rwanda cover 29.8 % of the surface area of the national territory of which plantation and natural forests occupies 17.9% and 11.9% respectively. In 2016/17, forestry activities have generated three million and seven hundred thousand (US$ 3.72 million) and created 61,243 Jobs as import substitution and has generated 1,665, 335 USD$ and exported more than 11,500 electrical poles to Tanzania Energy Authority and fetched 2,114,735 USD$ by June 2016. To avoid duplication, more information on surface areas and characteristics of forests were covered in chapter III and will not be provided in this chapter.

Figure 14: Current Natural Forest Coverage (Area in 000s ha)
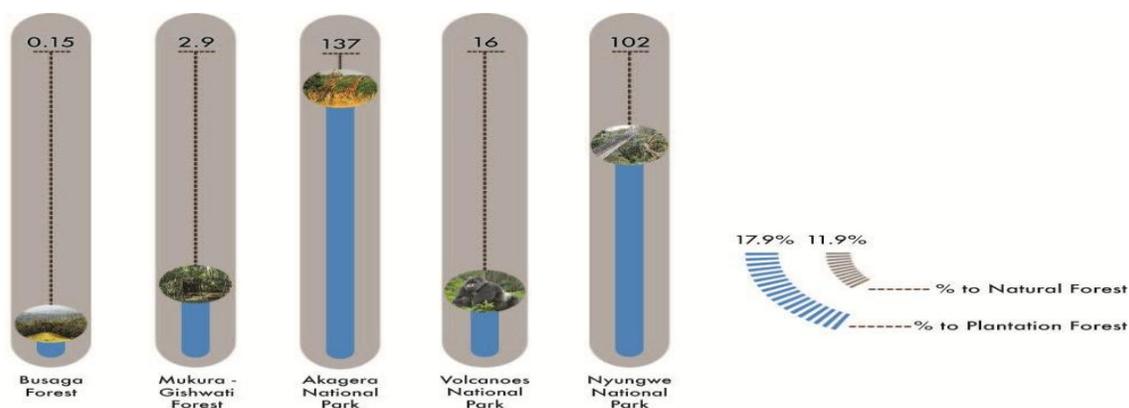
Source: Adapted from RWFA, 2018

Table 15: Forest plantation (Area in ha)

Year	2013	2014	2015	2016	2017
Forest plantation (Area in ha)	390,507	404,047	413,274	421,569	426,633
Percentage to the total National area	16	17	17.4	17.7	17.9

Source: RWFA, 2018

Human made forests consisting of forest plantations of exotic tree species (mostly eucalyptus and pine), woodlots and agro-forestry plantations cover 18.4 % and represent nearly 63 % of all forest cover. Planted forests supply almost all fuel wood, with charcoal accounting for about 15.2 % of households' primary energy sources. Rwanda is actively promoting agro-forestry to provide wood for fuel during the transition to available and affordable electricity for all (REMA, 2018).

B. Soil Resources

Soil resources in this section refer to information on the area and volume of soil protected against erosion or degradation, or made unavailable by changes in land cover and other sources. Extraction, soil erosion, catastrophic losses, and downward reappraisals and reclassifications are major causes of soil reduction in stock. That is why measurement of volume of soil is linked to the extent of soil under erosion and the impact of natural disasters to soil depletion due to economic activities. Available statistics covers the protection of land against erosion, irrigation and land consolidation.

In 2014, the percentage of land irrigated was 4%, land protected against erosion was 73% whereas land affected by consolidation represented 15.7%. Land protected against soil erosion was 66 % in urban and 73.6% in rural areas whereas land affected by land consolidation was 14% and 16% in urban and rural areas respectively.

Figure 15: Percentage of land area irrigated, protected against soil erosion, and affected by land consolidation by province.
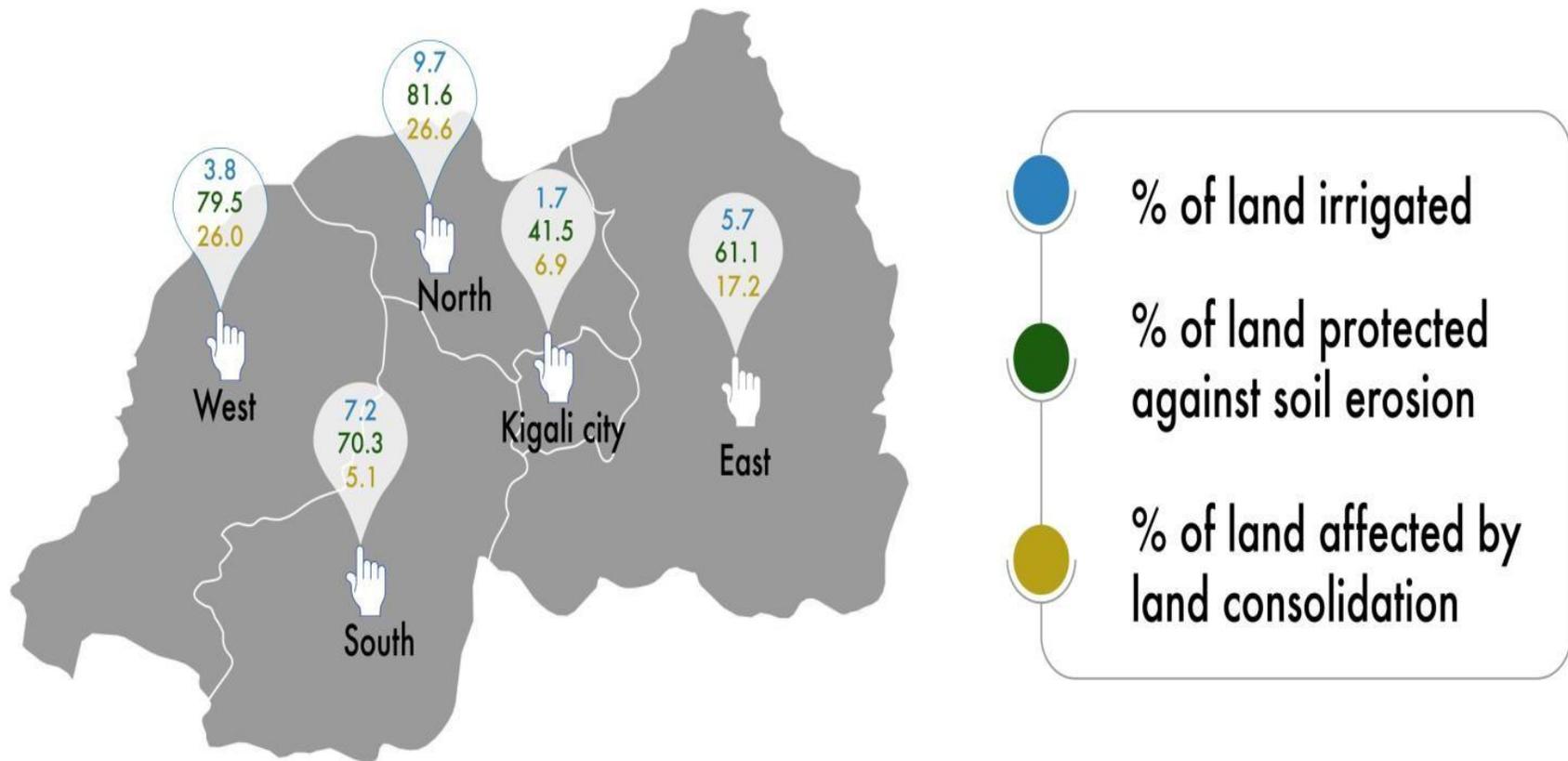
Table 16: Change in percentage of land irrigated, protected against soil erosion, and affected by land consolidation from 2014 to 2017

Desegregations	% of land Irrigated		% of land protected against soil erosion		% of land affected by land consolidation		Total cultivated land area (in 000 ha)	
	EICV5	EICV4	EICV5	EICV4	EICV5	EICV4	EICV 5	EICV 4
All Rwanda	**6.2**	**4.0**	**68.5**	**73.0**	**15.9**	**15.7**	**1,290**	**1,310**
Urban/rural								
Urban	9.6	6.6	56.9	66.1	24.4	14.1	211	109
Rural	5.6	3.8	70.8	73.6	14.3	15.9	1,079	1,200
Province								
Kigali City	1.7	5.9	41.5	70.8	6.9	5.0	96	79
Southern Province	7.2	4.3	70.3	83.7	5.1	7.8	364	303
Western Province	3.8	3.1	79.5	78.0	26.0	21.9	199	222
Northern Province	9.7	2.7	81.6	81.8	26.6	21.5	214	200
Eastern Province	5.7	4.5	61.1	61.2	17.2	17.2	417	506
Sex of head of household								
Male	7	4.4	70.2	73.3	17.4	16.7	999	1,023
Female	3.5	2.6	62.5	71.7	11.0	12.3	290	287

Source: NISR, 2018c

The findings of EICV5, revealed that the overall proportion of irrigated land is still low (6%) compared to 5 % in 2013-3014. The proportion of households using irrigation is highest in Northern Province (10%) from 3% in 2013-2014 and lowest in Kigali City (2%) from 6 % in 2013-2014. Urban expansion and reduction of farm land in Kigali City might be the reason behind the decline of irrigation practice in Kigali City.

Table 17: Percentage of crop-producing households with any plot protected from erosion, irrigated, affected by land consolidation, and crops added and removed due to regionalization, by province, urban/rural and sex of head of household

EICV5	With any plot protected from erosion	With any irrigated plot in the last season	With any plot affected by land consolidation	Added a crop due to regionalization	Removed a crop due to regionalization	Households engaging in crop production (000s)
All Rwanda	**80.7**	**14.2**	**26.2**	**22.6**	**20.8**	**2,227**
Urban/rural						
Urban	58.8	14.1	21.6	22	19.5	187
Rural	82.7	14.2	26.6	22.6	20.9	2040
Province						
Kigali City	51.8	8.6	7.3	6	4	115
Southern Province	87.7	22.4	16.3	15.9	13.9	579
Western Province	84.9	11.6	32.2	22.8	21.6	510
Northern Province	85.2	10.8	40.4	34	28.2	396
Eastern Province	73.3	11.9	24.8	24.3	24.8	627
Sex of head of household						
Male	81.5	15.1	27.7	24.1	21.8	1,657
Female	78.3	11.4	21.6	18.1	17.9	570

Source: NISR, 2018c

4.3 Livestock

Livestock are animal species that are raised by humans for commercial purposes, consumption or labour. Usually raised in agricultural settings, typical livestock species include cows, poultry, pigs, goats and sheep. Rising incomes and growing populations, especially in the developing world, have led to higher demands for livestock products, including milk, eggs and meat, thus driving growth in the livestock sector. Nonetheless, livestock rearing is associated with multiple environmental effects. Livestock production contributes to GHG emissions. Animal husbandry (grazing and production of feedstock) occupies a large percentage of land, directly or indirectly.

Table 18: Percentage of households raising different types of livestock during 2017 agricultural year by province and sex of household head

	Type of livestock (000s)								
	Cattle	Goats	sheep	Pigs	Hen	Other poultry	Rabbits	Other livestock	Households raising livestock (000s)
Rwanda	61	53.6	18.1	30.6	34	8.2	15	8.9	1,690
Province									
Kigali city	46.2	49.9	4.1	8.5	46	2.3	13.2	1.2	53
South	71.6	64.3	26.7	57.4	44	24	33.2	24.9	469
West	62.3	37	18	26.2	26	1.9	8.7	3.9	366
North	70.9	35.3	25.2	20.5	29	1	9.3	4.7	345
East	43.3	70.2	5.5	16.7	32	3.1	6	0.7	457
Sex									
Male	64.6	51.2	17.9	31.5	36	7.8	15.8	8.6	1,240
Female	51	60.2	18.6	28	27	8	12.9	9.8	449

Source: NISR (2018[b]). Agricultural Household Survey 2017. Kigali-Rwanda. p.47

Table 20 presents the distribution of livestock-raising households per type of animal. Country wide it was estimated 1.7 million livestock-rearing households at the day of interview. Cattle, goats, hens and pigs were the most commonly raised animals, at 61.0 %, 53.6 %t, 33.7 % and 30.6 % respectively of livestock-raising households. Cattle and sheep-rearing was particularly high in South (71.6 % and 26.7 %t respectively) and Northern (70.9 % and 25.2 % respectively) provinces. Goat-rearing was highest in Eastern province (70.2 %) and pig-rearing in Southern Province (57.4 %). Hen-rearing was highest in Kigali City. Raising cattle is higher among male-headed households than female-headed ones (64.6 % compared to 51.0 %), as is raising pigs (31.5 % compared to 28 %) and hen (36.2 % compared to 26.7 %). Besides goat-rearing was higher among female-headed households than male-headed households (60.2 % compared to 51.2 %) (NISR, 2018[b]).

4. 4 Biological Resources

Biological resources are renewable resources capable of regeneration through natural processes. Biological resources include aquatic resources and a range of other animal and plant resources (such as livestock, crops, wild animals and plants). One of the main features of living aquatic resources is that they are renewable and their sustainable exploitation relies on an in-depth understanding of the

aquatic ecosystems. Biological resources constitute an important part of biodiversity and ecosystems. Obviously, when harvesting and losses surpass natural or managed regeneration or replenishment, biological resources get depleted. In Rwanda, cultivated biological resources cover animal, tree, crop and plant resources yielding repeat products and their natural growth and regeneration are under the direct control, responsibility and management of different institutions. Available statistics focuses on their production, exports and revenues.

4.4.1 Aquatic resources

In 2016, fisheries and aquaculture contributed approximately RWF 23 billion to GDP. Volume production in aquaculture has been growing by about 16 per cent from when to when?.

Table 19: Fish Exports

Products	Units	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Fish Export						
Formal	Vol (Kg)	869,253	1,710,137	1,536,104	1,463,057	2,307,986
	Revenues (USD)	260,066	2,298,308	1,889,256	2,088,060	3,395,090
Informal	Vol (Kg)	2,573,390	1,663,206	2,194,751	6,323,948	9,854,805
	Revenues (USD)	3,966,416	2,827,652	6,591,440	11,951,797	20,146,888
Other fishery products	Vol (kg)	581,324	1,626,213	2,998,524	833,789	1,002,094
	Revenues (USD)	3,212,046	5,486,872	6,468,364	2,121,574	2,110,884
Total Fish export	Vol (Kg)	4,023,967	4,999,556	6,729,379	8,620,794	13,164,885
	Revenues (USD)	7,438,528	10,612,832	14,949,061	16,161,431	25,652,861

Source: NAEB, cited by NISR (2018a)

Figure 16: Trend of total fish exports in volume (000s kg) and revenues (000s USD)
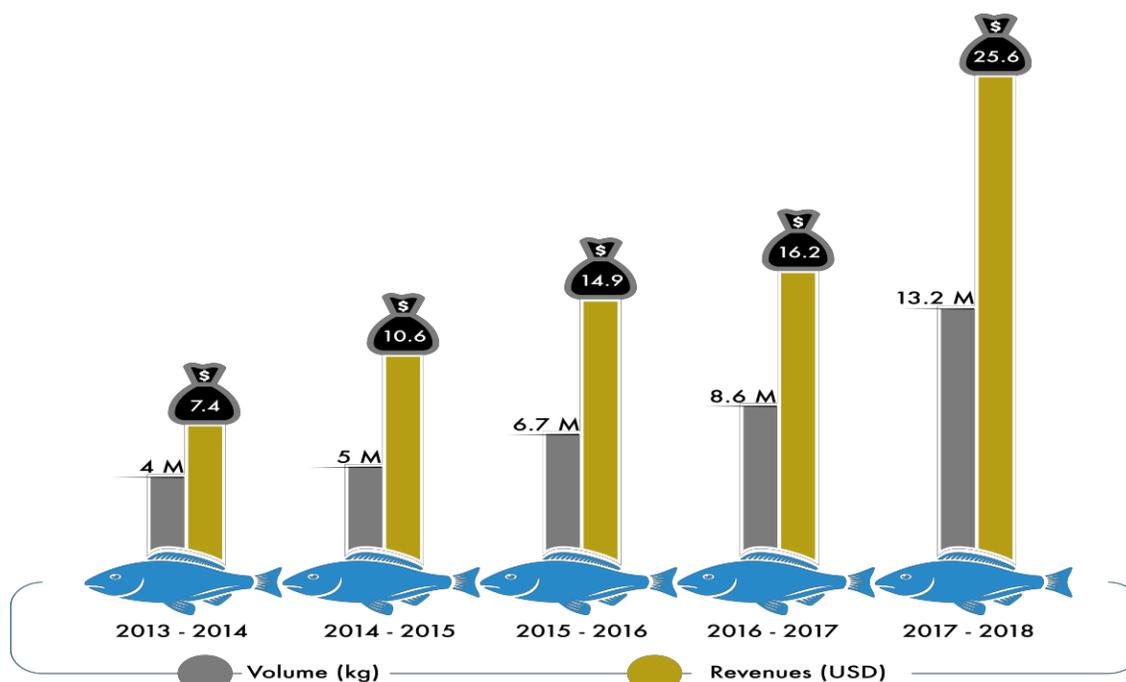
Source: NAEB, cited by NISR (2018a)

4.4.2 Crops

The Government of Rwanda recognizes that agriculture sector contributes about a third to the national GDP. In that framework, Rwanda elaborated the agriculture policy to contribute to the achievement of food security for Rwandan population and to boost the Country's economy. The policy whose implementation started in 2017 seeks to make agriculture and livestock more productive at the same time ensuring proper utilization of natural resources and sustainability for future generations. The policy is in line with key national development agenda which include Vision 2020 that aims at modernization of agriculture by employing 50% of the population by 2020 from 90% of the population as per 2000 and to have access to substantial income which allows meeting Rwanda population needs.

It is also consistent with the Strategic Plan for the Transformation of Agriculture in Rwanda Phase III (PSTA III), which aims to intensify and commercialize agriculture, and attain an annual agricultural growth of 8.5%, annual export growth of 28% and 40% of land under modern agriculture in 2017/2018. Crops data in this section will help in monitoring the efforts of the Government of Rwanda and its stakeholders to achieve those targets in agriculture sector.

Table 20: Production of major cash crops in Tons

Years	2011	2012	2013	2014	2015	2016	2017
Coffee	16,372	19,955	18,346	16,379	21,802	22,009	22,390
Tea	24,066	22,502	22,184	24,751	25,411	25,628	27,887

Source: NAEB, cited by NISR (2018a)

According to the third national communication for climate change (2018), in 2016, agriculture sector grew by 5 % and contributed 1.6 % points to the overall GDP growth. Coffee and tea constitute the main export crops. However, extensive agricultural practices by the population contribute to the degradation of the environment.

Table 21: Land area under production for major cash crops '000 Hectare

Year	2011	2012	2013	2014	2015	2016	2017
Coffee							
Total Coffee area	35.1	41.76	52.03	55.03	35.5	37.7	38.7
Coffee Area under production	24.57	29.23	36.42	38.42	30.514	30.8	31.36
Tea							
Total tea area	19.25	20.67	21.6	25.34	26.27	26.88	27.22
Tea area under production	15.07	15.38	15.62	17.22	17.22	18.82	20.47

Source: NAEB, cited by NISR (2018a)

While the annex 6, 7 and 8 highlight the quantity and income generated by respectively export of vegetables, fruits and cereals for the period of 2014 up to 2018, the table 31, 32 and 33 expose the quantity and value of other crops exported by Rwanda producers.

Table 22: Exports of Banana

Products		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Banana for cooking						
Formal	Vol (kg)	2,994	-	682	28,723	152,759
	Revenues (USD)	5,251	-	567	23,762	126,370
Informal	Vol (kg)	625,540	1,008,282	322,985	-	-
	Revenues (USD)	572,534	698,387	239,551	-	-
Total banana for cooking export	Vol (kg)	628,534	1,008,282	323,667	28,723	152,759
	Revenues (USD)	577,785	698,387	240,118	23,762	126,370
Banana for beer						
Formal	Vol (kg)	-	-	-	688	2,074
	Revenues (USD)	-	-	-	852	3,571
Informal	Vol (kg)	3,960	454,164	300,190	160,848	344,107
	Revenues (USD)	2,112	326,782	170,981	64,466	149,294
Total banana for beer export	Vol (kg)	3,960	454,164	300,190	161,536	346,181
	Revenues (USD)	2,112	326,782	170,981	65,317	152,864,933
Grand total	Volume(kg)	632,494	1,462,446	623,857	190,259	498,940
	Revenues (USD)	579,897	1,025,168	411,100	89,079	279,235

Source: NAEB, cited by NISR, (2018a)

Table 23: Export of Roots and tubers

Products		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Irish Potatoes Export						
Formal	Vol (Kg)	6,121,445	6,349,449	3,416,772	3,249,222	2,525,513
	Revenues (USD)	173,155	729,739	523,867	416,520	341,501
Informal	Vol (Kg)	6,092,665	8,076,889	7,958,532	4,501,275	14,225,199
	Revenues (USD)	1,533,282	1,930,300	2,043,073	1,303,614	2,925,655
Total Irish Potatoes export						
	Vol (Kg)	12,214,110	14,426,338	11,375,304	7,750,497	16,750,712
	Revenues (USD)	1,706,437	2,660,039	2,566,940	1,720,135	3,267,156
Cassava flour and roots export						
Formal	Vol (Kg)	386,051	3,376,781	2,509,718	2,926,090	4,459,326
	Revenues (USD)	166,095	3,587,256	457,755.30	826,585	5,593,865
Informal	Vol (Kg)	1,533,703	10,258,729	9,335,997.07	5,074,354	10,380,094
	Revenues (USD)	535,648	4,577,772	3,930,163.93	2,072,743	4,237,930
Total cassava export						
	Vol (Kg)	1,919,754	13,635,510	11,845,715.07	8,000,444	14,839,420
	Revenues (USD)	701,742	8,165,028	4,387,919.23	2,899,328	9,831,795
Export of sweet potatoes						
Formal	Vol (Kg)	-	118,750	178,805	773	251,459
	Revenues (USD)	-	13,834	26,132	655	16,548
Informal	Vol (Kg)	-	1,085,092	1,158,722	248,622	574,750
	Revenues (USD)	-	253,483	300,875	58,254	153,725
Total of export of sweet potatoes						
	Vol (Kg)	-	1,203,842	1,337,527.34	249,395	826,209
	Revenues (USD)	-	267,317	327,006.57	58,909	170,274
Export of other Roots and tubers						
Formal	Vol (Kg) / Number	-	-	28,000	-	37,127
	Revenues (USD)	-	-	4,341	-	7,558
Informal	Vol (Kg) / Number	-	24,404	34,346	130,769	376,522
	Revenues (USD)	-	5,865	13,005	79,845	238,577
Total of export of other roots and tubers						
	Vol (Kg) / Number	-	24,404	62,346	130,769	413,649
	Revenues (Frw)	-	5,865	17,346	79,845	246,135
Total of export of roots and tubers	Vol (Kg)	14,133,864	29,290,094	24,620,892.71	16,131,105	32,829,990
	Revenues (USD)	2,408,179	11,098,249	7,281,865.79	4,758,216	13,515,359

Source: NAEB, cited by NISR (2018a)

Table 24: Exports of Refined Pyrethrum

Refined Pyrethrum	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Formal					
Volumes (Kg)	18,541	9,864	22,231	9329	22,084
Revenues (USD)	4,941,684	1,793,782	4,117,301	1655350.4	3,769,929
Informal					
Volumes (Kg)	-	-	173	-	1,614
Revenues (USD)	-	-	45	-	4,896
Total					
Volumes (Kg)	18,541	9,864	22,404	9,329	23,698
Revenues (USD)	4,941,684	1,793,782	4,117,346	1,655,350	3,774,825
Average Price (USD/Kg)	267	182	184	177	159.3

Source: NAEB, cited by NISR (2018a)

4.4.3 Water Resources

Water is the most prestigious natural resource in every society. However, water resource faces growing challenges arising from demographic pressure, high demands associated with socio-economic development, degradation resulting from inappropriate land use practices; and the climate change. Rwanda has developed the National Policy for Water Resources Management in 2011 as a framework for the conservation, protection and management of water resources in Rwanda.

Since water is life, the management of water resources, in terms of quantities, distribution and quality, is one of key priorities today and therefore statistics on water resources, their abstraction, and consumption are critically needed to monitor many implementation of related policies and projects available in Rwanda.

Table 25: Water production by source location in (M^3)

Water Treatment center	District	2012	2013	2014	2015	2016-2017	2017-2018
Kimisagara	Nyarugenge	9,661,161	9,445,580	9,397,320	9,567,277	10,325,948	9,475,874
Karenge	Rwamagana	4,615,671	4,437,500	5,068,946	5,538,994	5,625,855	5,469,005
Gihira	Rubavu	2,814,753	2,963,918	3,102,529	3,184,445	3,121,998	3,318,497
Nzove	Nyarugenge	9,996,755	9,663,848	9,797,640	8,675,946	14,589,625	14,469,151
Kadahokwa	Huye	1,761,346	1,983,104	1,881,475	2,121,491	2,072,293	1,806,474
Mutobo	Musanze	2,413,930	3,521,009	4,038,811	3,423,180	2,442,878	2,488,960
Cyunyu	Rusizi	653,987	679,823	830,648	1,266,399	1,020,021	1,627,661
Gihuma	Muhanga	632,313	833,508	891,348	863,612	998,211	1,002,428
Muhazi	Rwamagana	825,464	989,740	1,117,099	1,135,704	1,232,124	1,539,900
Rwasaburo	Ngoma	501,056	471,605	481,009	438,926	473,781	565,638
Nyamabuye	Gicumbi	428,382	396,576	477,545	528,899	579,391	573,490
Gisuma	Nyamagabe	363,060	441,378	455,496	457,138	656,357	500,767
Mata&Nyabima	Nyaruguru		-	142,508	391,647	434,690	-	-
Nyagatare	Nyagatare	1,767,098	2,335,408	2,074,955	1,776,824	1,922,027	2,354,791
Gatsibo	Gatsibo		-	405,952	430,684	564,237	-	-
Mpanga	Nyanza	400,666	404,093	491,406	679,017	923,858	1,185,190
Kanyabusage	Karongi	273,749	297,278	554,037	761,597	460,370	443,349
Ngenda	Bugesera	950,239	1,094,678	1,146,893	1,156,649	1,264,496	1,258,140
Total		38,059,630	40,101,554	42,198,804	42,010,788	47,709,233	48,079,315

Source: WASAC, cited by NISR (2018a)

Figure 17: Total Water production in Rwanda (m^3)
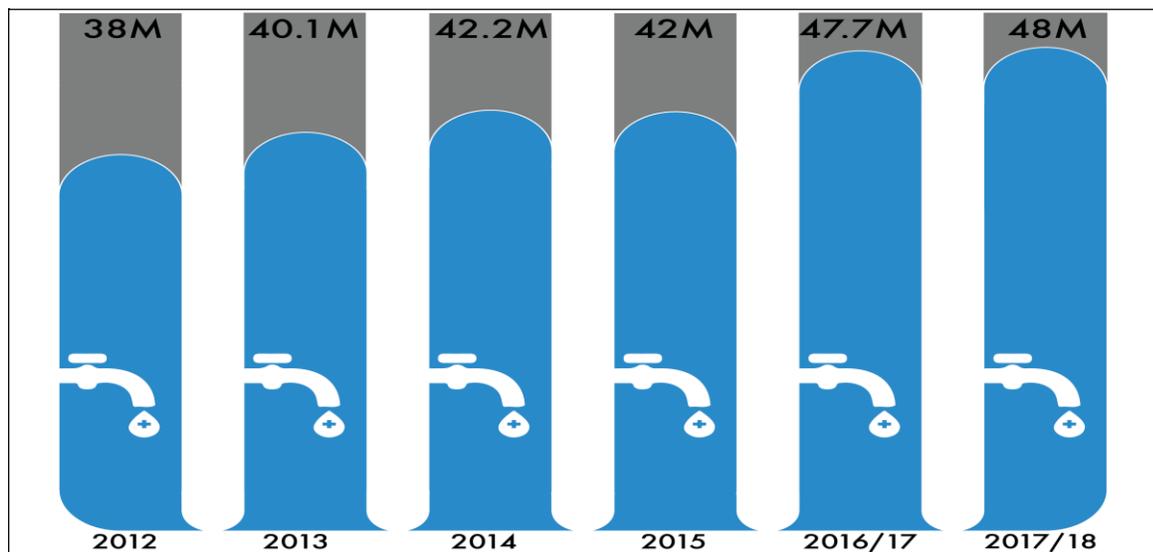
According to the EICV 5 report (2018), access to improved drinking water sources has increased in Rwanda, from 85% to 87% between 2013/14 and 2016/17. About 96% of households in Kigali City use improved drinking water source, with 46% of households using a public standpipe and 34% having water piped into their dwellings/yards. Kigali City has the largest percentage of households using improved drinking water source (96%) and Eastern Province has the lowest percentage of households using improved drinking water source (83%). Rural households can now reach an improved drinking water source more quickly than they could three years ago.

Table 26: Consumption price by quantity

	2010	2011	2012	2013	2014	2015	2016-2017	2017-2018
0-5 m^3	240	240	240	240	240	323	323	323
0-5 m^3	240	240	240	240	240	323	323	323
6-20 m^3	300	300	300	300	300	331	331	331
21-50 m^3	400	400	400	400	400	413	413	413
51-100 m^3	650	650	650	650	650	736	736	736
> 101 m^3	740	740	740	740	740	847	847	847
Industries	593	593	593	593	593	736	736	736

Table 27: Water Customers

Province	Branches	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
North	Gicumbi	2,623	2,970	3,034	3,213	3,645	3,850
	Rulindo		112	120	0	0	0
	Musanze	6,450	7,655	9,322	10,361	12,073	13,124
	Total	**9,073**	**10,737**	**12,476**	**13,574**	**15,718**	**16,974**
South	Muhanga	4,258	4,952	5,599	5,874	6,878	7,826
	Nyanza	1,874	2,177	2,448	2,593	3,052	3,675
	Ruhango	1,329	1,517	1,777	1,940	2,769	3,829
	Nyamagabe	1,573	1,865	2,456	2,518	2,820	2,980
	Huye	4,772	5,378	6,071	6,457	7,101	7,441
	Total	**13,806**	**15,889**	**18,351**	**19,382**	**22,620**	**25,751**
East	Nyagatare	3,652	4,917	5,662	6,748	8,393	9,269
	Ngoma	2,085	2,329	2,610	2,805	3,335	3,570
	Rwamagana	6,840	8,215	9,388	10,038	11,509	12,281
	Nyamata	3,940	5,063	6,144	6,686	8,204	9,132
	Total	**16,517**	**20,524**	**23,804**	**26,277**	**31,441**	**34,252**
West	Rusizi	3,212	4,162	5,877	6,624	8,203	9,613
	Karongi	1,947	2,682	3,489	3,663	4,322	4,580
	Rubavu	6,728	7,441	8,104	8,529	9,288	9,738
	Total	**11,887**	**14,285**	**17,470**	**18,816**	**21,813**	**23,931**
Kigali	**Total**	**67,110**	**73,933**	**85,219**	**89,216**	100,092	106,500
General Total		**118,393**	**135,368**	**157,320**	**167,265**	**191,684**	**207,408**

Source: WASAC, cited by NISR (2018a)

Figure 18: Trend of water customers
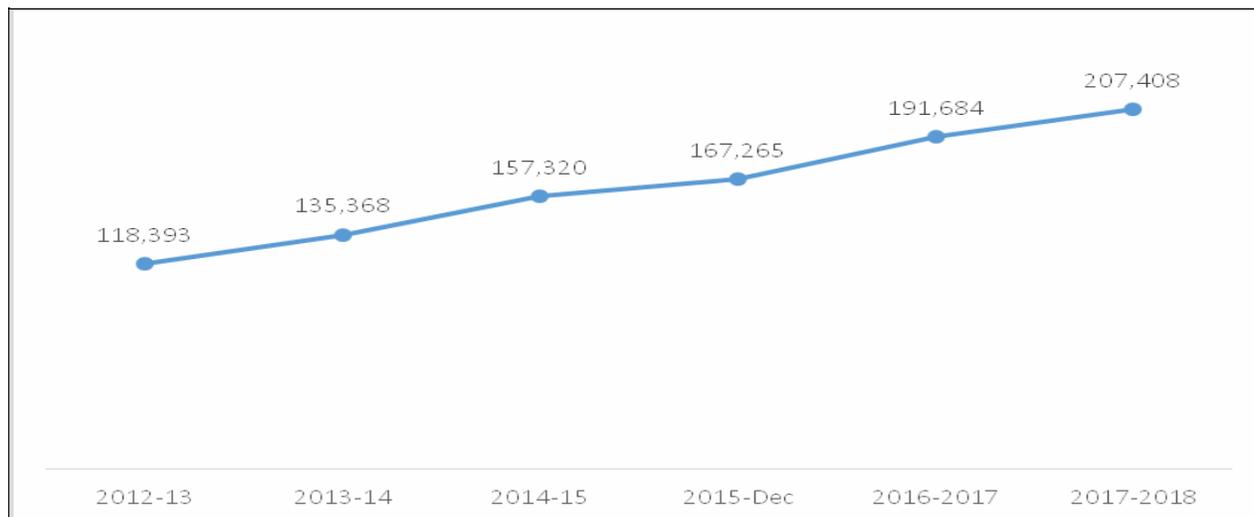
Source: WASAC, 2018

Table 28: Percentage of HHs with access to improved drinking water source by province, urban/ rural, quintile and sex of head of household

EICV5	% of that use improved drinking water	Improved drinking water source					
		Piped into dwelling/yard	Public standpipe	Borehole	Protected well	Protected spring	Rain water
All Rwanda	**87.4**	**9.4**	**35.4**	**3.0**	**1.2**	**38.3**	**0.1**
Urban/rural							
Urban	95.8	39.2	41.5	2.5	2.0	10.5	0.0
Rural	85.4	2.3	33.9	3.1	1.1	45.0	0.1
Province							
Kigali City	95.9	34	46.3	1.0	1.9	12.6	0.0
Southern Province	88.0	4.4	21.5	2.0	2.1	57.9	0.0
Western Province	86.5	5.6	35.2	0.6	0.6	44.3	0.3
Northern Province	87.5	5.7	35.9	0.1	0.9	44.9	0.0
Eastern Province	82.6	4.7	41.4	9.0	0.9	26.6	0.1
Sex of head of household							
Male	87.7	10.1	35.6	3.1	1.4	37.4	0.1
Female	86.6	7.3	34.6	2.6	0.9	41.1	0.1

Source: NISR, 2018c

Chapter Five: Residuals

5.1 Introduction

Statistics on residuals include the amount and characteristics of residuals generated by human production and consumption processes, their management, and their final release to the environment. Residuals are flows of solid, liquid and gaseous materials, and energy that are discarded, discharged or emitted by establishments and households through processes of production, consumption or accumulation. According to the FDES, the main groups of residuals are emissions of substances to air, water or soil, wastewater and waste, and the release of residuals from the application of chemical substances.

5.2 Emissions to air

Residuals may be discarded, discharged or emitted directly to the environment or be captured, collected, treated, recycled or reused. Once emitted in open spaces, they obviously turn to be called emissions to air. Eg: carbon dioxide (CO_2).

Normally carbon dioxide (CO_2) is an essential gas for life; animals exhale it, plants sequester it. It exists in Earth's atmosphere in comparably small concentrations, but is vital for sustaining life. CO_2 is also known as a greenhouse gas (GHG); a gas that absorbs and emits thermal radiation, creating the 'greenhouse effect'.

It is important to always note a clear difference between gas emissions and air pollution. Along with other greenhouse gases, such as nitrous oxide and methane, CO_2 is important in sustaining a habitable temperature for the planet. On one hand, these are considered to be ordinary gas emissions when their quantities range in a convenient proportion.

On the other hand, air pollution can be defined as the emission of harmful substances to the atmosphere. This broad definition therefore encapsulates a number of pollutants, including: Sulphur dioxide (SO_2), nitrogen oxides (NO_x), ozone (O_3), particulate matter (small suspended particles of varying sizes), carbon monoxide (CO) and volatile organic compounds (VOCs). Carbon dioxide (CO_2) and other greenhouse gases are not typically considered within this category and are most of the time treated separately (REMA, 2018).

Rwanda has one of the lowest emissions per capita in the world, estimated at 0.65 tones CO_2/ person (including land use change), compared to a global average of 4.63 tones CO_2/person. But recent economic growth has led to doubling of GHG emissions from 2003 to 2006 and this trend is set to continue.

The number of vehicles has increased from 140,149 vehicles registered in 2013 to 152,085 vehicles registered in 2014. GHG emissions from transport are approximately 5.4% of Rwanda's total emissions, some 269.9 Gg of CO_2eq. Local pollution is a concern due to the age and condition of the Rwandan fleet. (NISR, 2015).

According to the Third National Communication on climate change (2018), there is a baseline scenario developed in the LEAP software showing that, if nothing is done, GHG emissions will increase from 447.57Gg CO2 eq. in 2012 to 1,678.25 Gg CO2 eq. in 2050. GHG emissions from motorcycles are expected to be the dominant contributor to total GHG emissions from transport (REMA, 2018).

Table 29: Gas emissions by diesel-petrol-driven vehicles in Kigali City during the 2012-2013 period

Vehicle & Fuel type	Gas emissions per each type of vehicle and fuel			Total emissions
	Chemical component	Vehicles from Kigali City	Vehicles from outside Kigali	
Petrol vehicles	CO_2 (tons/year	146,500	3,767.1	150,267.1
	CO (tons/year)	13,163	338.5	13,501.5
	HC (m^3)	346,068	8,899.0	354,967.0
Diesel vehicles	CO_2 (tons/year)	366,632	9,428.0	376,060.0
	CO (tons/year)	4,781	123	4,905
Overall total gas emissions	CO_2 (tons/year)		526,327.1	
	CO (tons/year)		18.405.5	
	HC (m^3)		354,967.0	

Source: Nduwayezu et al. (2015), p.113

As indicated in Table 31, gas emissions are predominantly recorded in Kigali City, with petrol vehicles showing the highest level of carbon monoxide (CO) emission attributable to incomplete fuel combustion or partially oxidized fuel as compared with diesel-driven vehicles reported to produce less greenhouse gas emission and also have a better fuel economy and higher engine efficiency.

Table 30: Emissions of Greenhouse Gases (GHGs)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GHG Emissions per GDP (Gigaton/USD)									
14.4	13.41	11.68	10.93	11.08	10.59	9.7	9.84	9.72	10.54
GHG emissions per capita (kg per capita)									
532.39	567.22	591.49	614.83	634.9	648.43	637.48	643.1	636.77	676.23
GHG emissions from agriculture in (Gigaton CO$_2$ eq.)									
3,334.14	3,673.24	3,989.13	4,344.52	4,692.63	4,876.58	4,802.54	4,890.52	4,873.99	5,345.44

Source: REMA, 2018

A. Consumption of Ozone Depleting Substances (ODS)

Ozone-depleting substances (chlorines and bromines) can be emitted from natural and anthropogenic (man-made) sources. This is measured in tones of chlorofluorocarbon-11-equivalents (CFC$_{11}$ equivalents).

CFC$_{11}$ equivalents is a standardized measure to normalize the sum of a range of ozone-depleting substances to a value equivalent to their potential to deplete ozone.

In Rwanda the use of ODSs has been recorded over time, projects to phase them down are ongoing and a recent inventory on their potential emissions has published the following trend patterns.

Table 31: Emissions in (Gigaton CO2 eq.) from Product Uses as Substitutes for Ozone Depleting Substances

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0.42	0.84	1.27	1.72	2.2	2.71	3.26	4.29	5.63	7.18

Source: REMA, 2018

B. Waste Management and discharge of wastewater to the environment

In Rwanda all activities related to management of waste and wastewater are still developing in terms of practices and technology use. This implies that residential units are not currently serviced by centralized systems and utilities in either urban or rural areas. Today the sanitation infrastructures in Rwanda mainly include the following:

- Solid waste collection services is fully provided by the private companies and paid directly by households. The service user charge is set by the public sector represented by Rwanda Utility and Regulatory Agency (RURA) in collaboration with municipalities and private sector;

- Small wastewater treatment units specific to a building or a semi collective sewer network, which release uncontrolled treated effluent;

- Septic tanks for individual houses and small buildings which are emptied regularly with the fecal sludge disposed in dumping sites;

- Individual latrines, which are emptied regularly with the fecal sludge disposed in dumping sites.

According to the third national communication on climate change (2018), for instance in the capital city the wastes ending into the landfill was 141.38 tons/year in 2006 for the closed Nyanza landfill, and 495.76 tons/year in 2015 for current Nduba landfill.

A "collect and dump" routine is the dominant waste management modality in Rwandan cities. The management of dumping sites and landfills remains in the responsibility of the Districts and the Kigali City Council. Generally, the involvement of private sector has increased the service coverage where 90% of the population in Kigali has access to solid waste collection service in 2015 from 44% in 2012. The same improvement is also happening in other cities/towns where in 2015 an increase in service coverage was estimated to 35% from 20% in 2012.

Figure 19: % Coverage of waste collection service in Rwanda

Figure 20: Estimated amount of waste disposed (tons/year)
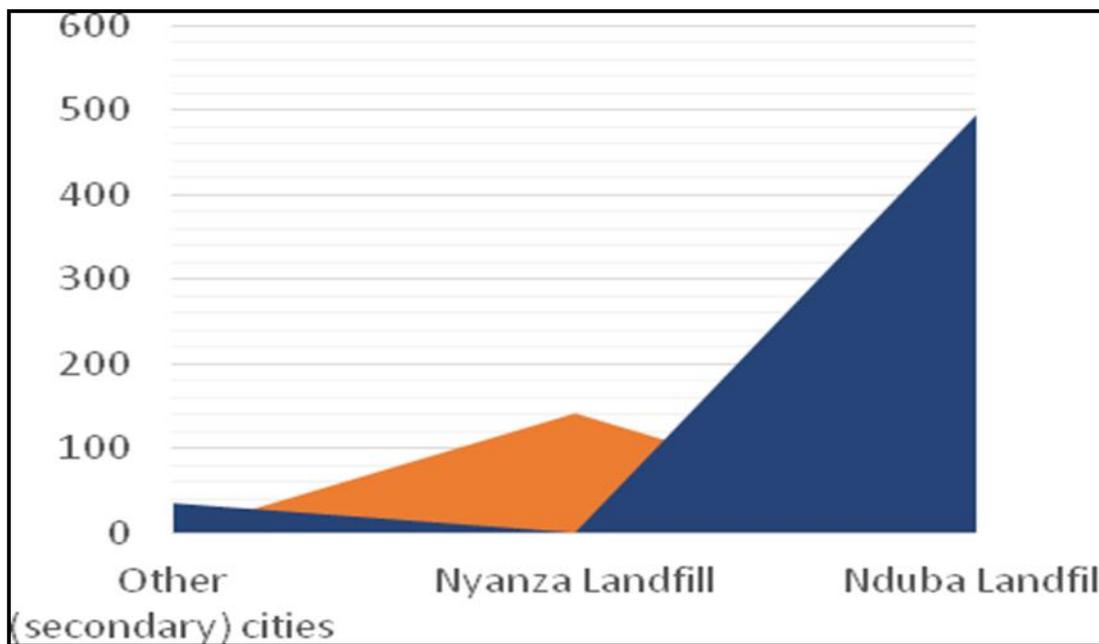
Since 2015, Kigali city strongly relies on one landfill located at North East of Kigali at Gasabo District, Nduba Hill at Muremure cell at 10 Km from Kigali Center.

The major concern here is to look on how all waste related activities are likely to affect the well-being of Rwanda population by comparing the benefits of sanitation services with the potential effects of discharging residuals into the open environment. the following graph illustrates trend of GHG emissions from 2006 to 2015.

Figure 21: Recent trend in main sources of emissions discharged from waste management sector
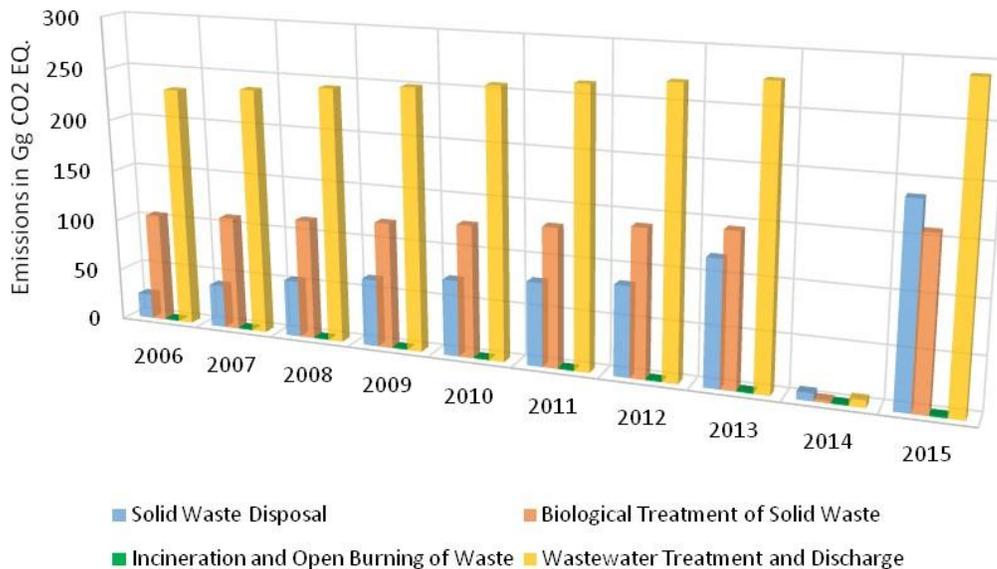
Source: REMA, 2018

According to RSB (2018), clean and safe drinking water, effective wastewater treatment, clean air, and proper waste disposal are basic elements for a high quality of life for people living in cities across the country.

Figure 22: Access to clean energy & access to regular waste collection

Source: REMA, 2018
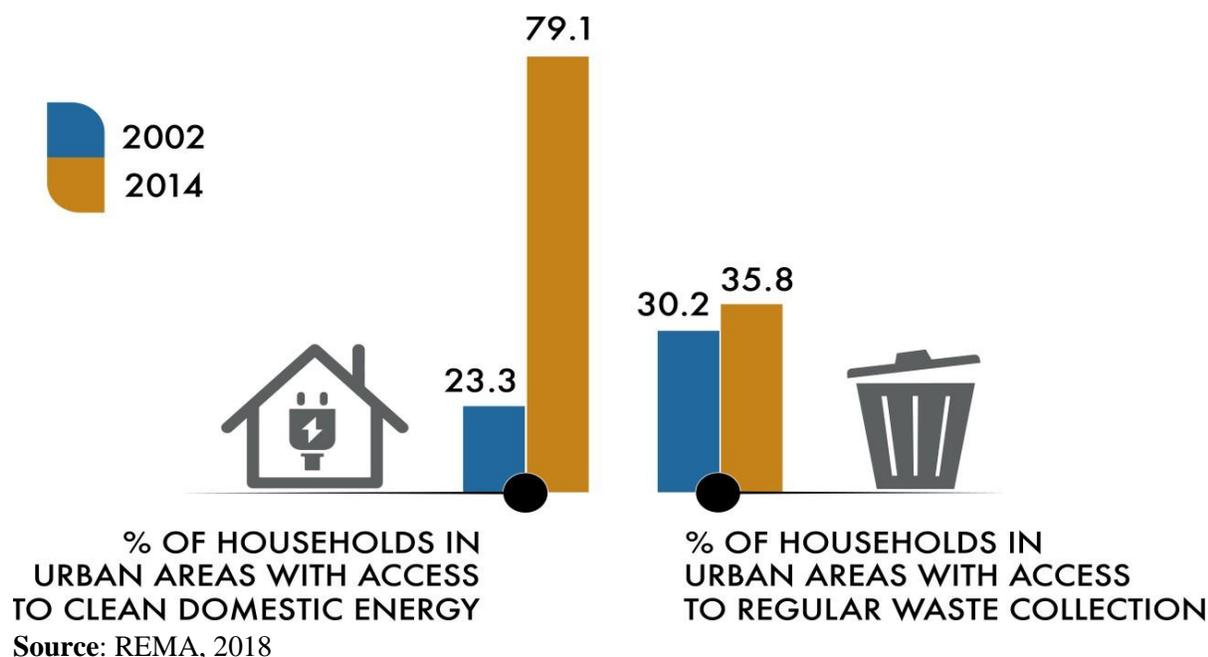
Solid waste is often called non-hazardous waste. Waste in the form of powders, liquids, and gases is reported as hazardous regardless of its toxic properties because it needs special handling to avoid unwanted dispersal. Although not considered hazardous, solid waste can cause considerable harm and damage, and may lead to diseases, air pollution and the poisoning of water sources for people and animals. Solid Waste (SW), refers to what we throw away each day in our cities and towns such as old appliances, household garbage and just about anything you can think of that people throw away at home, schools, and businesses (Alice et al, 2017). The Auditor General report 2016 states issues that are associated with liquid wastes and solid wastes management in Rwanda, with a case study of Nduba landfill. The issues include inappropriate waste disposal, lack of sustainable management system for solid and liquid waste, transportation issues, discharge and standard issues, reporting, inspection and penalty issues.

C. Release of chemical substances

Apart from some industrial residuals which are yet to be monitored, this section covers mainly management and disposal of Polychlorinated Biphenyls (PCBs) which are harmful to human

health and environment when they are released. PCBs were widely used as dielectric and coolant fluids, for example in electric transformers, capacitors, and electric motors. Due to PCBs' environmental toxicity and classification as a Persistent Organic Pollutant (POP), PCB production was banned.

In 2017, REMA conducted a complete inventory and mapping of electricity transformers in the entire country. A total of 2,344 transformers were inventoried of which 283 were suspected to be contaminated with PCBs as well as sites which will require further soil and water analysis.

D. Fertilizers' application, use of pesticides & insecticides

Chemical substances can also be emitted from the use of some agricultural inputs. Those applied in Rwanda are mainly made of the following:

- ☐ Nitrogen found in such chemical fertilizers promotes cell division and leafy vegetation;
- ☐ Phosphorus helps plants with photosynthesis and respiration and
- ☐ Potassium helps plants absorb the other nutrients

In whatever case, long-term use of chemical fertilizer is risking to change the soil pH, upset beneficial microbial ecosystems, increase pests, and even contribute to the release of greenhouse gases. Consequently, this results in the worsening of soil ecological environment, and making the heavy metals, nitrate, and other harmful components in agricultural products (MINAGRI, 2014). Chemical fertilizer use increased from 4Kg/Ha in 2006 to 30Kg/Ha in 2013, while fertilizer availability increased from annual quantities of 8,000MT to 35,000MT. PSTA 3 targets that fertilizer availability increases to 55,000MT per year and fertilizer use increases to 45kg/ha in 2017/18 (MINAGRI, 2014). The figure below displays the percentage of households who spend money of chemical fertilizers.

Figure 23: Households that incurred expenditure on chemical fertilizers

37.4% — Rural

26.0% — Urban
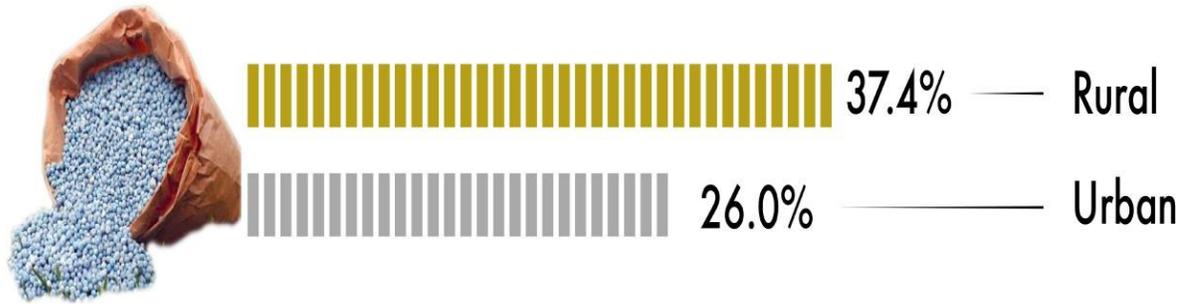
Currently in Rwanda, fertilizers are mainly used on cereals, roots and tubers, legumes, fruits and vegetables, tea and coffee. The main types of fertilizers used are urea, diammonium phosphate (DAP) and NPK formulations (mainly 17-17-17). The 25-5-5 and 20-10-10 NPK formulations are used on tea and coffee, respectively. (MINAGRI, 2014)

Figure 24: Household expenditure on fertilizers

Organic fertilizers — 9.3% — 11.9%

Chemical fertilizers — 28.9% — 36.4%

2010/11   2014/15
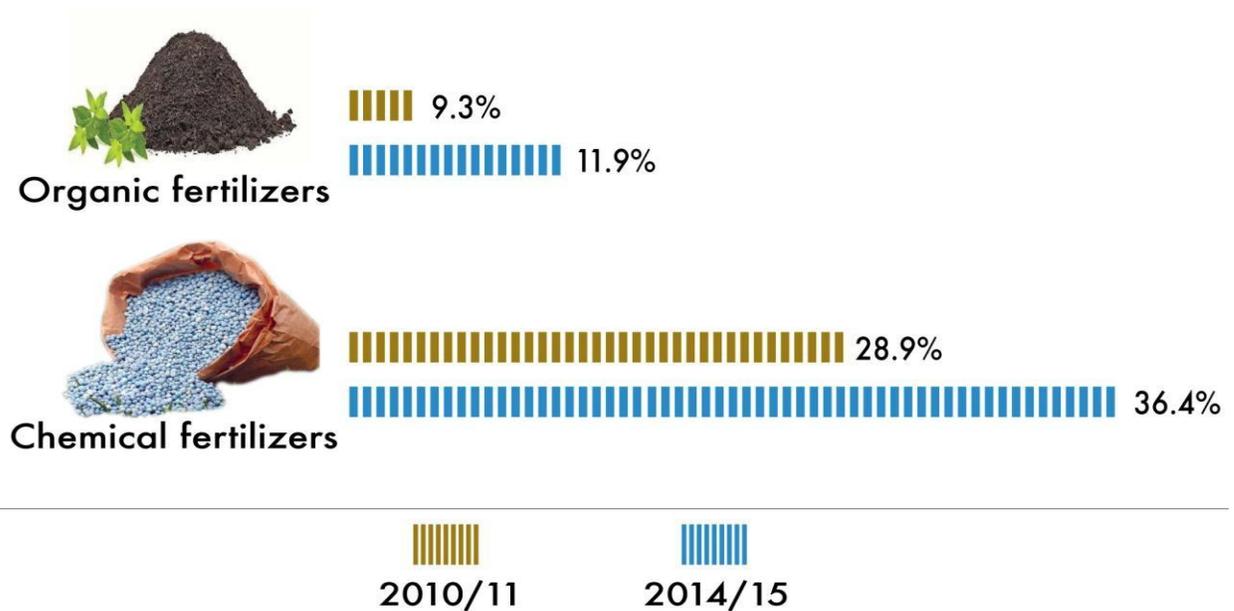
Figure 25: Percent share of fertilizer use by type and crops in 2012
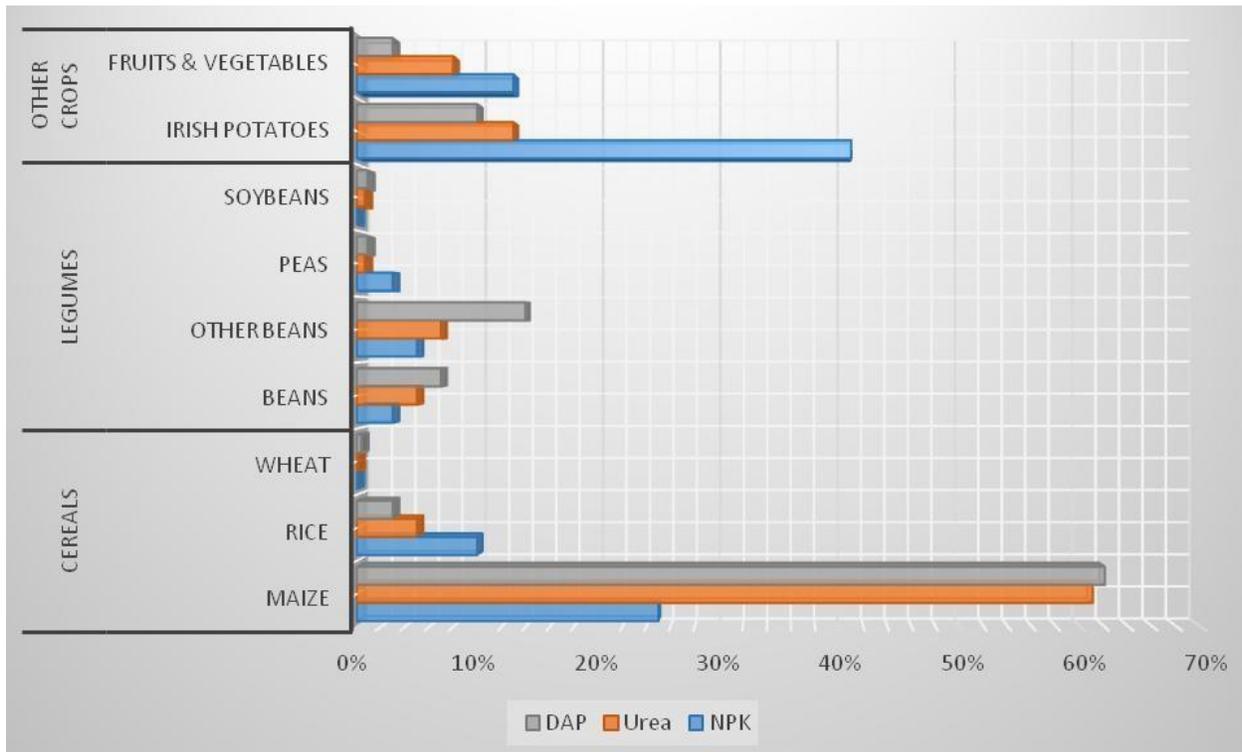
Source: MINAGRI, 2015

As special consideration, it has been estimated that for coffee and tea, the potential consumption is 15,000-20,000 MT of fertilizers per year based on the area planted and the recommended rate of fertilizer application.

Chapter Six: Extreme events and disasters

6.1 Introduction

Occurrence of disasters is obviously normal for Rwanda being a very hilly country. The country is prone to various types of disasters such as: floods, landslides, fires, epidemics, windstorms, hailstorms, lightning, earthquakes, droughts and extreme weather events. Losses from disasters have been increasing for long time due to population growth and lack of proactive disaster management planning and policies.

Among all these disasters – floods and storms are the most frequent and damaging. They also have a negative impact on the nation's development agenda. In addition to the natural factors, the losses from disasters are increasing due to the unsustainable human activities. The effects of a disaster, whether natural or human induced, are often far reaching.

The natural disasters that really affect people worldwide tend to become more intense as the years go on. In some areas, the population has gotten somewhat prepared for the eventuality of disasters and shelters are built for hurricanes and tornadoes. However, loss of property is still a problem, and predicting many natural disasters isn't easy.

Scientists, geologists, and storm watchers work hard to predict major disasters and avert as much damage as possible. With all the technology available, it has become easier to predict several weather related natural disasters. But there are still natural disasters that come up rather unexpectedly, such as earthquakes, wildfires, landslides, or even volcanic eruptions.

The severity of a disaster is measured in terms of lives lost, economic loss, and the ability of the population to rebuild. Events that occur in unpopulated areas are not considered disasters. So a flood on an uninhabited island would not count as a disaster, but a flood in a populated area is called a natural disaster.

All natural disasters cause loss in some way. Depending on the severity, lives can be lost in any number of disasters. Falling buildings or trees, freezing to death, being washed away, or heat stroke are just some of the deadly effects. Some disasters cause more loss of life than others, and population density affects the death count as well. For the case of Rwanda, there is still a long

way to go regarding the national effort in enforcement of the existing laws which need to be extended beyond immediate mitigation and responses to already occurred disasters. This implies adoption of complete approaches of disaster management planning and preparedness.

The chapter on extreme events and disasters organizes statistics on the occurrence of extreme events and disasters and their impacts on human well-being and the infrastructure of the human subsystem. In other words, it organizes statistics on the frequency and intensity of extreme events and disasters deriving from natural phenomena, as well as their impact on human lives and habitats and the environment as a whole. Statistics on natural extreme events and disasters are important to policymakers, analysts and civil society not only to assess the impact of an ongoing disaster, but also to monitor the frequency, intensity and impact of disasters over time.

6.2 Background impacts of disasters in Rwanda

Rwanda faces major extreme events like floods, earthquakes, landslides and drought causing severe damage and costs to the Rwandan society. Economic costs of the 2007 flood were over $20 million in 2 regions (around 0.1 – 0.6% of GDP).

With ongoing land degradation and higher rainfall intensities due to climate change and larger investments due to economic development, a 5-fold increase in costs related to disaster is expected by 2030.

Over the 33-year period from 1974 to 2007, drought affected about 4 million Rwandans and 2 million were affected by floods (Zimmerman & Byizigiro, 2012). One million of people were affected by the 2005/6 drought.

6.3 Occurrence of natural/technological extreme events and disasters

Natural hazards in Rwanda can be categorized as: geological; hydro-meteorological; and biological and technological. Rwanda is subject to hydro-meteorological hazards such as droughts, floods and various types of storms (i.e., windstorms, rainstorms and thunderstorms). Geological hazards in Rwanda include earthquakes and landslides, while biological and technological hazards include traffic accidents, diseases and epidemics. (UNDP, 2013).

Figure 26: Deaths due to disasters, from 2016-2017 to 2017-2018 periods

Table 32: Reported figures on drought, earthquake, landslide and rainstorm

	Drought			**Earthquake**		**Landslide**			**Storm**
	1996	1999	2003	2002	2008	2006	2010	2016	2017
Occurrence	1	1	1	1	1	1	2	1	2
Total death				45	36	24	21	54	3
Total pop injured				108	643		17		28
Homeless							5,920	4,000	
Total affected	82,000	894,545	1000,000	1,643	643	2,000	5,937	4,000	6,553

Table 33: Reported figures and effects of floods in Rwanda

Flood									
	2001	2002	2003	2007	2008	2011	2012	2015	2016
Occurrence	2	1	1	2	1	1	1	1	1
Total death	12	69		30		14	5	2	67
Total pop injured			16		51	20		6	
Total pop affected	3,000	20,000		4,500	11,295	3,588	11,160	3,425	
Homeless			7,000						

Table 34: Reported cases and incidence of other epidemics in Rwanda

Epidemics								
	1991	1996	1998	1999	2000	2002	2004	2006
Occurrence	1	1	1	3	1	1	1	1
Total death	32	10	55	76	10	83	4	35
Total pop affected	214	106	2951	488	164	636	540	300
Total affected	214	106	2951	488	164	636	540	300

Source: EAC Compendium, 2017

Figure 27: Death due to epidemics
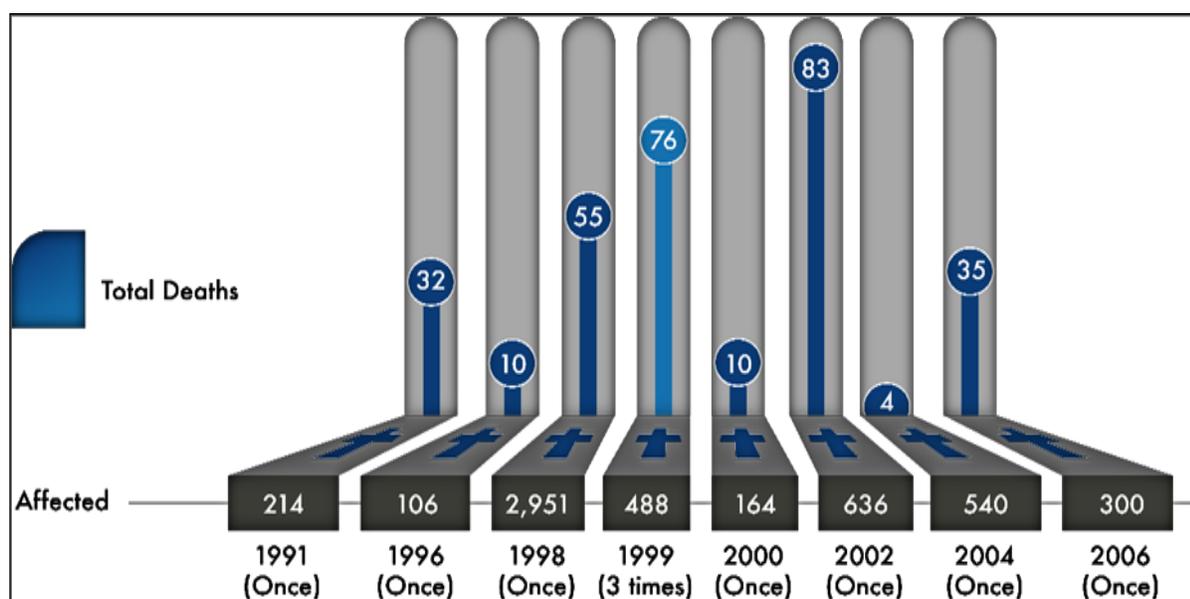
Source: Adapted from MINEMA, 2018 data

Figure 28: Number of injured due to disasters from 2016-2017, 2017-2018 and 2018-2019
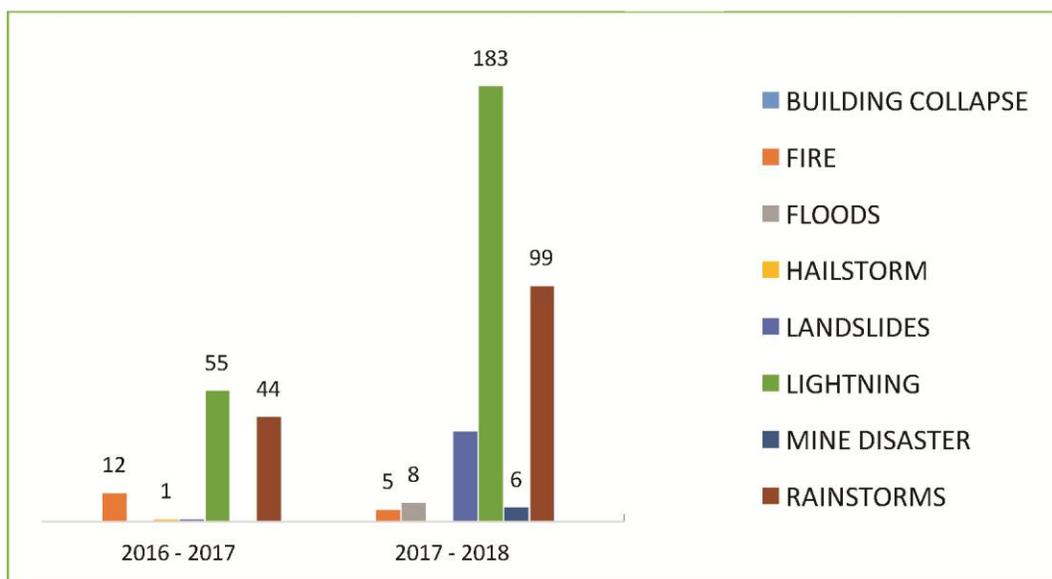
Source: MINEMA, 2018

Figure 29: Number of houses damaged due to disasters: from 2016-2017, 2017-2018 and 2018- 2019
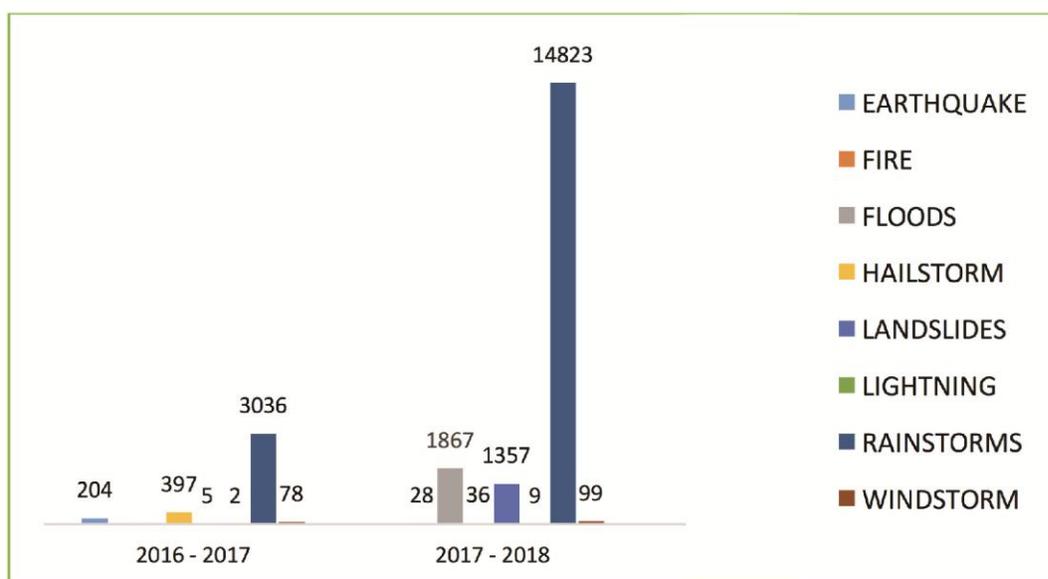
Source: MINEMA, 2018

Figure 30: Surface areas (ha) of crops damaged due to disasters: from 2016-2017, 2017-2018 and 2018-2019
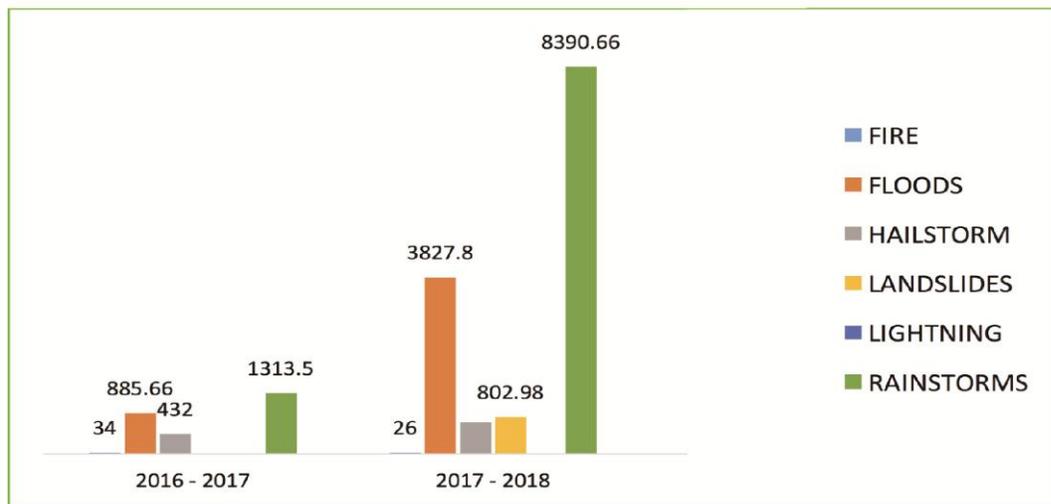
Source: MINEMA, 2018

Recently Rwanda has faced several disasters causing physical and economic damages and losses. The best known amongst these disasters are droughts that occurred in 1989, 2000, 2005- 2006 and 2014, the devastating landslides that occurred in 1988, 2006, 2010 and 2011 mainly in the northern and western provinces; the ever increasing floods across the country, the earthquake of 2008; and the windstorms that constantly hit different parts of the country (MIDIMAR, 2015).

6.3.1 Landslide exposure rate

In 2015, about 40 percent of the country's population was reported to be exposed to landslide at moderate to very high slope susceptibility. Fourteen percent of the exposed population being children aged <20 years and elderly aged >64 years. Over 1.6 million poor Rwandans (about fifteen percent of the total population) are exposed to landslides with majority coming from the Districts of Nyamagabe, Ngororero, Rutsiro, Nyabihu and Kamonyi. The housing exposure to landslides is highest in Nyabihu, Burera and Ngororero at very high slope susceptibility; and it is highest in the 3 Districts in Kigali City at high and moderate slope susceptibility.

A total of 1,478 schools are exposed to landslides at varying slope susceptibility levels. This is about 25% of the total schools in the country.

A total of 553 kilometers of paved national roads and 691 kilometers of unpaved national roads are exposed to landslides. These figures represent respectively 45% and 39% of total [classified] national paved and unpaved roads in the country. The total district roads exposed to landslides is 2,003 kilometers. This represents about 74% of the total length of the [classified] district roads in the country (REMA, 2015).

6.3.2 Earthquake exposure rate

Generally, the entire population of Rwanda is exposed with about 3.2 million people exposed to earthquake at "Modified Mercalli intensity" (MMI) scale of VII and approximately 7.3 million Rwandans are exposed to earthquake at intensity MMI VI. The population in all the districts in the western province are exposed to earthquake intensity VII including some districts in the southern and northern provinces. The rest of the country is also exposed to earthquake at intensity MMI VI. About 1.3 million poor Rwandans are exposed to earthquake of MMI VII and another 2.5 million people are exposed to earthquake of MMI VI. Exposure rate to extreme events per Province can be summarized in the table 50 for the period of 2016-2018.

Figure 31: Exposure to extreme events

	Change in temperature	Change in rainfall amount	Shift in rainfall start date	Drought episode	Flooding events	Wind events	Heat	Thunder
KIGALI CITY	0.5	0.625	0.615	0.32	0.135	0.465	0.28	0.325
SOUTHERN PROVINCE	0.62	0.725	0.685	0.575	0.225	0.525	0.47	0.45
WESTERN PROVINCE	0.38	0.64	0.575	0.32	0.26	0.53	0.265	0.555
NORTHERN PROVINCE	0.365	0.66	0.685	0.12	0.18	0.415	0.085	0.55
EASTERN PROVINCE	0.695	0.825	0.82	0.595	0.13	0.51	0.72	0.4

Source: REMA, 2015

Table 35: Disaster effects situation report (2016-2017, 2017-2018, 2018-2019)

Event	Deaths	Injured/ Trauma	House damaged	Crops Ha	Livestock	Class room	Health Centers	Roads	Churches	Bridges	Administrative Offices	Water supply	Translines
BUILDING COLLAPSE	1	3	0	0	0	0	0	0	1	0	0	0	0
EARTHQUAKE		0	204	0	0	0	1	0	0	0	0	0	0
FIRE	4	17	65	64	3	7	0	0	1	0	2	0	0
FLOODS	35	8	1931	4717.96	940	1	1	4	0	40	0	4	0
HAILSTORM	0	1	611	2688.5	2	1	0	0	0	0	0	0	0
LANDSLIDES	93	39	1366	872.48	128	0	0	20	1	30	0	4	2
LIGHTNING	105	271	11	1	101	0	0	0	3	0	1	0	7
MINE DISASTER	13	6	0	0	0	0	0	0	0	0	0	0	0
RAINSTORMS	117	186	18934	9906.66	291	289	6	23	60	43	30	3	95
WINDSTORM	0	0	181	0	0	7	0	0	2	0	0	0	1
TOTAL	368	531	23,303	18,250.6	1,465	305	8	47	68	113	33	11	105

Source: MINEMA, 2018

Chapter Seven: Human settlement and Environmental Health

7.1 Introduction

In 2012, Rwanda's level of urbanization was about 19 percent as compared to an average of 42 percent for Sub-Saharan Africa and over 50 percent globally. Based on UN population forecasts, Rwanda's urbanization is expected to reach 43 percent by 2050. The fast development of cities in Rwanda is very recent, and its annual urban growth rate of 4.5 per cent far exceeds the worldwide average of 1.8 per cent (MININFRA, 2011).

In highly ranking priorities, the State aims at upgrading settlements with potable water and electricity, improving roads and ensuring a better system of waste management as major elements of the SDGs, NST_1, Vision 2020 and the Urbanization Policy 2015. The later emphasize on improving the wellbeing of city dwellers by promoting the health and equitable development of the people as well as reducing their vulnerability to climate change.

7.2 Urban and rural population

According to the last National Census of 2012, the majority of the population of each province lives in rural areas. It shows the proportion of the population of each province living in urban areas. It is obvious that Kigali, the capital city has the highest proportion 76%, meaning that three inhabitants in four live in an urban area. The Western Province follows but with a proportion of only 12% people living in urban area, and the proportions of people living in urban areas for the remaining provinces are between 7% and 9%.

Figure 32: Rwanda Urbanization status by Province
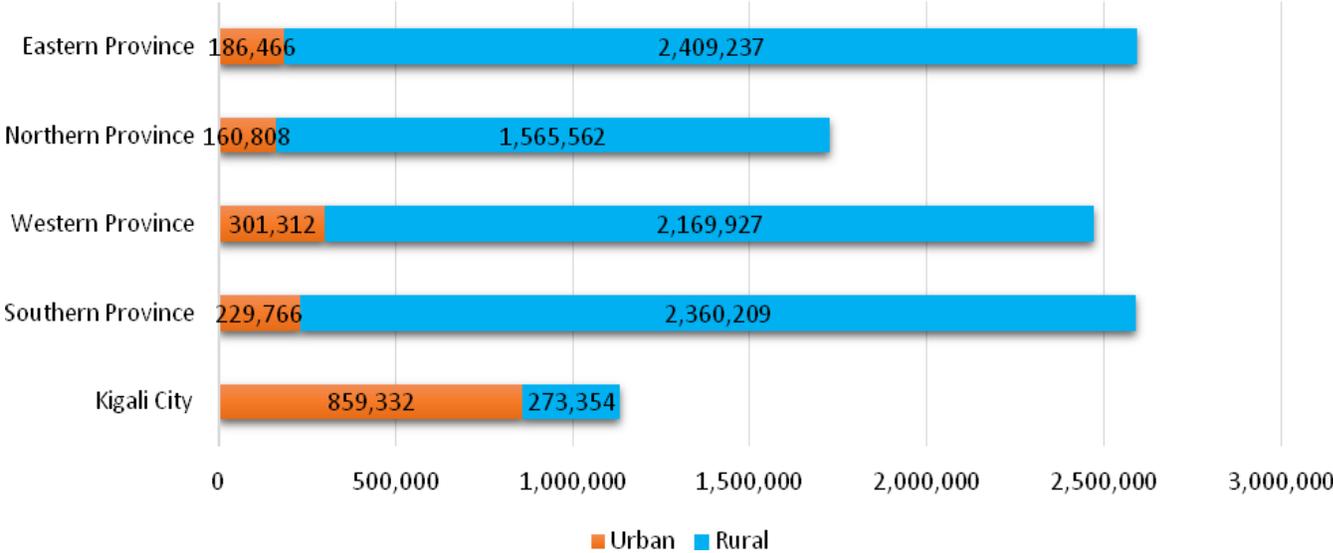
Source: NISR, 2012.

7.3 Access to selected basic services

To fulfill elementary requirements of developmental state, Rwanda has to ensure that all citizens, especially those belonging to poor and vulnerable groups have access to basic services. The national regal system highlights the public responsibility to ensure that such services are progressively expanded to all, within the limits of available resources. Basic services include: Education, Health care, Social welfare, Transport, Electricity and energy as well as Water and sanitation.

Figure 33: Primary fuel used for cooking

2013/14   2016/17

	2013/14	2016/17
Others	0.8%	0.9%
Gas	0.1%	1.1%
Charcoal	15.2%	17.4%
Firewood	83.3%	79.9%
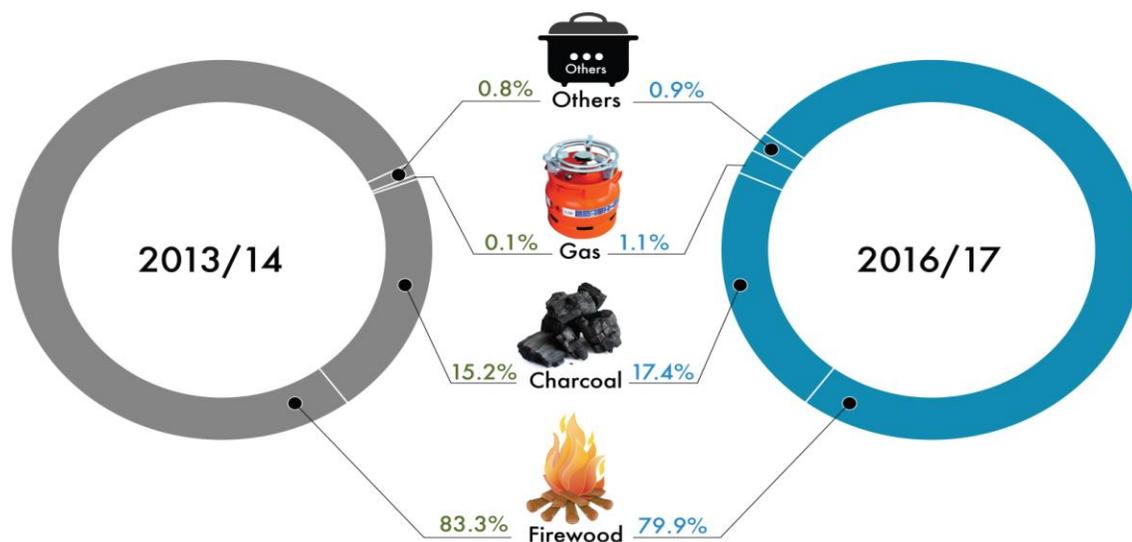
Source: NISR, 2018c

Figure 34: Percentage of households that use charcoal as main cooking fuel

2005/06 ⟩ 7.9
2010/11 ⟩ 10.6
2013/14 ⟩ 15.2
2016/17 ⟩ 17.4
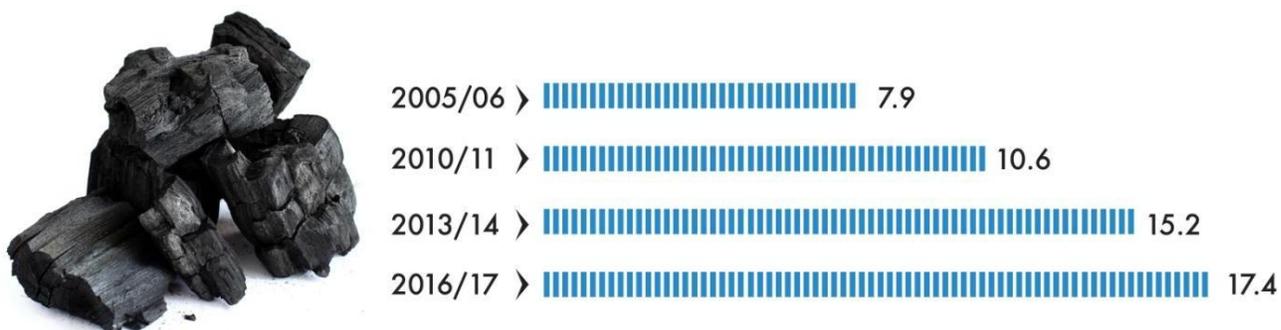
Source: NISR, 2018c

Current progress shows that Rwanda is achieving a good level of infrastructure development as portrayed in EICV 4 where data show that the mean walking time to services such as markets, health centers, primary and secondary schools in rural areas has reduced. For example, households who walk 1-2 hours to a health centre reduced from 41% in 2010-11 to 37% in 2013; while those who walk less than 30 minutes to a health centre increased from 13.5% in 2010-11 to 18% in 2013-14.

Figure 35: Trend of walking distance to a health center from 2010 to 2014

| HOUSEHOLDS WHO WALK 1-2 HOURS TO A HEALTH CENTER | HOUSEHOLDS WHO WALKS LESS THAN 30 MINUTES TO A HEALTH CENTER |

2010/11   2013/14

41%   37%   13.5%   18%
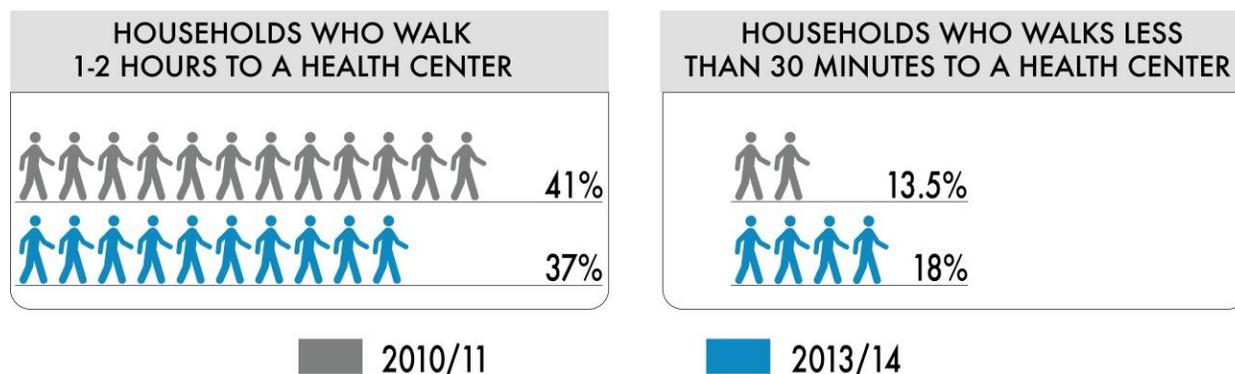
Source: NISR, EICV3 &4

The rate of using an improved drinking water source is higher in urban areas (90%) compared to rural areas (84%). At national level, 25% of households are within 0–4 minutes walking distance of an improved drinking water source while 58% of households are within 0–14 minutes walking distance (one-way).

In general, the proportion of households having access to improved sanitation increased from 75% in 2010-11 to 83% in 2013-14.

Figure 36: Percent of HHs (in urban) with access to drinking water

2005/06 > 70.3
2010/11 > 74.2
2013/14 > 84.8
2016/17 > 87.4
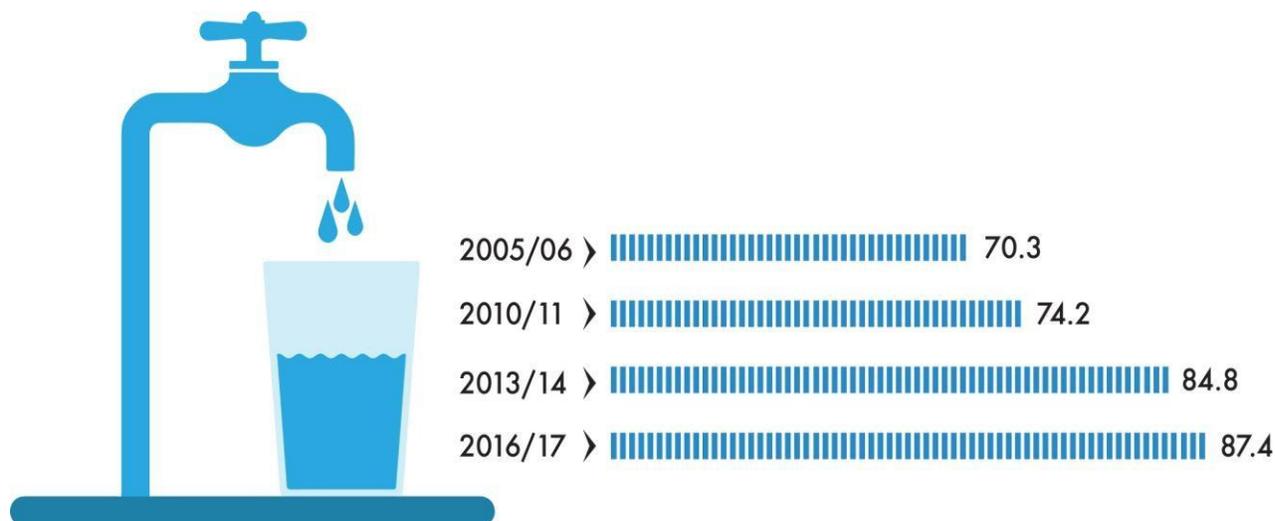
Source: NISR, EICV2, EICV3, EICV4, EICV5

Figure 37: Drinking water 2016/17
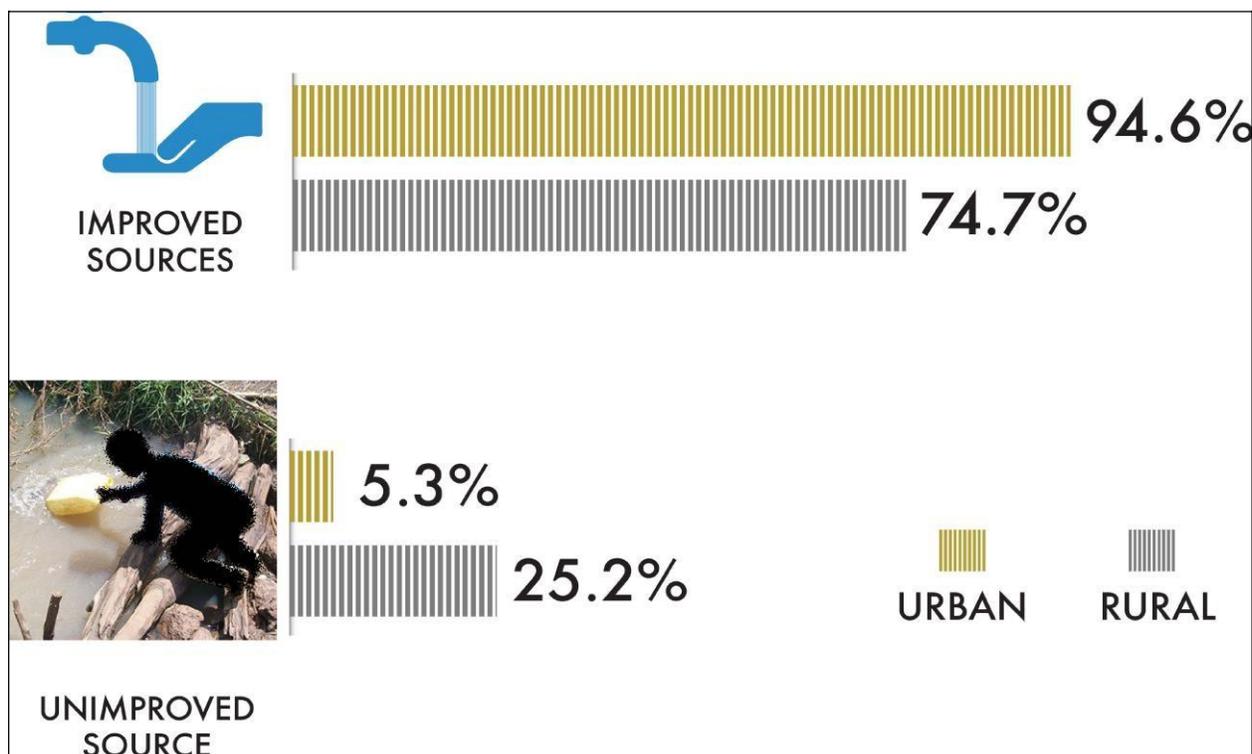
Source: NISR, 2018c

7.4 Housing conditions

During last National Census, Kigali was hosting about half of the urban population in Rwanda, it was estimated that total housing needs reach 458,256 units, of which 344,068 are to be newly constructed. Broken down to different purchasing powers, this was translated to:

- 43,436 units for social housing (12.6%);
- 186,163 units for affordable housing (54.1%);
- 112,867 units for mid-range housing (32.8%); and
- 1,601 units for premium housing (0.5%), for Kigali City.

Countrywide, the demand has not been thoroughly researched yet and studies are in preparation; it is estimated double of the total need in Kigali.

Despite this, significant progress has been made in the area of improving dwelling quality. For instance the use of metal sheets as roofing material has become more common across the country, with a rate of 61% at national level in 2013-14 compared to 54% in 2010-11.

Figure 38: Percentage of people with access to adequate housing vs those living in slums
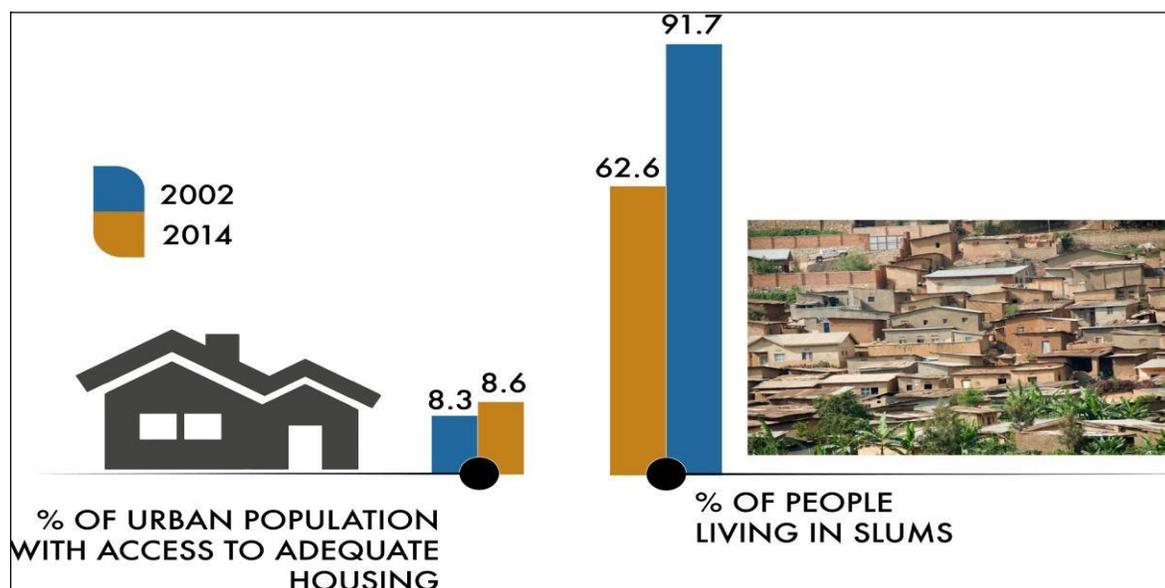
Source: NISR, 2015

The majority of households country wide use mud bricks as wall construction materials (36%), while those using tree trunks with mud has decreased in rural areas from 40% in 2010-11 to 33% in 2013-14. The proportion of households that use mud bricks covered with cement has increased notably from 19% in 2010-11 to 24% in 2013-14 at national level.

Figure 39: Change in urban characteristics of Rwanda settlement between 2012 and 2014

	Percentage of people living in slums	Percentage of urban population with access to adequate housing	Percentage of households in urban areas with access to safe drinking water	Percentage of people residing in urban areas with access to adequate sanitation	Percentage of households in urban areas with flush toilets	Percentage of households in urban areas with access to regular waste collection	Percentage of households in urban areas with access to clean domestic energy	Percentage of people residing in urban areas with access to public transport
2002	91.7	8.3	79.3		2.2	30.2	23.3	
2014	62.6	8.6	90	93.5	8.6	35.8	79.1	87.2

Source: MININFRA, 2015

In transport sub-sector, the proportion of households accessing all-weather roads regularly or often has increased by three percentage points from 93% in 2010-11 to 96% in 2013-14 at national level. The majority of rural households in Rwanda walk to an all-weather road in less than 20 minutes. The usage rate of public transport stages, in 2013-14 stands at 82% in urban areas compared to 43.5% in rural areas. In 2015, about 18% and 65% of rural and urban households respectively used to walk less than 20 minutes to a public transport stage. (NISR, 2015).

7.5 Exposure to ambient pollution

In 2012, over three million premature deaths globally were attributed to poor ambient air quality. Approximately 87% of these deaths occurred in low and middle-income countries. In the same period, Rwanda recorded 2,227 deaths attributed to ambient air pollution and resulted in a total of 108,622 years of life lost. The main cause of death and years of life lost from poor air quality in Rwanda was acute lower respiratory disease or stroke.

Long term health conditions associated with poor air quality can also put a strain on health services. The top cause of morbidity in health centres in Rwanda was acute respiratory infections, accounting for 21.7% of all patients admitted to health centres and 6.8% of patients admitted to hospitals. Respiratory infections are the largest cause of deaths in children under the age of five in Rwanda. Here is the status of morbidity resulting from ambient air pollution:

Figure 40: Number of deaths attributed to ambient air pollution in Rwanda
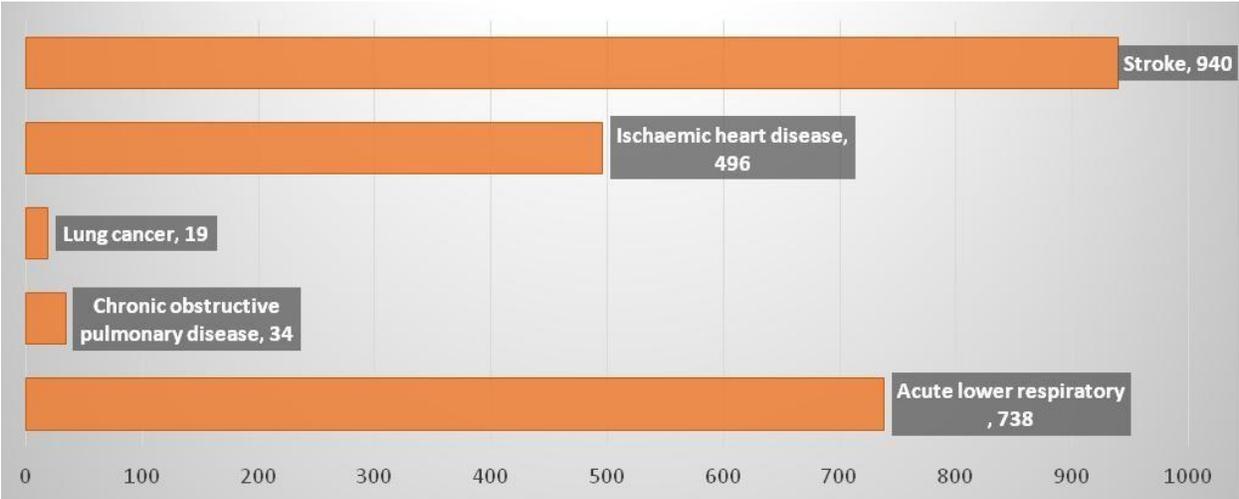
Source: MoH, 2017

There is an obvious linkage between air pollution and serious cardio- vascular & respiratory diseases. According to the International Journal of PharmTech Research; carbon monoxide, fine particulate matters sulfur dioxide, nitrogen dioxide, and ozone are the air pollutants that cause stroke, of which fine particles have major role.

7.6 Environmental concerns specific to urban settlements

Today, more than half of the world's population lives in cities, a proportion that will grow to about two-thirds by 2050. With natural population growth and as people increasingly move to cities, attracted by job opportunities and the promise of a better life, the pressure on urban areas increases. Newcomers need housing and services, such as water, energy, waste management, sanitation, roads, education and health care, among others. Urban growth can quickly outpace the ability of municipal governments to provide needed services to everyone.

In Rwanda, only 16.6 per cent of the population lives in urban areas and the country has one of the highest annual urban growth rates worldwide. This has often resulted in unplanned settlements in environmentally fragile areas such as on steep slopes or in wetlands. In turn, the pressure on the environment can result in eroding soils causing landslides; polluted waters, which can lead to water- borne illness; and increased traffic that fouls the air and affects respiratory health. Unplanned urban growth threatens the very land and waters that support human life and allow for economic growth.

The main environmental issues facing the city include the fact that almost 80 per cent of the city's residents live in unplanned settlements; despite Kigali's increased water production capacity, demand is exceeding supply; municipal sanitation and liquid waste management are still relatively poor.

Currently about 5 per cent of municipal waste is taken to the Nduba landfill and only 2 per cent is recycled; and over 95 per cent of Kigali City residents use biomass fuel for cooking, which puts pressure on forest resources and creates indoor air pollution that jeopardizes the health of those exposed.

The public transport is another important aspect of environmental concern. Under the Vision 2020 a special importance is granted to the transportation sector that plays a strategic role for the

flourishing of the socio-economic sectors by stimulating economic growth by facilitating access to domestic and international markets on one hand, while increasing internal growths of production and services by improving accessibility and mobility of people and goods on the other.

In 2012, the Government of Rwanda has decided to develop the Public Transport Policy and Strategy for Rwanda which outlines the current status, strategies, priorities and action plan for intercity, rural, international and urban public transport system for Rwanda. The main aim of this policy is therefore to reduce traffic congestion, energy use and pollution, and thus to increase mobility and accessibility of people and goods by developing an appropriate public transport system for Rwanda, which in turn would contribute more efficiently to the growth of the national economy, to the economic development and to the poverty reduction. Therefore, it is substantial value that data for monitoring, assessing and modeling public transport system performance are produced and compiled in order to ensure the aim of the policy is attained.

Figure 41: Public Transport stage
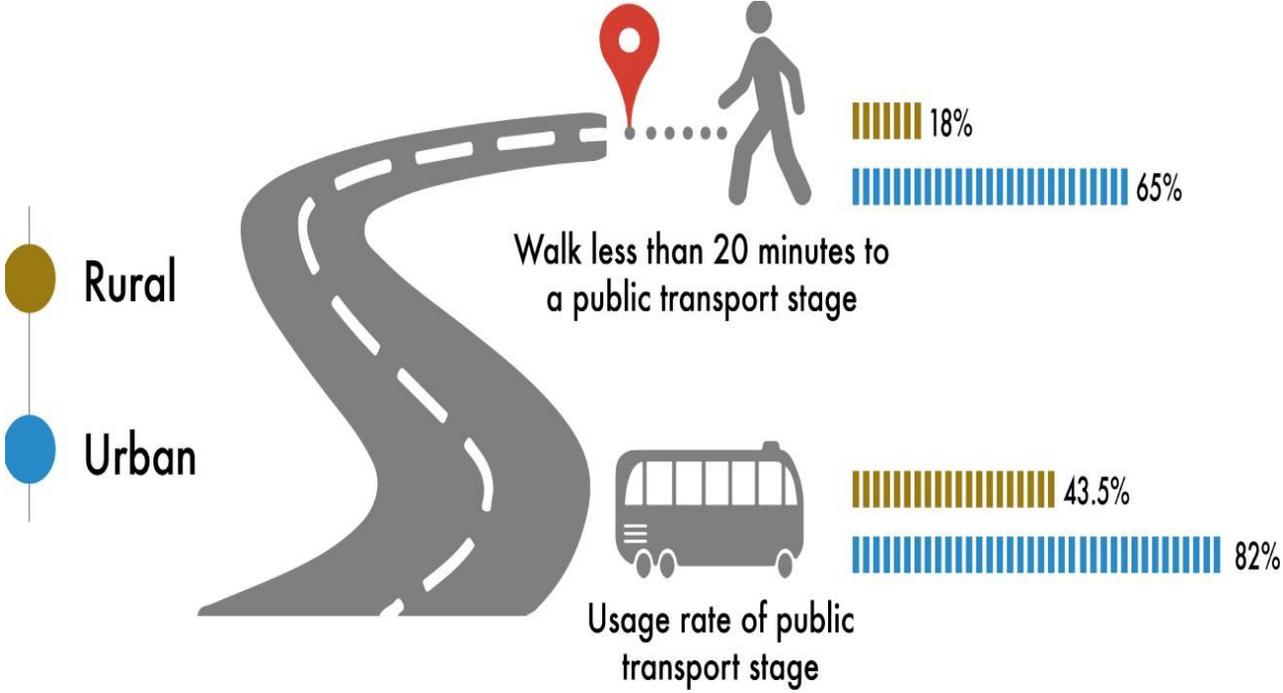
Source: NISR, 2015

Table 36: Kilometers (Km) of roads constructed in 2017/18 Fiscal year (FY) and their quality

N/O	Indicators	Units	Baseline (FY2016/l 7)	EDPRS-2 (FY2017/18)	Current performance
1	Percentage of District road Class 1 in Good condition	%	55	60	57.2
2	Number of Km of unpaved road upgraded to paved road	Km	1,526	2,002	1,916
3	Number of Km of integrated roads created in regional urban areas including disable access facilities	Km	256	140	316
4	Number of Km of scheduled bus routes (Rural, Inter-city and Urban combined)	Km	13,934	9,290	13,934
5	Number of Km of High Quality footpath and pedestrian track including disable access facilities	Km	256	200	316
6	Number of passengers transported in air transport per year by all airlines combined	Numbers	768,968	1,444,399	926,571
7	Number of Km of formal inland water transport service	Km	0	170	0

Source: MININFRA, 2018

In order to attain the desired development impact of the 7 Year Government Program, EDPRS-2, Vision 2020 and other strategic interventions, the Transport sector implemented different projects and programs alongside formulation of various institutional frameworks in the fiscal year 2017/18 (MININFRA, 2018). Transport infrastructure and services have been gradually improved to ensure policy integration in transport as a whole in nationwide social economic activities. The key objective of the Transport Sector Strategic Plan (TSSP) was to develop an integrated multimodal transport system while ensuring economy, safety, and environment sustainability.

According to the Transport Sector Backward-Looking Joint Sector Review Report 2017/18, while some indicators have surpassed the targets, others are on track or on watch but formal inland water transport service is still lagging behind to achieve the targets of EDPRS-2 (see table 40 for more details).

7.7 Airborne, Vector borne and waterborne diseases and conditions

A. Airborne diseases

According to IndexMundi 2016, lower respiratory disease is an unexpected, but serious health concern in Rwanda. The elderly, specifically those over 80, are especially vulnerable to lower respiratory infections after a lifetime of exposure to factors that cause lower respiratory infections.

Air pollution and malnutrition are the leading contributors to respiratory infections. Interestingly, neither are factors which an individual can directly control. Individuals are vulnerable to lower respiratory infections throughout their life due to these environmental factors. Tobacco, alcohol and drug usage only account for about 10 percent of lower respiratory diseases. In Rwanda Tuberculosis (TB) cases are relatively high and remained slightly constant from 5,979 to 5,759 in 2013 and 2017 respectively.. Death rate associated with TB has increased from 5% to 8.5% in 2013 and 2017 respectively. (RBC/ Tuberculosis unit cited in NISR,2018b).

Table 37: Incidence of Tuberculosis from 2012 to 2017

Year	2012	2013	2014	2015	2016	2017
TB Presumptives/TB Presumptives	165,864	185,375	204,742	181,324	161,038	161,141
TB cases all forms	6,207	5,979	5,907	5,637	5,576	5,759
TB smear positive pulmonary/ TB New pulmonary bacteriological conformed	3,571	3,870	3,571	3,754	3,717	3,826
TB retreatment cases	329	331	427	452	346	547
TB Therapeutic success (New pulmonary bacteriological conformed) in %	89	90	89	91	88.4	87.6
TB failures rate (in %)	4	3	3	2	1.6	1.3
TB Death rate associated with tuberculosis (in %)	5	5	5	5	5.8	8.5
MDR (multidrug resistant TB)	57	40	157	94	79	80

Source: RBC/Tuberculosis unit, cited by NISR, 2018b

B. Waterborne diseases

According to the World Health Organization (WHO), Waterborne diseases are linked to significant disease burden worldwide. Proper household water and sanitation practices can increase resilience to waterborne disease risks. These measures include sanitary sewage disposal, safe water piping materials and storage, and education on hygienic behaviors. Energy-efficient water infrastructure and water conservation measures can also decrease the burden of waterborne diseases. Climate change-induced flooding and droughts can impact household water and sanitation infrastructure and related health risks. For instance, flooding can disperse faecal contaminants, increasing risks of outbreaks of foodborne and waterborne diseases such as Hepatitis A, Typhoid fever, Diarhea, etc.

C. Vector borne diseases

This section includes commonly acquired through the bite of an infected arthropod: **Malaria** - caused by single-cell parasitic protozoa *Plasmodium*; transmitted to humans via the bite of the female Anopheles mosquito.

Its parasites multiply in the liver attacking red blood cells resulting in cycles of fever, chills, and sweats accompanied by anemia; death due to damage to vital organs and interruption of blood supply to the brain; endemic in 100, mostly tropical, countries with 90% of cases and the majority of 1.5-2.5 million estimated annual deaths occurring in sub-Saharan Africa.

In 2013, 900,000 people in Rwanda were diagnosed with malaria and of these, 409 died, with 30 per cent of them being children under five. In Rwanda, malaria proportional mortality rate among people above 5 years increased from 4.2% in 2012 to 9.4 % in 2014, before decreasing slightly to 8.7 in 2016 and to 4.5% in 2017.

Table 38: Malaria proportional Mortality 2009-2013

Year	2012	2013	2014	2015	2016	2017
Under 5 Deaths due to Malaria	48	64	173	130	158	139
Above 5 Deaths due to Malaria	314	401	416	401	685	244
Under 5 Malaria proportional Mortality (%)	2.91	3.45	3.41	3.0	3.8	3.6
Above 5 malaria proportional Mortality (%)	4.26	5.51	9.4	5.6	8.7	4.5

Source: RBC/Malaria unit, cited by NISR, 2018b

Chapter Eight: Environmental protection, management and engagement

8.1 Introduction

Rwanda's engagement in the protection and management of the environment and, therefore, the resources it dedicates to that task, is related to information, awareness and social demand. It is also related to the Rwanda's ability to finance environmental protection activities and participate in international efforts directed at these activities. International stewardship, national political engagement, civil society participation, and effective policies and programmes have a role to play in mutually reinforcing each other.

The chapter 8 of this compendium is related to the component 6 of FDES (2013) and organizes information on environmental protection and resource management expenditure to improve the environment and maintain ecosystem health. Statistics on environmental governance, institutional strength, enforcement of regulations and extreme event preparedness are also considered. This chapter also includes information on a wide variety of programmes and actions to increase awareness, including environmental information and education, as well as private and community activities aimed at diminishing environmental impacts and improving the quality of local environments.

The statistics and indicators included in this chapter have been structured as per the above mentioned components and sub-components. Whenever it was possible, statistics were included for each sub-component. To avoid duplication, "**Extreme event preparedness and disasters management"** which was covered in chapter 6 is not included in chapter 8.

8.2 Environmental protection and resource management expenditure

The environmental protection and resource management expenditure measure the public and private commitment to protect, restore and manage environment for more sustainable use. In other word it is the money spent on all purposeful activities directly aimed at the prevention, reduction and elimination of pollution or nuisances resulting from production processes or from the consumption of goods and services. For the public sector administrative, monitoring and enforcement expenditures are included.

- Main data are provided by surveys, administrative records or corporate reports:

> ➢ Environmental protection activities: air, climate, waste, soil, biodiversity, ...
>
> Resource management activities: reducing extraction, restoration, finding substitutes, monitoring, production of goods & services to manage.

- Challenges encountered:
  - ➢ Disaggregating environmental from related expenditures
  - ➢ Distinguishing "primary purpose"

Economic activities whose primary purpose is to reduce or eliminate pressures on the environment or to make more efficient use of natural resources:

- ✓ Environmental restoration, conservation;
- ✓ Resource management;
- ✓ Technologies to reduce impacts;
- ✓ Taxes, subsidies and permits.

The Rwanda's Green Fund (FONERWA) is an initiative of the Government of Rwanda to support environment protection and deal with the impact of climate change. The fund is a cross sectoral financing mechanism (Government of Rwanda and development partners) to achieve development objectives of environmentally sustainable, climate resilient and green economic growth. The Government of Rwanda has demonstrated its commitment to the fund and the nation's green growth by contributing US $4 million dollars. In addition, domestic capitalization sources include:

- Environmental fines and fees;

- Environmental Impact Assessment (EIA) fees such as proceeds from forestry and water funds;

- Other environmental revenue and seed financing from domestic stakeholders.

Rwanda's Green Fund is the only fund in that mobilizes financial resources from the government's own revenue sources. This makes it less vulnerable to external aid shocks.

To classifying environmental protection and resource management expenditures according to their purpose, an important distinction should be made between those who bear the expenditures. They may be the general government, corporations, non-profit institutions and households.

While the tables 39 combined both general government, corporations, non-profit institutions environmental protection and resource management expenditures, the annex 19 shows the environmental management projects executed under financial support of national or international partners according to different commitments.

Table 39: Budget programmes

Programme outcome	2010-11	2011-12	2012-13	2013-14	2014-15
Ecosystems rehabilitated	3,042,645,000	5,688,140,600	4,205,165,400	2,842,645,000	2,101,820,000
Sustainable climate change management	107,388,000	3,374,314,500	1,304,160,000	671,745,000	38,760,000
Environmental issues mainstreamed	373,125,000	976,470,000	512,745,250	518,453,763	646,668,326
National capacity for environmental information management	405,000,000	1,168,562,500	770,402,500	235,862,500	252,362,500
Pollution management ensured	97,185,000	469,794,000	327,180,000	251,769,000	312,075,000
Adequate and sustainable institutional Capacity developed	1,607,817,972	1,784,758,972	1,529,390,829	1,653,927,686	1,484,808,686

Source: REMA, (2015)

8.3 *Environmental governance and regulation*

Rwanda integrated environmental protection in its growth strategy and in most all speech of high authorities, they recognized that there is no trade-off between economic growth and protecting the environment, they complement each other. Rwanda made the headlines in September 2008 when it become one of the first countries in the world to ban plastic bags. These have since been replaced by biodegradable bags made from materials such as cotton, banana fiber papyrus and others (UNESCO, 2016). The *Second Economic Development for Poverty Reduction Strategy* (EDPRS2) pursues a 'green economy' approach to economic transformation, with a focus on green urbanization and green innovation in public and private industry.

The table 40 indicates that in Rwanda 7 national policies, 8 strategic national regulations, 15 laws and 25 Ministerial orders/instructions are in place for environmental governance and regulation.

Table 40: Environment regulations

Type of regulations	Regulations
National policies	- Rwanda Environmental Policy (2003) - National Environment and Climate Change Policy (June 2018) - National e-Waste Management Policy for Rwanda (2015) - Rwanda Tourism Policy (2009) - Sectorial Policy on Water and Sanitation (2004) - Rwanda Biodiversity Policy (September 2011) - Rwanda wildlife Policy, March 2013
Strategic national regulations	- National Strategy and Action Plan for the Conservation of Biodiversity in Rwanda (2003) - Environment Sub-Sector Strategic Plan 2010-2015 (2010) - Five-Year Strategic Plan for the Environment and Natural Resource Sector 2009-2013 (2009) - National environment and climate change Policy, June 2018 - Rwanda Environmental Education for Sustainable Development Strategy: A Strategy and Action Plan for 2010-2015 (May 2010) - National Strategy for climate Change and Low Carbon Development (2011) - Environment and Climate Change Sub-sector strategic Plan 2013/14-2017/2018 (2012) - National Biodiversity Strategy and Action Plan (December 2016)

Laws put in place 	- Organic Law determining the modalities of protection, conservation and promotion of environment in Rwanda N° 04/2005 of 08/04/2005 - Organic Law determining the modalities of protection, conservation and promotion of environment in Rwanda N° 04/2005 of 08/04/2005; - Law governing biodiversity in Rwanda N° 70/2013 of 02/09/2013 - Law determining the organization, functioning and mission of the National Fund for Environment (FONERWA) (2012) - Law determining the mission, organization and functioning of Rwanda Environment Management Authority (REMA) (2013) - Law relating to the prohibition of manufacturing, importation, use and sale of polythene bags in Rwanda N°57/2008 of 10/09/2008 - Law N° 70/2013 of 02/09/2013 Governing biodiversity in Rwanda (2013) - Law authorising the accession of Rwanda to the International Union for Conservation of Nature and Natural Resources (IUCN) N° 57/2013 of 10/08/2013 - Law authorising the ratification of the Treaty of 05 February 2005 on the conservation and sustainable management of forest ecosystems in Central Africa and establishing the Central African Forests Commission (COMIFAC) N° 58/2013 of 10/08/2013 - Law authorising the accession of Rwanda to the Regional Centre for Mapping of Resources for Development (RCMRD) N° 59/2013 of 10/08/2013 - Law governing the preservation of air quality and prevention of air pollution in Rwanda N° 18/2016 of 18/05/2016 - Law relating to disaster management N°41/2015 of 29/08/2015 - Law establishing the Gishwati -Mukura National Park Nº45/2015 of 15/10/2015 - Law N° 18/2016 of 18/05/2016 Governing the preservation of Air quality and prevention of Air pollution in Rwanda (2016) - Law N°48/2018 of 13/08/2018 on Environment (2018)
Ministerial Order/Instruction 	- Ministerial Order of 2008 related to the requirements and procedure for environmental impact assessment (2008) - Ministerial Order establishing modalities of inspecting companies or activities that pollute the environment N° 005/2008 of 15/08/2008 - Ministerial Order preventing activities that pollute the atmosphere N°003/16.01 of 15/07/2010 - Ministerial Order governing the importation and exportation of wild animals N°004/16.01 of 15/07/2010 - Ministerial Order determining the list of prohibited plains to constructions N°005/16.01 of 15/07/2010 - Ministerial Order establishing special regulations relating to burying toxic wastes N°006/16.01 of 15/07/2010 - Ministerial Order establishing modalities of inspecting companies or activities that pollute the environment N° 005/2008 of 15/08/2008

- Ministerial Order relating to the requirements and procedure for environmental impact assessment N° 003/2008 of 15/08/2008
- Ministerial Order establishing the list of works, activities and projects that have to undertake an environment impact assessment N° 004/2008 of 15/08/2008
- Ministerial Order establishing modalities of inspecting companies or activities that pollute the environment N° 005/2008 of 15/08/2008
- Ministerial Order No006/2008 of 15/08/2008 regulating the importation and exportation of ozone layer depleting substances products and equipment containing such substances N° 006/2008 of 15/08/2008
- Ministerial Order establishing the list of protected animal and plant species N° 007/2008 of 15/08/2008
- Prime Minister's Instructions No005/03 of 27/12/2013 preventing Air Pollution caused by vehicular emissions and machines using petroleum products in Rwanda (2014)
- Prime Minister's Order determining the list of chemicals and other prohibited pollutants N° 26/03 of 23/10/2008
- Prime Minister's Order determining a list of prohibited drugs unless authorized or temporary permitted N°27/03 of 23/10/2008
- Ministerial order No 007/2008 of 15/08/2008 establishing the list of protected animal and animal and plants species (2008).
- Ministerial order No 006/16.01 of 15/07/2010 establishing special regulations relating to burying toxic wastes (2010).
- Ministerial order of 2008 Establishing modalities of inspecting companies or activities that pollute the environment (2008)
- Ministerial Order determining the length of land on shores of lakes and rivers transferred to public property N° 007/16.01 of 15/07/2010
- Ministerial order N°004/MINICOM/2010 of 14/09/2010 determining the modalities of environment conservation in mining and quarry extraction (2010).
- Ministerial order of 2008 relating to requirements and procedure for environmental impact assessment (2008).
- Ministerial Instructions No 003 of 30/07/2013 relating to the Management and exploitation of used Paper (2013)
- Ministerial instruction on the use and manufacturing of Plastic bags in Rwanda (2004)
- Ministerial order N°008/16.01 of 26/11/2010 establishing rules and procedures for Rwanda environment management authorities (2010).

8.4 Participation in MEAs and environmental conventions

Rwanda has signed and/or ratified and made effective international conventions, protocols and some of the important Multilateral Environmental Agreements (MEAs) are briefly presented in table 40. Article 3 of the Official Gazette nº 41 of 14/10/2013 determining the organization, functioning and responsibilities of REMA, stipulates that REMA has the mandate to coordinate all MEAs and environmental conventions ratified by Rwanda, and the responsibility to advise the Government on policies, strategies and legislation related to the management of the environment as well as the implementation of environment related international conventions. Multilateral Environmental Agreements (MEAs) ratified by Rwanda are presented in table 41 below.

Table 41: Multilateral Environmental Agreements (MEAs) and environmental conventions signed by Rwanda

N/O	Multilateral environmental Agreements (MEA)	Rectification, Acceptance, Accession, Approval by Rwanda
	I. Conventions	
1	The United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol to the United Nations Framework Convention On Climate Change (1992) and the Paris Agreement	22/07/2004 and 6/10/2016
2	Convention on Biodiversity (CBD) (1992)	22/10/1998
3	Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (1992)	20/03/2012
4	Cartagena Protocol on Biosafety to the Convention of Biological Biodiversity	24/05/2000
5	UN Convention to combat Desertification (UNCDD)	22/10/1998
6	Stockholm Convention on Persistent Organic Pollutants/POPs	5/6/2002
7	Nile Basin Initiative (NBI) Secretariat	
8	Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal	7/6/2004
9	Bamako Convention on the Ban of the Import into Africa and the Control of Trans-boundary Movement and Management of Hazardous Wastes within Africa	26/08/1991
10	MINAMATA Convention	29/06/2017
11	Vienna Convention for the protection of ozone layer	11/10/2001
12	Montreal Protocol on Substances that Deplete the Ozone Layer	11/10/2001
13	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	7/1/2004
14	Convention on Wetlands (RAMSAR Convention)	1/4/2006

15	The Convention for the Conservation of Migratory Species of Wild Animals (CMS)	1/1/2005
16	African-Eurasian Water Birds Agreement AEWA	1/9/2014
17	Washington Agreement on International trade in Endangered Species (CITES)	18/01/1981
18	World Meteorological Organization	4/2/1963
	II Regional Bodies	
1	Central African Forest Commission (COMIFAC)	10/8/2013
2	RCMRD (Regional Centre for Mapping for Resources Development)	10/8/2013
3	IUCN (International Union for Conservation of Nature)	10/8/2013
4	African Ministerial Conference on the Environment (AMCEN)	On the sidelines of the COP22 UN Climate Talks in Morocco Rwanda attended the African Ministerial Conference on the Environment (AMCEN): Sunday 13/11/2016. Rwanda attended the African Ministerial Conference on the Environment (AMCEN): Sunday 12-16/06/2017 in Libreville
5	International Network for Bamboo and Rattan	Rwanda has a policy on planting bamboo
6	Strategic Approach to International Chemicals Management (SAICM)	Jul-02
7	Gaborone Declaration for Sustainability in Africa	25-May-12

Source: REMA, 2018

8.5 Environmental perception and awareness

Rwanda has numerous educational initiatives aimed at creating greater awareness of environmental issues, training and capacity building programmes to build a future workforce that has the knowledge and tools to protect and restore the country's natural resources and environmental assets. These include a strategy for Environmental Education for Sustainable Development (EESD) and a five-year Action Plan. The Greening Schools Programme uses EESD as a tool to mainstream environment and climate change for sustainability within the education system.

Piloted Eco-school programmes in 100 schools by two civil society organizations (ARAMA foundation and Foundation Saint Dominique Savio) and initiated in 2011 by Rwanda Environment Management Authority (REMA), the Greening Schools Programme engages children in hands-on activities aimed at creating environmental friendly learning conditions at school. The activities include: tree nursery making and tree planting, planting passparum and putting up sign posts with environmental conservation messages, hygiene and sanitation activities, activities related to resource efficiency and waste management, among others. The Greening Schools Programme was handed over to the Ministry of Education in December 2015. Furthermore, 'green schools' endeavours to extend learning beyond the classroom and help students develop responsible attitudes and commitment, both at home and in the wider community.

Table 42: Implementation of environment and climate change activities in Education sector

No	Sub Programs	Key Indicators	% Achievement 2013-14	% Achievement 2014-15	Score
	All sub programs	EIA integrated in all sub programs	20	20	Poor
1	Pre-Primary, Primary, Lower Secondary, Upper Secondary Education	Environmental Management Plan (EMP) annual reports submitted to REMA	0	0	Weak
2		Greening schools conducted	60	60	Sufficient
3		School health clubs monitored and evaluated	69	70	Sufficient
		TVET and HLIs Curriculum developed	90	80	Good
	School Health and Environment Technical Vocational education and training (TVET) and	Research on climate change conducted	80	80	Good
4	Higher Education (HLIs)	Environmental & climate change mainstreamed in education programs	49	75	Sufficient

Source: REMA, (2015)

8.6 Environmental engagement

The compendium is intended to capture any available statistics on a country's pro-environmental activities and programmes. Pro-environmental activities are those undertaken by civil society or community groups to protect, improve and manage the environment. In case of Rwanda, since 2007, a number of Non Government Organisation (NGOs) and Community Based Organisations (CBOs) working on environmental education, public awareness and climate change and development growth aspects in Rwanda were gathered under one umbrella organization known as Rwanda Environmental NGOs Forum (RENGOF). The table below highlights the current members of RENGOF, Partners, Donors and Affiliations.

Table 43 : Rwanda Environmental NGO's Forum, Partners, Donors and Affiliations

Members of RENGOF	Partners	Members	Affiliations
• APEFA • ARECO • BAIR • FHA • GREEN • COVER • JUEC • PRGP • REDO • SDEI • UNA • VER • RWANDA BAMBOO	• Ministry of Environment; • Rwanda Natural Resources Authority (RNRA); • Rwanda Environmental Management Authority (REMA); • Ministry of Agriculture (MINAGRI); • Local Administration and Community; • Community Based Associations (CBA)	• GWP (Global Water Partnership) • UNEP/UNDP • Danish Ministry of Foreign Affairs	• FONERWA (Environment and Climate Change Fund) • GoR-UN Program on Green Economy • LAFREC Project Landscape Approach to Forest restoration and Conservation • SICM *(Strengthening Institutional Capacity of MINIRENA)* LDCF (Least Developed Country Fund Project)

Source: http://www. rengofrwanda.rw/

8.7 *Environmental Information and Awareness*

The environmental Information and Awareness covers statistics about environmental information and diverse processes that contribute to increasing social awareness of environmental issues, thus promoting pro-environmental engagement and actions by the public and decision-makers at both local and national levels.

Table 44: Percent of Households (HH) received information about environmental issues, and main sources of information

EICV / Source of information	% of HHs receiving any info on environmental issues		Total number of HHs (000s)		Meetings / trainings		School		Radio/TV		Other type of media		Others	
	EICV 4	EICV 5	EICV 4	EICV 5	EICV 4	EICV 5	EICV 4	EICV 5	EICV 4	EICV 5	EICV 4	EICV 5	EICV 4	EICV 5
All	**84.9**	**81.4**	**2,493**	**2,708**	**56.2**	**64.4**	**0.6**	**0.2**	**42.9**	**34.9**	**0.1**	**0.3**	**0.2**	**0.1**
Kigali City	87.3	75.7	295	410	34.9	30.2	1.0	0.4	63.3	68.2	0.6	1.0	0.2	0.2
Southern	82.9	86	597	626	58	68.8	0.6	0.3	41.3	30.6	0.1	0.2	0	0.1
Western	77.5	74.8	559	574	68.3	72.1	0.5	0.4	30.5	27.3	0.1	0.1	0.7	0.2
Northern	89.5	76.4	394	422	65.5	70.7	0.9	0.1	33.5	29.1	0.1	0.1	0.1	0
Eastern	89.0	89.2	647	677	49.3	69.3	0.5	0.1	50.1	30.2	0.1	0.2	0	0.2
Urban	85.7	75.4	426	524	36.1	33.3	1.1	0.6	62.2	64.7	0.4	1.1	0.1	0.3
Rural	84.7	82.8	2,067	2,184	60.4	71.2	0.6	0.2	38.8	28.4	0.1	0.1	0.2	0.1

Source: NISR. EICV4 & EICV5

Figure 42: Percent of the household members who received information on environmental issues
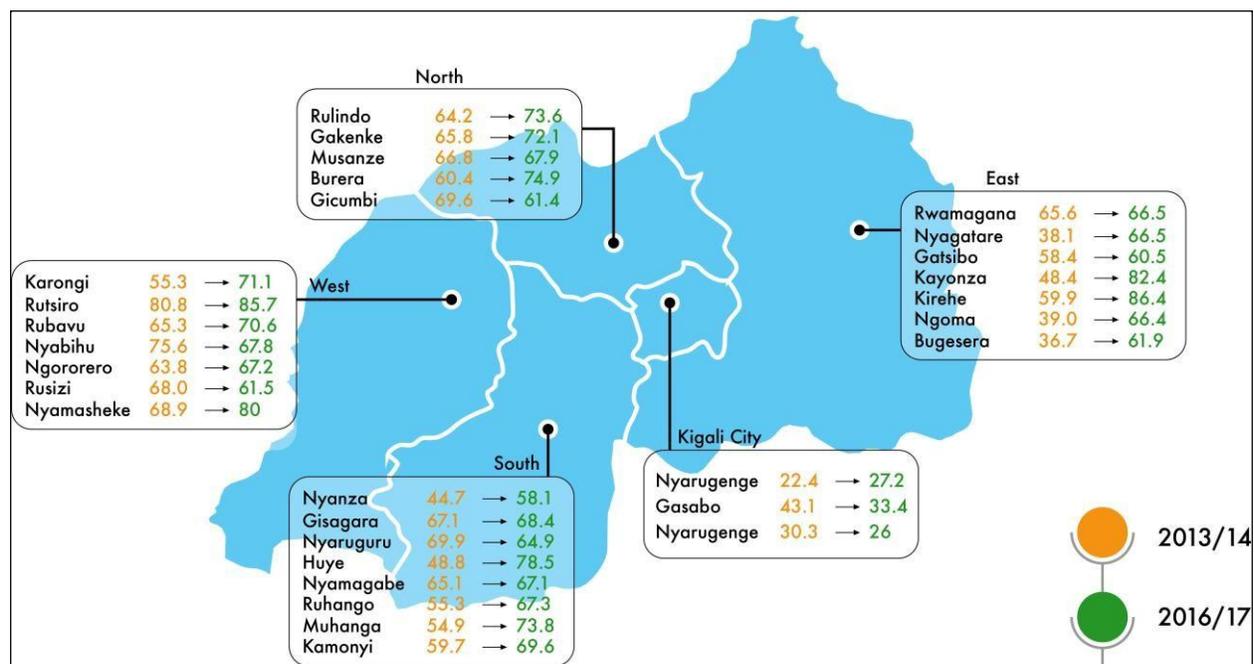
Source: NISR, EICV4 & EICV5

The table 44 and below figure show that 84.9% and 81.4% of households in Rwanda receive information on environmental issues in 2013/14 and 2016/17 respectively. For EICV4, Northern Province has the highest percentage (89.5%) of households that reported to have received information on environmental issues whereas Western Province shows the lowest percentage (77.5%). For EICV5, Eastern Province has the highest percentage (89.2%) of households that reported to have received information on environmental issues whereas Western Province shows the lowest percentage (74.8%). The main sources of information were meetings and training (56%) and radio or TV (43%). As one would expect, radio and TV were more frequently stated as the main source in urban areas than in rural areas (NISR, 2018c).

Figure 43: Environmental Information and Awareness

All Rwanda

Meetings/Training
56.2%
64.4%

Radio/TV
42.9%
34.9%

SCHOOL
0.6%
0.2%

	Rural	Urban
	60.4%	36.1%
	71.2%	33.3
	38.8%	62.2%
	28.4%	64.7%
	0.6%	1.1%
	0.2%	0.6%

● 2013/14   ● 2016/17

Source: Adapted from data of NISR, EICV4 & EICV5

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Annexes

Annex 1 : Population of Rwanda in 2012

Province & District	Count			Percent	
	Total	**Urban**	**Rural**	**Urban**	**Rural**
RWANDA	**10,515,973**	**1,737,684**	**8,778,289**	**16.5**	**83.5**
Kigali City	**1,132,686**	**859,332**	**273,354**	**75.9**	**24.1**
Nyarugenge	284,561	214,020	70,541	75.2	24.8
Gasabo	529,561	365,371	164,190	69	31
Kicukiro	318,564	279,941	38,623	87.9	12.1
Southern Province	**2,589,975**	**229,766**	**2,360,209**	**8.9**	**91.1**
Nyanza	323,719	25,417	298,302	7.9	92.1
Gisagara	322,506	5,011	317,495	1.6	98.4
Nyaruguru	294,334	5,922	288,412	2	98
Huye	328,398	52,768	275,630	16.1	83.9
Nyamagabe	341,491	24,946	316,545	7.3	92.7
Ruhango	319,885	26,059	293,826	8.1	91.9
Muhanga	319,141	50,608	268,533	15.9	84.1
Kamonyi	340,501	39,035	301,466	11.5	88.5
Western Province	**2,471,239**	**301,312**	**2,169,927**	**12.2**	**87.8**
Karongi	331,808	22,756	309,052	6.9	93.1
Rutsiro	324,654	7,034	317,620	2.2	97.8
Rubavu	403,662	149,209	254,453	37	63
Nyabihu	294,740	40,673	254,067	13.8	86.2
Ngororero	333,713	12,245	321,468	3.7	96.3
Rusizi	400,858	63,258	337,600	15.8	84.2
Nyamasheke	381,804	6,137	375,667	1.6	98.4
Northern Province	**1,726,370**	**160,808**	**1,565,562**	**9.3**	**90.7**
Rulindo	287,681	8,630	279,051	3	97
Gakenke	338,234	9,347	328,887	2.8	97.2
Musanze	368,267	102,082	266,185	27.7	72.3
Burera	336,582	6,205	330,377	1.8	98.2
Gicumbi	395,606	34,544	361,062	8.7	91.3
Eastern Province	**2,595,703**	**186,466**	**2,409,237**	**7.2**	**92.8**
Rwamagana	313,461	26,959	286,502	8.6	91.4
Nyagatare	465,855	47,480	418,375	10.2	89.8
Gatsibo	433,020	23,914	409,106	5.5	94.5
Kayonza	344,157	34,008	310,149	9.9	90.1

Kirehe	340,368	10,083	330,285	3	97
Ngoma	336,928	15,236	321,692	4.5	95.5
Bugesera	361,914	28,786	333,128	8	92

Source: NISR, (2012)

Annex 2: Evolution of the size of the urban population, 2012-2032 by projection scenarios

Projections year	High Scenario		Medium Scenario		Low Scenario		Urbanization rate
	Rwanda	Urban	Rwanda	Urban	Rwanda	Urban	
2012	10,482,641	1,732,175	10,482,641	1,732,175	10,482,641	1,732,175	16.5 %
2014	11,002,628	1,963,969	10,996,891	1,962,945	10,978,629	1,959,685	17.9 %
2015	11,274,221	2,088,549	11,262,564	2,086,390	11,225,545	2,079,532	18.5 %
2017	11,839,419	2,353,085	11,809,300	2,347,098	11,713,993	2,328,156	19.9 %
2020	12,738,767	2,789,790	12,663,116	2,773,222	12,422,803	2,720,594	21.9 %
2022	13,371,543	3,108,884	13,252,272	3,081,153	12,897,779	2,998,734	23.3 %
2027	15,064,603	4,010,951	14,779,042	3,934,920	14,137,062	3,763,993	26.6 %
2032	16,875,142	5,062,543	16,332,184	4,899,655	15,402,934	4,620,880	30 %
Increase between 2012 and 2032	61.0%	192.3%	55.8%	182.9%	46.9%	166.8%	

Annex 3: Evolution of the size of the rural population, 2012-2032 by projection scenarios

Projections Year	High Scenario		Medium Scenario		Low Scenario	
	Rwanda	Rural	Rwanda	Rural	Rwanda	Rural
2012	10,482,641	8,750,466	10,482,641	8,750,466	10,482,641	8,750,466
2014	11,002,628	9,038,659	10,996,891	9,033,946	10,978,629	9,018,944
2015	11,274,221	9,185,672	11,262,564	9,176,174	11,225,545	9,146,013
2017	11,839,419	9,486,335	11,809,300	9,462,201	11,713,993	9,385,837
2020	12,738,767	9,948,977	12,663,116	9,889,893	12,422,803	9,702,209
2022	13,371,543	10,262,660	13,252,272	10,171,119	12,897,779	9,899,045
2027	15,064,603	11,053,653	14,779,042	10,844,122	14,137,062	10,373,069
2032	16,875,142	11,812,599	16,332,184	11,432,529	15,402,934	10,782,054
% of Increase between 2012 and 2032	61.0 %	35.0 %	55.8 %	30.7 %	46.9 %	23.2 %

Annex 4: Percent of Households (HH) received information about environmental issues, and main sources of information

	Percentage of HHs received information about environmental issues, and main source s of information												
	EICV5	EICV4	EICV5	EICV4	EICV5	EICV4	EICV5	EICV4	EICV5	EICV4	EICV5	EICV4	EICV5	EICV4
	% of HHs receiving any info on environmental issues		Total number of HHs(000s)		Meetings / Trainings		School		Radio / TV		Other type of media		Others	
All Rwanda	**81.4**	**84.9**	**2,708**	**2,493**	**64.4**	**56.2**	**0.2**	**0.6**	**34.9**	**42.9**	**0.3**	**0.1**	**0.1**	**0.2**
Nyarugenge	72.9	80.8	81	73.0	27.2	22.4	0.7	0.6	70.8	76.5	1.1	0.5	0.2	0.0
Gasabo	72.8	87.4	230	147.0	33.4	43.1	0.3	1.6	64.8	54.9	1.2	0.2	0.3	0.2
Kicukiro	84.6	93.3	98	76.0	26	30.3	0.4	0.5	73	67.6	0.6	1.2	0	0.4
Nyanza	94.1	83.4	79	77.0	58.1	44.7	0.5	0.7	41.3	54.6	0	0.0	0.2	0.0
Gisagara	74.8	97.3	82	79.0	68.4	67.1	0.7	0.0	30.7	32.9	0.3	0.0	0	0.0
Nyaruguru	70.3	86.8	64	61.0	64.9	69.9	0	1.0	34.8	28.7	0	0.5	0.3	0.0
Huye	97.7	80.5	82	79.0	78.5	48.8	0	0.0	21.5	51.0	0	0.3	0	0.0
Nyamagabe	83.8	70.1	77	73.0	67.1	65.1	0.9	1.5	31.9	33.4	0	0.0	0	0.0
Ruhango	83.9	84.8	71	77.0	67.3	55.3	0.3	0.3	31.3	44.4	1	0.0	0	0.0
Muhanga	89.1	78.5	78	73.0	73.8	54.9	0.2	0.8	25.2	44.1	0.7	0.0	0	0.3
Kamonyi	90.5	81.9	93	79.0	69.6	59.7	0	0.5	30.4	39.8	0	0.0	0	0.0
Karongi	71.6	70.2	78	75.0	71.1	55.3	0	0.6	28.9	39.2	0	0.0	0	5.0
Rutsiro	67.2	82.9	73	73.0	85.7	80.8	1.2	0.7	12.6	18.5	0.1	0.0	0.3	0.0
Rubavu	86.5	71.2	96	92.0	70.6	65.3	0.5	0.0	28.7	34.8	0.2	0.0	0	0.0
Nyabihu	67	91.1	67	64.0	67.8	75.6	0.4	0.6	31.8	23.8	0	0.0	0	0.0

Ngororero	80.6	88.6	82	81.0	67.2	63.8	0.5	0.7	31.8	35.5	0	0.0	0.5	0.0
Rusizi	57.5	70.2	95	89.0	61.5	68.0	0	0.6	37.9	30.9	0	0.3	0.6	0.2
Nyamasheke	91.7	73.1	83	86.0	80	68.9	0	0.5	19.7	30.3	0	0.0	0.2	0.3
Rulindo	96.8	90.1	78	69.0	73.6	64.2	0	0.0	26.4	35.2	0	0.4	0	0.2
Gakenke	92	85.6	84	80.0	72.1	65.8	0	1.1	27.9	32.9	0	0.0	0	0.3
Musanze	71.7	88.9	91	86.0	67.9	66.8	0.4	0.8	31.8	32.4	0	0.0	0	0.0
Burera	75.4	93.2	82	74.0	74.9	60.4	0	0.9	25.1	38.7	0	0.0	0	0.0
Gicumbi	49.2	90.1	88	86.0	61.4	69.6	0	1.6	37.4	28.9	0.8	0.0	0.4	0.0
Rwamagana	90.2	95.0	89	85.0	66.5	65.6	0	0.2	33.5	34.3	0	0.0	0	0.0
Nyagatare	83.4	83.4	132	113.0	66.5	38.1	0	0.8	33.1	61.1	0.2	0.0	0.2	0.0
Gatsibo	95.2	84.3	108	105.0	60.5	58.4	0.2	0.3	38.9	41.4	0.2	0.0	0.2	0.0
Kayonza	89.7	83.8	83	86.0	82.4	48.4	0	1.1	17.3	50.5	0.1	0.0	0.2	0.0
Kirehe	88.5	95.4	87	84.0	86.4	59.9	0.2	0.4	13.1	39.5	0	0.2	0.2	0.0
Ngoma	92.7	97.5	83	81.0	66.4	39.0	0.2	0.4	32.9	60.6	0	0.0	0.4	0.0
Bugesera	86.8	87.3	95	94.0	61.9	36.7	0	0.2	37.1	62.6	1	0.5	0	0.0

Source: NISR. EICV4 &EICV5

Annex 5: Electricity production by source location

Years	2011	2012	2013	2014	2015
Total production (Kwh)	345,496,093	392,984,907	413,141,377	476,142,374	523,728,903
Gihira	2,860,223	10,546,201	9,330,220	8,610,040	8, 063 ,988
Gisenyi	991,517	3,691,476	4,850,368	5,171,248	6,554,959
Jabana I	11,506,710	6,373,200	5,041,590	15,026,840	20,935,640
Jabana II	97,794,960	106,122,907	97,451,524	97,676,287	100,404,544
Rental power Gikondo	80,458,071	82,222,772	84,693,904	76,502,005	2,514,081
Rental power II Mukungwa	0	7,682,804	67,759,450	56,291,710	0
Rukarara	34,957,140	34,556,300	32,894,260	34,600,047	43,351,818
Murunda	1,183,394	554,295	570,919	471,531	549,513
Rugezi	4,395,775	2,007,777	438,452	0	1,124,599
Keya	4,043,800	503,2	682,68	2,021,300	2,714,527
Cyimbili	342,885	1,002,302	270,9	150	216,893
Mazimeru	-	1,987,097	227,308	1,762,053	239,548
Nkora	1,245,206	2,770,000	1,442,400	99,9	1,231,203
Gasashi	-	-	53,324	3,808	0
Ntaruka	30,840,640	45,904,520	23,323,000	39,485,794	36,422,900
Mukungwa I	68,466,770	77,928,030	71,468,150	70,157,090	10,990,087
Mukungwa II	-	-	2,562,956	1,950,688	10,139,109
Solar energy Jali	298,791	305,864	142,381	297,211	201,657
Gaz methane	6,110,211	8,826,162	9,937,590	15,618,028	15,381,095

Musarara	-	-	2,848,723.4	2,818,009
Nshili 1	-	-	95,648	0
Rukarara 2	-	-	8,442,992	12,044,868
Giciye	-	-	6,824,077	9,931,998
GigaWatt Global	-	-	4,735,396	13,347,205
Nyabarongo 1	-	-	21,020,000	137,724,500
SES KSEZ	-	-	5,147,130	59,047,823
Nyabahanga	-	-	359	0
Nyirabuhombohombo	-	-	483,54	0
Janja	-	-	311,898	0
Agatobwe	-	-	125,885	126,819
Mutobo	-	-	176,169	140,596
Nyamyotsi 2	-	-	34,977	11,807
Nyamyotsi 1	-	- -		7,225
SES CIMERWA			-	19,520,377
Kivu Watt			-	7,971,510

Source: NISR, 2018b

Annex 6: Exports of Vegetables

Vegetables	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Onions					
Vols (kg)	1,476,365	1,255,929	761,808	1,222,752	1,677,652
Revenues FOB (USD)	532,134	901,415	250,526	516,348	932,003
Fresh beans					
Vols (kg)	22,647,045	15,173,917	6,873,338	7,393,525	4,376,623
Revenues FOB (USD)	5,087,584	2,629,714	1,118,087	2,877,741	1,876,718
Tomatoes fresh and paste					
Vols (kg)	-	126,376	1,726,579	2,406,509	4,321,957
Revenues FOB (USD)	-	192,242	739,677	2,683,100	4,338,172
Egg plants					
Vols (kg)	1,818	-	682,961	1,554,669	2,066,330
Revenues FOB (USD)	1,284	-	220,104	842,553	603,954
Cabbages					
Vols (kg)	1,052,434	1,505,125	1,928,713	1,848,687	2,472,651
Revenues FOB (USD)	212,329	320,162	247,242	259,632	441,922
Green Pepper					
Vols (kg)	4,236	18,370	47,943	90832	72,547
Revenues FOB (USD)	6,861	43,979	26,151	45095.61712	78,847
Red Pepper					
Vols (kg)	710	-	174,109	284231.5	357,770
Revenues FOB (USD)	976	-	178,792	338,549,3216	484,341
Carrots					
Vols (kg)	55,167	528,137	864,394	1,302,286	1,009,392
Revenues FOB (USD)	20,547	119,761	136,875	412,717	199,700
Freshpeas					
Vols (Kg)	266,248	155,584	211,493	226,779	157,842
Revenues (USD	254,602	163,989	224,903	173,034	135,205
Vols (kg)	4,680	-	-	-	-

Revenues FOB (USD)	10,497	-	-	-	-
Vols (kg)	1,043	-	-	-	-
Revenues FOB (USD)	2,231	-	-	-	-
Vols (kg)	150	-	-	-	-
Revenues FOB (USD)	120	-	-	-	-
Vols (Kg)	150	2,939	119,899	317,674	1,094,274
Revenues (USD	120	12,574	210,982	714,379	1,774,971
Cassava leaves					
Vols (Kg)	482,143	217,055	193,591	134,674	95,292
Revenues (USD	75,668	35,032	36,088	92,343	34,551
Cucumber Fresh					
Vols (Kg)	-	-	40,485	41691	135,467
Revenues (USD	-	-	12,368	223,1245,133	67,919
Ginger Fresh					
Vols (kg)	410	-	-	-	-
Revenues FOB(USD)	615	-	-	-	-
Broccoli					
Vols (kg)	-	-	-	-	3,278
Revenues FOB (USD)	-	-	-	-	5,464
Mushrooms					
Vols (Kg)	-	-	3,166	8235.7	48,282
Revenues (USD	-	-	7,238	24669.44414	214,966
Other Vegetables and spices					
Vols (kg)	5,940,189	2,686,834	2,992,462	2,394,717	2,645,817
Revenues FOB (USD)	3,284,987	1,189,045	1,072,662	1,999,292.48	1,200,620
Total					
Vols (kg)	31,933,834	21,670,266	16,620,941.13	19,227,263.21	20,635,174
Revenues FOB (USD)	9,494,442	5,607,913	4,481,694.80	11,001,765.58	12,389,352

Source: NAEB, 2018

Annex 7: Exports of Fruits

Fruits	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Oranges and other Similar					
Vols (Kg)	104,405	194,988.00	253,940	209,157	408,343
Revenues (USD	85,730	113,043.17	128,636	123,756	190,345
Passion Fruits					
Vols (Kg)	76,972	200	66,233	88,280	251,895
Revenues FOB (USD	17,004	318.48	31,767	173,220	318,404
Lemons					
Vols (Kg)	1,079	1,780.00	-	-	-
Revenues FOB (USD	1,567	1,685.58	-	-	-
Pineapples					
Vols (Kg)	340,288	256,227.00	198,683	101,697	75,675
Revenues (USD	134,604	93,740.46	83,293	167,152	251,494
Tamarillo					
Vols (Kg)	-	-	11,057	6,104	138,063
Revenues FOB (USD	-	-	6,587	4,924	185,359
Ripe Bananas					
Vols (Kg)	165,797	266,470	1,813,191	1,880,248	2,555,470
Revenues (USD	138,103	222,848	411,943	731,677	839,564
Mangoes					
Vols (Kg)	300	-	121,924	284,177	295,734
Revenues FOB (USD	300	-	46,186	138,284	129,964
Apples					
Vols (Kg)	2,985	-	60	-	45,080
Revenues FOB (USD	3,716	-	283	-	33,678
Watermelons					
Vols (kg)	5,219	3,090	-	-	-
Revenues FOB (USD)	9,400	5,172	-	-	-
Strawberry (fraise)					
Vols (Kg)	-	-	12,706	22,791	14,742

Revenues FOB (USD	-	-	13,573	20,230	10,657
Grape and wine grape					
Vols (Kg)	-	-	-	25,140	47,465
Revenues FOB (USD	-	-	-	67,359	195,222
Guava (Goyave) amapera					
Vols (Kg)	-	-	76,061	117,772	68,758
Revenues FOB (USD	-	-	19,340	28,893	16,282
Avocadoes					
Vols (Kg)	523,875	433,641	395,837	105,428	336,742
Revenues (USD	75,443	73,057.12	91,493	37,155	265,891
Redish Fresh					
Vols (Kg)	-	-	-	-	-
Revenues FOB (USD	-	-	-	-	-
Fruit Juices and Jams					
Vols (Kg)	88,672	56,678.00	77,995	2,767,046	4,070,441
Revenues (USD	25,181	88,884.31	48,965	2,553,680	3,286,469
Macadamia nut					
Vols (Kg)	-	-	45,460	87,195	233,612
Revenues (USD	-	-	159,987	458,745	1,061,197
Pears					
Vols (kg)	300	-	-	-	-
Revenues FOB (USD)	359	-	-	-	-
Okra Fresh		-	-	-	-
Vols (kg)	2,564	-	-	-	-
Revenues FOB (USD)	4,812	-	-	-	-
Other Fruits and nuts					
Vols (Kg)	574,238	535,243	535,996	222,178	215,377
Revenues (USD	160,804	470,401	216,093	79,899	106,212
Total Fruits					
Vols (Kg)	1,886,694	1,748,317	3,609,144	5,917,213	8,757,396
Revenues (USD	657,023	1,069,150	1,258,146	4,584,972	6,890,738

Source: NAEB, 2018

Annex 8: Exports of Cereals

Products		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
		Maize grains				
Formal	Vol (kg)	1,553,897	1,280,158	2,796,604	4,433,413	1,527,791
	Revenues (USD)	1,224,088	419,894	930,271	1,001,333	391,531
Informal	Vol (Kg)	3,430,950	2,172,127	2,829,160	2,536,270	4,978,024
	Revenues (USD)	686,302	297,103	375,293	712,386	1,391,537
		Total maize Grains export				
	Vol (kg)	4,984,847	3,452,285	5,625,764	6,969,683	6,505,815
	Revenues (USD)	1,910,390	716,997	1,305,564	1,713,719	1,783,067
		Wheat Grain				
Formal	Vol(kg)	1,035,914	-	2,805,073	4,099,455	-
	Revenues(USD)	1,112,507	-	1,563,530	1,377,731	-
Informal	Vol (Kg)	45,437	50,189	84,816	33,401	306,773
	Revenues(USD)	23,104	25,612	50,090	15,567	111,744
		Total wheat Grains export				
	Vol (kg)	1,081,351	50,189	2,889,889	4,132,856	306,773
	Revenues(USD)	1,135,611	25,612	1,613,620	1,393,298	111,744
		Sorghum Grains export				
Formal	Vol(kg)	19,594	183,396	525,445	3,592,670	91,352
	Revenues (USD)	4,951	55,988	632,970	1,370,728	35,712
Informal	Vol (Kg)	752,503	1,053,214	940,439	546,455	610,296
	Revenues (USD)	304,070	517,455	382,234	245,287	277,990
		Total Sorghum Grains export				
	Vol(kg)	772,097	1,236,610	1,465,884	4,139,125	701,648
	Revenues (USD)	309,021	573,443	1,015,203	1,616,015	313,701.73

		Rice Grains export				
Formal	Vol (kg)	3,428,922	29,750	6,832,900	37,856,042	59,409,169
	Revenues (USD)	1,645,266	9,968	4,668,744	25,860,926	34,316,360
Informal	Vol (Kg)	1,369,797	833,551	600,403	924697	631,395
	Revenues (USD)	1,487,080	834,408	517,102	744972.2603	563,881
		Total Rice Grains export				
	Vol (kg)	4,798,719	863,301	7,433,302	38,780,739	60,040,564
	Revenues (USD)	3,132,345	844,376	5,185,845	26,605,898	34,880,241
		Other cereals grains export				
Formal	Vol (kg)	-	1,759	-	44,970	37,303
	Revenues (USD)	-	723	-	26,479	61,416
Informal	Vol (Kg)	507,529	30,719	34,710	287	3,927
	Revenues(USD)	3,971	105,823	9,823	72	861
		Total other cereals export				
	Vol (kg)	507,529	32,478	34,710	45,257	41,230
	Revenues (USD)	3,971	106,546	9,823	26,550	62,276
		Maize Flour export				
Formal	Vol (kg)	3,166,226	11,542,044	8,453,330	11,382,416	51,803,977
	Revenues (USD)	2,442,865	8,441,838	3,680,171	4,446,879	12,244,697
Informal	Vol (Kg)	11,270,883	13,281,828	12,266,069	9,961,775	10,895,983
	Revenues (USD)	7,701,397	7,109,337	6,732,692	5,591,212	5,079,103
		Total Maize Flour export				
	Vol(kg)	14,437,109	24,823,872	20,719,399	21,344,191	62,699,960
	Revenues (USD)	10,144,262	15,551,175	10,412,863	10,038,090	17,323,800

	Wheat Flour export					
Formal	Vol(kg)	7,738,707	17,348,910	6,700,121	32,903,099	58,539,545
	Revenues (USD)	8,326,704	12,228,424	4,027,999	17,360,783	34,195,200
Informal	Vol(Kg)	2,612,901	1,047,739	1,200,256	3,409,371	489,586
	Revenues (USD)	3,103,534	972,264	792,331	2,008,751	308,487
	Total Wheat Flour export					
	Vol (kg)	10,351,608	18,396,649	7,900,377	36,312,470	59,029,131
	Revenues (USD)	11,430,238	13,200,688	4,820,330	19,369,533	34,503,687
	Sorghum flours					
Formal	Vol (kg)	-	-	-	3,140,946	29,843
	Revenues (USD)	-	-	-	1,198,342	11,169
Informal	Vol(Kg)	-	-	-	31,242	55,411
	Revenues (USD)	-	-	-	16,124	26,418
	Total sorghum flour export					
	Vol (Kg)	-	-	-	3,172,188	85,254
	Revenues (USD)	-	-	-	1,214,467	37,587
	Wheat brand					
Formal	Vol (kg)	-	-	-	15,603,625	34,730,852
	Revenues (USD)	-	-	-	1,427,762	7,225,510
Informal	Vol (kg)	-	-	-	-	-
	Revenues (USD)	-	-	-	-	-
Total wheat brand	Vol (kg)	-	-	-	15,603,625	34,730,852
	Revenues (USD)	-	-	-	1,427,762	7,225,510

					Maize brand	
Formal	Vol (kg)	-	-	-	3,864,714	4,000,163
	Revenues (USD)	-	-	-	438,053	952,491
Informal	Vol (kg)	-	-	-	-	-
	Revenues (USD)	-	-	-	-	-
Total maize brand	Vol (kg)	-	-	-	3,864,714	4,000,163
	Revenues (USD)	-	-	-	438,053	952,491
					Malt	
Formal	Vol (kg)	-	-	-	1,246,676	480,533
	Revenues (USD)	-	-	-	782,742	447,765
Informal	Vol (kg)	-	-	-	-	-
	Revenues (USD)	-	-	-	-	-
Total Malt	Vol (kg)	-	-	-	1,246,676	480,533
	Revenues (USD)	-	-	-	782,742	447,765
					Mullet flour export	
Formal	Vol (kg)	-	-	-	554	636
	Revenues (USD)	-	-	-	1,084	1,275
Informal	Vol(kg)	-	-	-	8,960	8,370
	Revenues (USD)	-	-	-	5,379	6,430
Total	Vol (kg)	-	-	-	9,514	9,006
	Revenues(USD)	-	-	-	6,463	7,705
Formal	Vol (kg)	-	-	-	1,704,754	5,849,370
	Revenues (USD)	-	-	-	2,728,733	5,818,470

Informal	Vol (kg)	-	-	-	4,592,719	2,920,280
	Revenues (USD)	-	-	-	631,823	578,707
Total Bakery, Biscuits, spageti, amandazi , feed products and Other						
	Vol (kg)	-	-	-	6,297,473	8,769,650
	Revenues (USD)	-	-	-	3,360,556	6,397,176
Other cereals flour export						
Formal	Vol (kg)	233,394	421,486	6,194,735	33,935	278779.4
	Revenues (USD)	561,616	524,514	2,664,858	42,090	207050.8677
Informal	Vol (Kg)	34,698	2,151,436	2,460,277	7,250	7,583
	Revenues (USD)	25,386	767,477	652,356	4,930	4,236
Total other cereals flour export						
	Vol (kg)	268,092	2,572,922	8,655,012	41,185	286,362
	Revenues (USD)	587,002	1,291,991	3,317,214	47,020	211,287
Grand total	Volume (kg)	37,201,352	51,428,305	54,724,337	141,959,696	237,686,941
	Revenues (USD)	28,652,841	32,310,827	27,680,463	68,040,167	104,258,040

Source: NAEB, cited by NISR (2018a)

Annex 9: Limits levels for emission sources

Pollutant	Guideline	Limit Level	Test Method
Sulphur oxides* SO$_x$	Large Combustion Plants (LCP) using solid fuel with thermal effect of:	Yearly average of:	IS0 4221: 1980,
	50 to 100 MWth	850 mg/Nm^3	
	100 to 300 MWth	200 mg/Nm^3	
	> 300 MWth	200 mg/Nm^3	
	LCP using liquid fuel with thermal effect of: 50 to 100 MWth	850 mg/Nm^3	
	100 to 300 MWth	400 to 200 mg/Nm^3 (linear decrease)	
	> 300 MWth	200 mg/Nm^3	

	LCP using gaseous fuel	35 mg/Nm^3	
	LCP using low calorific gases from gasification of refinery residues, coke oven gas, blast-furnace gas	800 mg/Nm^3	
Carbon monoxide CO	Liquid fuel combustion with heat output exceeding 5MW.	Not to exceed 175 mg/Nm^3	ISO 4224:2000
	Solid fuel combustion with the heat output of 50MW and above	Not to exceed the level of 250 mg/Nm^3	
Hydrocarbon (as Total Organic Carbon)		Not to exceed 20 mg/Nm^3	ISO 12884:2000
Dust	Inert dust, including cement.	Not to exceed 250mg/Nm^3 (24h mean value)	ISO 12141:2002
Nitrogen Oxides[*] NO$_x$			ISO 7996:1985
	LCP using solid fuel with thermal effect of:	Yearly average of:	
	50 to 500 MWth	600 mg/Nm^3	
	>500 MWth	500 mg/Nm^3	

	LCP using liquid fuel with thermal effect of:		
	50 to 500 MWth	450 mg/Nm^3	
	>500 MWth	400 mg/Nm^3	
	LCP using liquid fuel with thermal effect of:		
	50 to 500 MWth	300 mg/Nm^3	
	>500 MWth	200 mg/Nm^3	
Lead	Not to exceed 5 tonne/year of lead or lead compounds (measured as elemental lead) by a stationary source	0.15μg/Nm^3	ISO 9855:1993

Source: EAC, 2015

Annex 10: Ambient Air Quality Tolerance Limits

	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***	Test methods
1.	Sulphur oxides (SO$_X$);	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	IS0 4221-1980
		24 hours**	125 µg/m^3	*80 µg/m^3*	30 µg/m^3	
		Annual Average		*0.019 ppm/50µg/m^3*		
		Month Average				
		24 Hours		*0.048ppm /125µg/m^3*		
		One Hour				
		Instant Peak		*500 µg/m^3*		
		Instant Peak (10 min)		*0.191 ppm*		
2.	Oxides of Nitrogen (NO$_X$);	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3	ISO7996: 1985
		24 hours**	150 µg/m^3	80 µg/m^3	30 µg/m^3	
		8 hours				
		Annual Average		*0.2 ppm*		
		Month Average		*0.3 ppm*		
		24 Hours		*0.4 ppm*		
		One Hour		*0.8 ppm*		

			Industrial area	Residential, Rural & Other area	Controlled areas***	
		Instant Peak		1.4 ppm		
3.	*Nitrogen Dioxide*	*Annual Average*	150 µg/m^3	0.05 ppm		IS0 6768:1998
		Month Average		0.08 ppm		
		24 Hours	100 µg/m^3	0.1 ppm		
		One Hour		0.2 ppm		
		Instant Peak		0.5 ppm		
4.	Suspended particulate matter (SPM)	Annual Average*	360 µg/m^3	140 µg/m^3	70 µg/m^3	ISO 9835:1993
		24 hours**	500 µg/m^3	200 µg/m^3	100 µg/m^3	
			Industrial area	**Residential, Rural & Other area**	**Controlled areas*****	
		mg/Kg				
		Annual Average****		100 µg/m^3		
		24 hours***		180 µg/m^3		
5.	Respirable particulate matter (<10µm) (RPM)	Annual Average*	70 µg/m^3	50 µg/m^3	50 µg/m^3	ISO 9835:1993
		24 hours**	150 µg/Nm^3	100 µg/Nm^3	75 µg/Nm^3	
6.	PM$_{2.5}$	Annual Average	35 µg/m^3			ISO 9835:1993
		24 hours	75 µg/m^3			
7.	Lead (Pb)	Annual Average*	1.0 µg/Nm^3	0.75 µg/Nm^3	0.50 µg/m^3	ISO

No.	Pollutant	Averaging period			
		24 hours**	1.5 µg/m³	1.00 µg/m³	0.75 µg/m³
		Month Average		2.5	
8.	Carbon monoxide (CO)/ carbon dioxide (CO_2)	*8 hours**	*5.0 mg/m³*	*2.0 mg/m³*	*1.0 mg/m³*
		1 hour	*10.0 mg/m³*	*4.0 mg/m³*	*2.0 mg/m³*
		mg/Kg			
		*24 hours**			
9.	Non-methane hydrocarbons				
		instant Peak	*700ppb*		
10.	Total VOC	*6 mg/m³*			
11.	Ozone	1-Hour	200 µg/m³	0.12 ppm	
		8 hour (instant Peak)	120 µg/m³	1.25 ppm	

Source: EAC, 2015

Annex 11: Chemical tolerances for swimming pool water

Characteristics	Tolerance	Test methods
Total alkalinity(as $CaCo_3$), mg/l, max	50-500	ISO 9963
pH	7.2-8.0	ISO 1566/12020
Total residual chlorine, mg/l, range	1.5-3.0	ISO 7393
Oxygen absorbed in 4 hrs at 27C, mg/l, max	1.0	ISO 5813/5814
Total dissolved solids, mg/l, max	1500	ISO 11923
Chloride(as CI),mg/l, max	500	ISO 9297

Iron, mg/l, max	0.1	ISO 6232
Heavy metals (as Pb), mg/max	0.1	ISO 8288
Color, Hazen units, max	10	ISO 7887
Turbidity, NTU, max Aluminium (as A1) mg/l, max	10 0.1	ISO 7072 ISO 10566/ISO 12020
Odor	Odorless	
Taste	Palatable	

Source: RSB (2013). RS 189 2013 Water quality — Swimming pool — Tolerance Limit

Annex 12: Tolerance limits of discharged domestic wastewater

Parameter	Limits
TDS mg/l	≤1500
TSS mg/l	≤50
pH	5.0-9.0
Total Nitrogen mg/l	≤30
Nitrite mg/l	≤2
Ammonium mg/l	≤5
Total phosphorus	≤5
Temperature variation of treated water compare to ambient temperature of water	≤3
BOD5 mg/l	≤50
COD mg/l	≤400
Coli forms number/100ml	≤400
Oil and Grease mg/l	≤10
Chlorine mg/l	≤2
Sulfate mg/l	≤500
Color TCU	50
Turbidity NTU	30

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Annex 13: Chemical requirements for water intended for human consumption

Constituents	High Calcium Lime			Magnesium Lime
	Grade A	Grade B	Grade C	
Available lime calculated as calcium oxide percent, min	95.5	95.0	95.0	95.0
Available lime calculated as calcium hydroxide percent, min	80.0	65.0	60.0	65.0
Magnesium oxide, percent, max	0.6	0.6	0.6	3.0
Carbone dioxide, percent, max	3.0	4.0	5.0	3.0
Silica and insoluble mineral matter, percent, max	2.0	3.5	4.5	3.5

Source: RSB (2015). RSS 277 2015 Water Treatment- Hydrated Lime - Specification

Annex 14: Maximum concentration of trace elements in irrigation water

Constituents	Long term use (mg/l)	short time use (mg/l)
Aluminum (Al)	5.0	2.0
Arsenic (As)	0.10	2.0
Beryllium (Be)	0.10	0.5
cadmium (Cd)	0.01	0.05
Chromium (Cr)	0.1	1.0
Cobalt (Co)	0.05	5.0
Copper (Cu)	0.2	5.0
Fluoride (F-)	1.0	15.0
Iron (Fe)	5.0	20.0
Lead (Pb)	5.0	10.0
Lithium (Li)	0.5	2.5
Manganese (Mg)	0.2	10
Molybdenum (Mo)	0.01	0.05
Nickel (Ni)	0.2	2.0
Selenium (Se)	0.02	0.02
Vanadium (V)	0.1	1.0
Zinc (Zn)	2.0	10.0

Source: RSB (2013). RS 188 2013 Water quality - Irrigation- Tolerance Limits

Annex 15: Ambient Air Quality at Property Boundary for General Pollutants

	Pollutant	Time weighted Average	Property Boundary
1	Particulate matter (PM)	Annual Average	50 mg/m^3
		24 hours	70 mg/m^3
2	Oxides of Nitrogen (NO$_X$);	Annual Average	80 mg/m^3
		24 hours	150 mg/m^3
3	Sulphur oxides (SO$_X$)	Annual Average	50 mg/m^3
		24 hours	125 mg/m^3

Source: EAC (2010). RS EAS 751 2010 Air quality - specification

Annex 16: Tolerance limits of discharged industrial wastewater (Physical and microbiological requirements)

Determinants	Units	Upper limit and ranges
Temperature increase	°C	3 (variation)
pH	-	6.0-9.0
Dissolved oxygen (min)	%sat	60
BOD5 (max)	mg/l à 20°C	50
COD (max)	mg/l	250
Oil and Grease	Mg/l	10
Colour	TCU	50
Turbidity	NTU	30
Total Dissolved Solids (TDS)	mg/l	2000
Total Suspended Solids (TSS)	mg/l	50
Faecal coliform	Counts/100 ml	1000
Coliforms	Number/100 ml	400

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Annex 17: Tolerance limits of discharged industrial wastewater (Chemical requirements-Macro determinants)

Determinants in mg/l	Upper limit and ranges
Free and saline ammonia (as N)	50
Ortho phosphate (as P) or soluble phosphate	1.5
Phenol	2
Calcium as Ca	500
Chloride as Cl	600
Chlorine residual	1
Fluoride as F	1.5
Potassium as K	100
Sodium as Na	400
Sulphate as SO4	400
Sulphide	1.0
Zinc as Zn	5.0

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Annex 18: Tolerance limits of discharged industrial wastewater (Chemical requirements-Micro determinants)

Determinants in mg/l, unless otherwise stated	Upper limit and ranges
Arsenic as A	0.01
Benzine mg/l	0.00
Boron as B	0.5
Cadmium as cd	0.01
Chromium total (Cr)	0.05
Chromium as Cr (total)	0.5
Cobalt as Co	1

Copper as Cu	3
Cyanide as CN	0.1
Iron as Fe	3.5
Lead as Pb	0.1
Manganese as Mn	0.1
Mercury as Hg (total)	0.002
Nickel as Ni	2
Selenium as S	0.02

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Annex 19 : Interventions executed under the Environment and Natural Resources (ENR) sector & other Related Sectors

S/N	Name of Intervention	Implementing Agency	Source of fund and projects costs	Estimated budget	Main Achievements
1	Greater Virunga Transboundary Program (GVTP)	Greater Virunga Trans-boundary Collaboration secretariat	ICCN, RDB and UWA with their partners in the region, - The Executive Secretariat sits from 2008 in Kigali to coordinate and link stakeholders on behalf of the Protected Area Authorities.	USD 3,875,000 for 3 years period	- Signing of the Treaty the Greater Virunga Trans-boundary Collaboration on Wildlife Conservation and Tourism Development; - Signing of a 3 year funding agreement between GVTC and the Ministry of Foreign Trade & Development Cooperation of the Netherlands, - Collaboration& partnership between GVTC and Clemson University (USA) aimed at GVTC reinforcement; - The Five-year Trans-boundary Strategic Plan.

2	Energising Development (EnDev) Rwanda	GIZ-EDCL	GIZ Project	€ 15,641,000	- The first three privately operated micro-hydropower (500 kW, 438 kW and 96 kW) are supplying more than 20,000 people with electricity. - Four further plants are in the development stage. - At present, 14 solar companies are involved in the programme, which has successfully supported two Project with isolated networks in 23 villages. Some 24,000 people have already gained access to renewable energy thanks to the fund. - The earmarked funds of 50 million US

					dollars serve to improve their access to financing. Companies can thus obtain loans through the World Bank's programme as well as subsidies via EnDev.
3	Building resilience of communities living in degraded forests, savannas and wetlands of Rwanda through an ecosystem management approach	Rwanda Environment Management Authority (REMA)	UNEP/GEF Project	14,844,000 USD	- Project launch; - Recruitment of project staff; - Mapping of intervention areas; - Budget and work plan revision; - contact with beneficiaries; - Draft of MoUs and subproject on activities to be implemented in intervention Districts.
4	The program for Supporting Ecosystem Rehabilitation and Protection for Pro-poor Green Growth	Rwanda Environment Management Authority (REMA)	UNDP Project cost	Frw 1,849,520,000	423 Ha were rehabilitated by radical terraces, progressive terraces, agro forestry and demarcation lines at Rusizi, Musanze Bugesera and Ngororero District the activities completed at 100% - 148 families were relocated from island by construction of green villages in Rusizi, Bugesera and Musanze Districts. Other 92 houses are completed at 98% and relocation of households will be done in this Q2 2017-18. - The project supported the capacity building of project staff and communities beneficiaries.
5	Vulnerable Ecosystem Recovery	Rwanda Environment Management	FONERWA Project	Rwf 3,724,188,800	Reduced erosion by about 1400 tons annually by implementing erosion control practices on 946 Ha that were appropriate

	Towards Climate Change Resilience Program (VERP)	Authority (REMA)			for the slopes, soil types, and climatic conditions of Ruhondo and Burera lake watersheds and Bugarama wetland watershed; - Invasive species removed from Cyohoha lake on 350 Ha; - 9,000 green job created by the project through community work approach; - 185 Households supported with biogas system; - 1,460 households supported with solar home system; - 1,060 people supported with rain water harvesting tanks; - 660 households supported with small income generation sub Project;
6	Restoration of critical community infrastructure and emergency off-farm livelihoods for landslide-affected population in Gakenke District	Ministry of Disaster Management and Refugee Affairs	Centre for Emergency Response Framework		18 bridges repaired in Gakenke District, Productive assets damaged during landslides were replaced
7	Enhancing Climate Change Resilience in Great Lakes Region	Association pour la Conservation de la Nature au Rwanda	Mac Arthur Foundation Project	US$ 65,300	- Final version of CRAG Intervention Plan was developed. - Capacity building to Local Conservation Groups (LCGs) to enhance resilience to climate change through actions that reduce

	Watersheds: the Lake Kivu Catchment and Rusizi River CRAG				soil erosion and improve their livelihoods. - Awareness and enforcement of riparian legislation through LCG networks; - Business plans of key catchments in the Kivu-Rusizi CRAG developed; - Key stakeholders (hydropower, mining, agriculture, fisheries) in the Kivu-Rusizi CRAG and their impacts (positive and negative) identified.
8	Beekeeping integrated to the environment around volcanoes National park	Rural Environment and Development Organisation (REDO)	SNV		- 458 beekeepers, grouping into 21 Business Group Enterprises/ Cooperatives have been identified; - 458 beneficiaries (279 in Musanze District and 179 in Burera District) received onsite training, - 14 VSLGs formed and trained on the culture of saving. Now 7 VSLGs are located in Musanze District and the remaining and other remaining are located in Burera District; - 4 cooperatives received the total loan of 3,800,000 Rwf
9	Promoting Sustainable Agriculture in a Changing Climate in Bugesera District	Nile Basin Discourse Forum in Rwanda	Nordic Climate Facility		- 4 solar systems already installed in Juru, Rilima, Rweru and Kamabuye Sectors. - four nursery beds have been established each containing 25,500 (102,000) fruit seedlings that will be grafted.

10	Promoting Sustainable Agriculture in a Changing Climate in Bugesera District	Rwanda Environnemental Conservation Organisation (RECOR)	Nordic Climate Facility (NCF)/ Swedish Meteorological and Hydrological Institute (SMHI)	154,000 €	- Establishment of 4 nursery beds within 4 sectors of project zone with the capacity of 26,000 fruit tress seedlings each.
11	Plastic waste Recycling project	ECOPLASTIC Ltd	Own revenue		- Dustbin bag used for collecting waste Hygiene & cleanliness: Different kinds of Dustbin bags used for collecting waste according to the type of waste in different services. - Sheeting used for greed in& building Social welfare & Health. - The hermetic bags Social welfare & Health: The hermetic bags used for storing food; - Tubing bags - Agriculture: Tubing bags used for the multiplication of the nursery trees; - The plastic bags intended to cover improved Bananas; - Agriculture: Plastic bags intended to cover improved Bananas. Tubing bags used for the multiplication of nursery trees PICS bags for crops storage without pesticides Sheeting used for modern agriculture.

Source: Ministry of Environment , 2018