



# Greenhouse Gas Emissions in Rwanda

## Rwanda Numbers at a Glance (2014)

**7.59 MtCO<sub>2</sub>e\***

Total GHG emissions  
(0.37% of world total)  
World: 48,892 MtCO<sub>2</sub>e

**11,345,357**

Population  
World: 7,268,986,176

**0.67**

tCO<sub>2</sub>e per capita  
World: 6.73 tCO<sub>2</sub>e

**US\$ 7,633 Million**

GDP\*\*  
World: US\$73,479 Billion

**994**

tCO<sub>2</sub>e/million US\$ GDP  
World: 665 tCO<sub>2</sub>e/million US\$ GDP

**-5.79 MtCO<sub>2</sub>e (-43%)**

Change in GHG emissions  
(1990-2014)  
World: +15,069 MtCO<sub>2</sub>e  
(+45%)

Sources: WRI CAIT 4.0, 2017. Emissions including Land-Use Change and Forestry. Global Warming Potentials are from the Intergovernmental Panel on Climate Change Second Assessment Report.

\*Million metric tons of carbon dioxide equivalent.

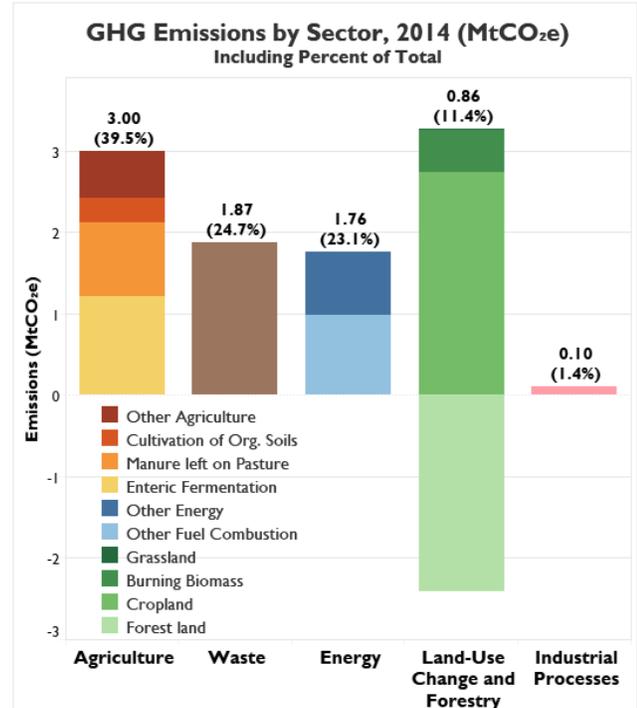
\*\*Gross Domestic Product (GDP) in constant 2010 US\$

This document is based on information available at the date of publication, and does not reflect official views of the U.S. government. Sources may be incomplete or contradictory. Judgment and knowledge of the national context should be used to interpret and supplement this information. USAID assumes no liability for the contents or use of the information in this document.

## Greenhouse Gas (GHG) Emissions by Sector

According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), Rwanda's GHG emissions in 2014 were primarily from activities in the agriculture sector (39.5%), followed by waste (24.7%), and energy (23.1%). Land-use change and forestry (LUCF) and industrial processes (IP) contributed 11.4% (net) and 1.4% of total emissions, respectively.<sup>1</sup>

Rwanda's [Second National Communication](#) (SNC) to the UNFCCC, submitted in 2012 includes a GHG inventory for 2002-2005, which also shows agriculture activities to have been the greatest source of emissions in 2005 (78.0%), followed by energy (17.8%), IP (3.0%), and waste (0.9%).<sup>2</sup> Emissions from land use, land-use change, and forestry (LULUCF) amounted to 4.02 MtCO<sub>2</sub>e, but removals absorbed 8.55 MtCO<sub>2</sub>e during the same year, resulting in Rwanda being a net carbon sink of 4.53 MtCO<sub>2</sub>e in 2005.



Sources: WRI CAIT 4.0, 2017, FAOSTAT, 2018

## Change in GHG Emissions in Rwanda (1990-2014)

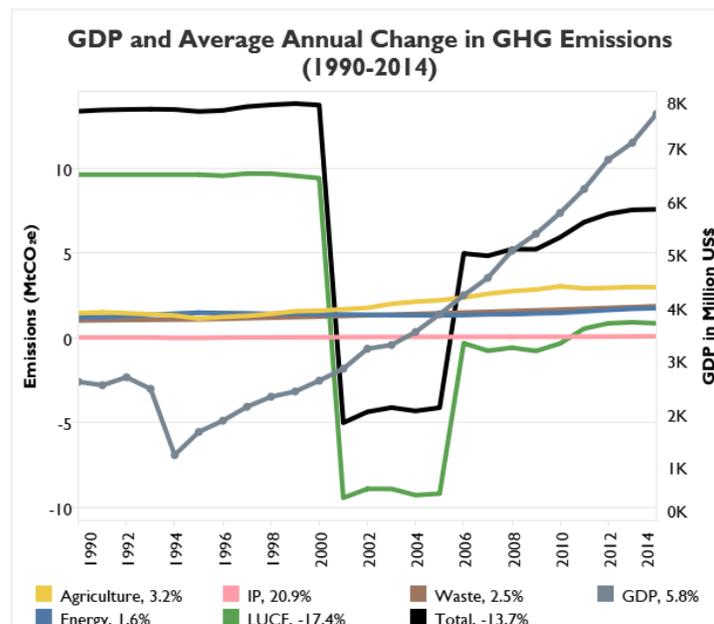
WRI CAIT data show that Rwanda's GHG emissions were relatively steady from 1990-2000, and again from 2006-2014. From 2001-2005, Rwanda was a net carbon sink, absorbing 4.5 MtCO<sub>2</sub>e more than was emitted. Total GHG emissions followed LUCF trends closely. From 1990-2014, emissions decreased by 5.79 MtCO<sub>2</sub>e (-43%), with the average annual change being -13.7%. The change in emissions from selected sources is discussed below.

**Agriculture:** Emissions from agriculture doubled (105%) from 1990-2014, due to increased emissions from enteric fermentation from livestock (41%) and manure left on pasture (31%). During the same period, Food and Agriculture Organization (FAO) data show growth in the number of ruminant livestock, with populations of cattle, goats, and sheep increasing by around 99%, 135%, and 62%, respectively.<sup>3</sup> From 1990-2014, emissions from synthetic fertilizers increased by 466%, but represent only a small share (2%) of 2014 agriculture emissions. The FAO notes, Rwanda began the Crop Intensification Program (CIP) in 2007, which provides subsidized chemical fertilizer to farmers. Agriculture is an important economic sector, employing 72% of the workforce and contributing 33% of GDP.<sup>4</sup>

**Waste:** Waste emissions increased by around 82% from 1990-2014.<sup>5</sup> By 2012, waste generation in Kigali City was four times more than in 2007, averaging between 1,800 and 2,000 tons per day.<sup>6</sup> To dispose of waste, Rwanda's SNC notes that, in rare cases, waste is openly incinerated by individuals and there are very few cases of institutions using an incinerator.<sup>7</sup> Wastewater is untreated.

**Energy:** Emissions from the energy sector increased 44% from 1990-2014, due to "other fuel combustion," i.e., emissions from stationary and mobile sources and biomass combustion. According to the SNC, biomass accounts for around 86% of these emissions, petroleum 11%, and electricity only 3%. The African Development Bank noted recently that the electricity energy mix is now hydro (48%), diesel and heavy fuel oil (25%), methane gas (14%), peat (7%), and solar (6%).<sup>8</sup>

**LUCF:** WRI CAIT data show that LUCF emissions decreased 91% from 1990-2014, following the trajectory of emissions and removals from forest land. Until 2000, LUCF was the largest contributor to GHG emissions in Rwanda, due to emissions from forest land and cropland. From 2000-2001, emissions from forest land appear to have changed dramatically, from emissions of 6.4 MtCO<sub>2</sub>e to removals of 12.4 MtCO<sub>2</sub>e, while emissions from cropland remained unchanged. From 2005 onwards, forest land was a decreasing carbon sink and LUCF overall became a net source of emissions again in 2011. The suddenness of the decrease shown in the figure may be due to the infrequency of reporting, as other sources show a similar but steadier trend of LULUCF becoming a smaller carbon sink from 2000-2010.<sup>9</sup> According to the Forest Investment Program, Rwanda's natural forests declined by about 64% between 1960 and 2007 due to anthropogenic activities and resettlement of refugees following the civil war. The main drivers of deforestation are agriculture, infrastructure development, urbanization, artisanal mining, forest product extraction, and limited forestry extension services.<sup>10</sup> However,



Source: WRI CAIT 4.0, 2017.

plantation expansion in Rwanda has resulted in forest gains equivalent to an annual reforestation rate estimated at 2.47% for the period 2005-2010, the 5th highest in the world, according to FAO data. Total forest area has increased 37% from 1990-2010, from approximately 318,000 hectares (ha) in 1990 to 435,000 ha in 2010.<sup>11</sup> Rwanda began an aggressive program to halt and reverse deforestation towards the end of the last decade, creating and protecting national parks and nature reserves. To ensure development and management of the sector, it published the [2017 National Forest Policy](#), [Forest Sector Strategic Plan 2018-2024](#), and National Forest Management Plan 2017-2026.

## Carbon Intensity: GHG Emissions Relative to Gross Domestic Product

Rwanda's GDP increased 193% from 1990-2014, while GHG emissions decreased 43%. This period includes Rwanda's 1990-1994 civil war, when GDP decreased 53%. Since then, Rwanda has made significant progress in rehabilitating and stabilizing its economy and GDP grew 359% from 1995-2014. In 2014, Rwanda emitted slightly more GHGs relative to GDP than the world average. Services contributed to 47% of GDP, followed by agriculture (33%) and industry (14%); 5% was attributed to adjustment for taxes and subsidies on products.

## Climate Change Mitigation Targets and Plans

In its Intended Nationally Determined Contribution (INDC), Rwanda pledged to reduce emissions relative to business-as-usual scenario emission levels by 2030, however no quantified reduction target has been set. The INDC specifies that reductions are based on policies and actions that are conditioned upon receipt of international finance, technology, and capacity building. They focus on the following mitigation sectors or actions: low carbon energy mix; sustainable small-scale energy installation; energy efficiency and demand side management; efficient resilient transport system; green industry and private sector development; low carbon urban systems; and sustainable forestry, agroforestry and biomass energy. Upon ratification of the [Paris Agreement](#) in 2016, the INDC became Rwanda's [first NDC](#).

<sup>1</sup> World Resources Institute Climate Analysis Indicators Tool (WRI CAIT 4.0, 2017). Global Warming Potentials (GWPs) are the 100-year GWPs from the Intergovernmental Panel on Climate Change (IPCC) [Second Assessment Report \(SAR\)](#).

<sup>2</sup> Republic of Rwanda, Ministry of Natural Resources. [Second National Communication \(SNC\)](#) to the UNFCCC, 2012. The SNC inventory shows total GHG and sector emissions in GgCO<sub>2</sub>e for 2002-2005. It can be difficult to compare inventory results from different sources and different years due to different data sources. For example, for the waste sector, the SNC uses national data sources whereas CAIT draws on EPA for waste data (see U.S. Environmental Protection Agency (EPA). 2012. "Global Non-CO<sub>2</sub> GHG Emissions: 1990-2030." Washington, DC: U.S. Environmental Protection Agency).

<sup>3</sup> Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). Rwanda, [Emissions – Land use total](#) and [Emissions – Agriculture total](#), viewed on August 19, 2018.

<sup>4</sup> FAO 2018. [Rwanda at a Glance](#).

<sup>5</sup> The EPA waste data that WRI CAIT uses is from regional data, which do not include Rwanda-specific information.

<sup>6</sup> Isugi, J., & Niu, D. (2016). [Research on Landfill and Composting Guidelines in Kigali City, Rwanda Based on China's Experience](#). Tongji University, The State Key Laboratory of Pollution Control and Resource Reuse, School of Environmental Science and Engineering. International Proceedings of Chemical, Biological and Environmental Engineering (IPCBE) Volume 94. doi: 10.7763/IPCBE

<sup>7</sup> Rwanda. Second National Communication (SNC), 2012.

<sup>8</sup> African Development Bank Group, 2018. [Scaling Up Electricity Access Program Phase II \(SEAP II\), Rwanda Appraisal Report](#). September 2018.

<sup>9</sup> International Institute for Sustainable Development, 2013. [Republic of Rwanda: Greenhouse gas emissions baseline Projection](#). Seton Stiebert. March 2013.

<sup>10</sup> Republic of Rwanda, Ministry of Lands and Forestry. [Forest Investment Program for Rwanda](#). From 1984-2015, there was a 45.27% loss of key natural forests (see Table 6). The rate of habitat conversion (change in forest area plus change in woodland area minus net plantation expansion) was 50% from 1990-2005.

<sup>11</sup> FAO. [Global Forest Resources Assessment](#), Global Tables, 2010. Rwanda is classified under West and Central Africa, while USAID considers it part of East Africa.